United Nations A/CONF.184/6

General Assembly

Distr.: General
18 October 1999

Original: English

Report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (Vienna, 19-30 July 1999)*

* The present document is an advance version of the report of the United Nations Conference on the Peaceful Uses of Outer Space held at the United Nations Office at Vienna from 19 to 30 July 1999.

99-30174 (E) 201099

Abbreviations

ADEOS	Advanced Earth Observing Satellite
AFRICOVER	Digital Land Cover Database for Africa
ALOS	Advanced Land Observing Satellite
ARTEMIS	African Real-Time Environmental Monitoring Information System
AVHRR	Advanced Very High Resolution Radiometer
CBERS	China-Brazil Earth Resources Satellite
CEOS	Committee on Earth Observation Satellites
CLIRSEN	Centre for Integrated Surveying of Natural Resources
CNES	Centre national d'études spatiales (France)
COPINE	cooperative information network linking scientists, educators, professionals and decision makers in Africa
COSPAR	Committee on Space Research
COSPAS-SARSAT	International Search and Rescue Satellite System
DLR	German Aerospace Center
ECA	Economic Commission for Africa
ECLAC	Economic Commission for Latin America and the Caribbean
EGNOS	European Geostationary Navigation Overlay Service
EIMS	environmental information and modelling system
EMPRES	Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases
ENRIN	Environment and Natural Resource Information Networks
EPIRB	emerging position-indicating radio beacon
ESA	European Space Agency
ESCAP	Economic and Social Commission for Asia and the Pacific
ESCWA	Economic and Social Commission for Western Asia
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
EURISY	European Association for the International Space Year
Eurocontrol	European Organization for the Safety of Air Navigation
EUTELSAT	European Telecommunications Satellite Organization
FAME	Forest Assessment and Monitoring Environment
FAO	Food and Agriculture Organization of the United Nations
GARS	Geological Applications of Remote Sensing
GCOS	Global Climate Observing System
GIEWS	Global Information and Early Warning System
GII	global information infrastructure
GIS	Geographic Information System
GLONASS	Global Navigation Satellite System (Russian Federation)
GMPCS	global mobile personal communications by satellite
GMS	Geostationary Meteorological Satellite
GNSS	global navigation satellite system
GOES	Geostationary Operational Environmental Satellite
GOFC	Global Observation of Forest Cover
GOMS	Geostationary Operational Meteorological Satellite
GOOS	Global Ocean Observing System

GPS	Global Positioning System
GRID	Global Resource Information Database
GSO	geostationary satellite orbit
GTOS	Global Terrestrial Observing System
IAU	International Astronomical Union
ICAO	International Civil Aviation Organization
ICSU	International Council for Science
IGOS	Integrated Global Observing Strategy
IMO	International Maritime Organization
IMSO	International Mobile Satellite Organization
INFOCLIMA	World Climate Data Information Referral System
INFOTERRA	International Environment Information System
INPE	National Institute for Space Research (Brazil)
INSAT	Indian National Satellite
INTELSAT	International Telecommunications Satellite Organization
Intersputnik	International Organization of Space Communications
IOMAC	Indian Ocean Marine Affairs Cooperation
IRS	Indian Remote Sensing Satellite
ISO	International Organization for Standardization
ISRO	Indian Space Research Organization
ITU	International Telecommunication Union
JERS	Japan Earth Resources Satellite
Landsat	Land Remote Sensing Satellite
LEO	low-Earth orbit
MAB	Man and the Biosphere
MERCOSUR	Southern Cone Common Market
NASA	National Aeronautics and Space Administration (United States of America)
NASDA	National Space Development Agency (Japan)
NOAA	National Oceanic and Atmospheric Administration (United States of America)
POLDER	Polarization of the Earth's Reflectances
PRODES	Brazilian Amazon Deforestation Survey Project
ProMIS	Programme Management Information System
RAMSES	Reconnaissance and Management System of the Environment of Schistocerca
RAPIDE	African Network for Integration and Development
REIMP	Regional Environmental Information Management Project
RESAP	Regional Space Applications Programme for Sustainable Development
SeaWiFS	Sea-viewing Wide Field-of-view Sensor
SOTER	Global Soil and Terrain Database
SPOT	Satellite pour l'observation de la Terre
SPS	Standard Positioning Service
TCDC	technical cooperation among developing countries
TOPS	technology outreach programme on space for university educators
TREES	Tropical Ecosystem Environment Observation by Satellite

TRMM	Tropical Rainfall Measuring System
UNDCP	United Nations International Drug Control Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNISPACE 82	Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space
UNISPACE III	Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space
UNITAR	United Nations Institute for Training and Research
VSAT	very small aperture terminal
WAAS	Wide Area Augmentation System
WHO	World Health Organization
WMO	World Meteorological Organization

Contents

I. Resolutions adopted by the Conference

Resolution 1

The Space Millennium: Vienna Declaration on Space and Human Development*

The States participating in the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), held in Vienna from 19 to 30 July 1999,

I

Reaffirming the aims and principles of the Charter of the United Nations, the principles of international law and the relevant resolutions of the General Assembly,

Having in mind that humans have always gazed at the sky with wonder and that from such was born the curiosity that drove early astronomers to study the movements of celestial bodies, from which the foundations of modern space science and technology were laid,

Recognizing the importance of space science and space applications for the fundamental knowledge of the universe, education, health, environmental monitoring, management of natural resources, disaster management, meteorological forecasting and climate modelling, satellite navigation and communications, and the major contribution that space science and technology make to the well-being of humanity and specifically to economic, social and cultural development,

Considering that space transcends national boundaries and interests, permitting the development of global solutions to address common challenges and providing a vantage point from which to view planet Earth,

Noting the positive developments in international relations since the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space, held in Vienna from 9 to 21 August 1982,[1]

Reaffirming the common interest of all humanity in the progress of the exploration and use of outer space for peaceful purposes, and convinced of the need to prevent an arms race in outer space as an essential condition for the promotion of international cooperation in this regard,

Recognizing that outer space should be the province of all humankind, to be utilized for peaceful purposes and in the interests of maintaining international peace and security, in accordance with international law, including the Charter of the United Nations and as proclaimed in the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies,[2]

Reaffirming General Assembly resolution 51/122 of 13 December 1996, entitled "Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries",

Recognizing that the orderly conduct of space activities is beneficial to all countries, whether or not they have already become active in space research or have started to utilize space applications, and that active support for space activities is expressed in the observance by States and by international organizations of the provisions of the outer space treaties,

Noting with satisfaction that the United Nations conferences on the exploration and peaceful uses of outer space were held in Vienna in 1968 and in 1982, leading to many new initiatives, including the creation of the United Nations Programme on Space Applications and the establishment of regional centres for space science and technology education, affiliated to the United Nations, which are contributing to a better understanding of space technology and to capacity-building in the utilization of space technology at the local level for social and economic development,

Noting the benefits and applications of space technologies in addressing the unprecedented challenges to sustainable development, and noting also the effectiveness of space instruments for dealing with the challenges posed by the pollution of the environment, depletion of natural resources, loss of biodiversity and the effects of natural and anthropogenic disasters,

Recognizing that significant changes have occurred in the structure and content of world space activity, as reflected in the increasing number of participants in space activities at all levels and the growing contribution of the private sector to the promotion and implementation of space activities,

* Adopted by the Conference at its 10th plenary meeting, on 30 July 1999.

Recognizing also that the use of space technology should be in accordance with the principles set out in Agenda 21[3] for the benefit of all nations and peoples and that its applications should be extended to developing countries,

Recognizing further the role played in recent years in the field of space by the Committee on the Peaceful Uses of Outer Space, as well as the role of States in the formulation of policies and implementation of international cooperation in that field,

Realizing that the above-mentioned challenges can be met for the benefit of all humanity by considering the mutual interests of all parties, sharing space knowledge and resources, coordinating missions and projects between interested States and strengthening international cooperation in the exploration and peaceful uses of outer space,

Convinced that efforts should be undertaken to facilitate substantive joint projects between "space-faring" and "non-space-faring" countries, as well as among developing countries, which could result in the undertaking of projects that are beyond the means of individual countries,

Taking note with satisfaction of the valuable contributions of participants of the Technical Forum and the Space Generation Forum to the work of UNISPACE III,

1. *Declare* the following as the nucleus of a strategy to address global challenges in the future:

(a) Protecting the Earth's environment and managing its resources: action should be taken:

(i) To develop a comprehensive, worldwide, environmental monitoring strategy for long-term global observations by building on existing space and ground capabilities, through the coordination of the activities of various entities and organizations involved in such efforts;

(ii) To improve the management of the Earth's natural resources by increasing and facilitating the research and operational use of remote sensing data, enhancing the coordination of remote sensing systems and increasing access to, and the affordability of, imagery;

(iii) To develop and implement the Integrated Global Observing Strategy so as to enable access to and the use of space-based and other Earth observation data;

(iv) To enhance weather and climate forecasting by expanding international cooperation in the field of meteorological satellite applications;

(v) To ensure, to the extent possible, that all space activities, in particular those which may have harmful effects on the local and global environment, are carried out in a manner that limits such effects and to take appropriate measures to achieve that objective;

(b) Using space applications for human security, development and welfare: action should be taken:

(i) To improve public health services by expanding and coordinating space-based services for telemedicine and for controlling infectious diseases;

(ii) To implement an integrated, global system, especially through international cooperation, to manage natural disaster mitigation, relief and prevention efforts, especially of an international nature, through Earth observation, communications and other space-based services, making maximum use of existing capabilities and filling gaps in worldwide satellite coverage;

(iii) To promote literacy and enhance rural education by improving and coordinating educational programmes and satellite-related infrastructure;

(iv) To improve knowledge-sharing by giving more importance to the promotion of universal access to space-based communication services and by devising efficient policies, infrastructure, standards and applications development projects;

(v) To improve the efficiency and security of transport, search and rescue, geodesy and other activities by promoting the enhancement of, universal access to and compatibility of space-based navigation and positioning systems;

(vi) To assist States, especially developing countries, in applying the results of space research with a view to promoting the sustainable development of all peoples;

(c) Advancing scientific knowledge of space and protecting the space environment: action should be taken:

(i) To improve the scientific knowledge of near and outer space by promoting cooperative activities in such areas as astronomy, space biology and medicine, space physics, the study of near-Earth objects and planetary exploration;

(ii) To improve the protection of the near-Earth space and outer space environments through further research in and implementation of mitigation measures for space debris;

(iii) To improve the international coordination of activities related to near-Earth objects, harmonizing the worldwide efforts directed at identification, follow-up observation and orbit prediction, while at the same time giving consideration to developing a common strategy that would include future activities related to near-Earth objects;

(iv) To protect the near and outer space environments through further research on designs, safety measures and procedures associated with the use of nuclear power sources in outer space;

(v) To ensure that all users of space consider the possible consequences of their activities, whether ongoing or planned, before further irreversible actions are taken affecting future utilization of near-Earth space or outer space, especially in areas such as astronomy, Earth observation and remote sensing, as well as global positioning and navigation systems, where unwanted emissions have become an issue of concern as they interfere with bands in the electromagnetic spectrum already used for those applications;

(d) Enhancing education and training opportunities and ensuring public awareness of the importance of space activities: action should be taken:

(i) To enhance capacity-building through the development of human and budgetary resources, the training and professional development of teachers, the exchange of teaching methods, materials and experience and the development of infrastructure and policy regulations;

(ii) To increase awareness among decision makers and the general public of the importance of peaceful space activities for improving the common economic and social welfare of humanity;

(iii) To establish and/or strengthen national mechanisms to coordinate the appropriate development of space activities and foster the participation of all the sectors concerned;

(iv) To improve the sharing of information on and use of spin-offs from space activities, in particular between developed and developing countries, by making use of appropriate communications technologies;

(v) To encourage all States to provide their children and youth, especially females, through appropriate educational programmes, with opportunities to learn more about space science and technology and their importance to human development and to participate fully in activities related to space science and technology, as an investment in the future;

(vi) To create, within the framework of the Committee on the Peaceful Uses of Outer Space, a consultative mechanism to facilitate the continued participation of young people from all over the world, especially young people from developing countries and young women, in cooperative space-related activities;

(vii) To consider the creation of awards to recognize outstanding contributions in space activity, in particular for youth;

(e) Strengthening and repositioning of space activities in the United Nations system: action should be taken:

(i) To reaffirm the role of the Committee on the Peaceful Uses of Outer Space, its two subcommittees and its secretariat in leading global efforts for the exploration and peaceful use of outer space relating to significant global issues;

(ii) To assist in the improvement of the capacity-building process in developing countries and countries with economies in transition by emphasizing the development and transfer of knowledge and skills, by ensuring sustainable funding mechanisms for the regional centres for space science and technology education, affiliated to the United Nations, by enhancing support for the United Nations Programme on Space Applications through the provision of adequate resources, and by participating in the implementation of the new strategy of the Programme arising from UNISPACE III;

(iii) To encourage the increased use of space-related systems and services by the specialized agencies and programmes of the United Nations system and by the private sector around the world, where appropriate, in order to support United Nations efforts to promote the exploration and peaceful uses of outer space;

(iv) To promote the efforts of the Committee on the Peaceful Uses of Outer Space in the development of space law by inviting States to ratify or accede to, and inviting intergovernmental organizations to declare acceptance of, the outer space treaties[4] developed by the Committee and by considering the further development of space law to meet the needs of the international community, taking into particular account the needs of developing countries and countries with economies in transition;

(v) To further consider the agenda structure and working methods of the Committee on the Peaceful Uses of Outer Space and its two subcommittees to better reflect issues of global concern, including international cooperation in space activities, taking into particular account the needs of developing countries and countries with economies in transition, as set out in the report of the Committee on its fortieth session;[5]

(vi) To strengthen the coordination of mutually beneficial activities between the Committee on the Peaceful Uses of Outer Space and other United Nations entities;

(f) Promoting international cooperation: action should be taken to follow up the decision by the States participating in UNISPACE III:

(i) To take note of the recommendations of the regional preparatory conferences for Africa and the Middle East, for Asia and the Pacific, for eastern Europe and for Latin America and the Caribbean that are relevant to efforts made at the global and regional levels, as set forth in sections A and B, respectively, of the annex to the present Declaration, and to call upon the international community, to the extent feasible, to consider those recommendations in appropriate forums;

(ii) To establish a special voluntary United Nations fund for the purpose of implementing the recommendations of UNISPACE III, in particular the activities of the regional centres for space science and technology education, taking into account the recommendations of the regional preparatory conferences. All States should be invited to support the fund financially or in kind in an annual letter from the Secretary-General that will, *inter alia*, identify priority project proposals for enhancing and assisting technical cooperation activities, in particular for human resource development. The Secretariat will provide annually to the Committee on the Peaceful Uses of Outer Space a report listing those States which have responded to the Secretary-General's invitation;

(iii) To adopt measures aimed at identifying new and innovative sources of financing at the international level, including in the private sector, in order to support the implementation of the recommendations of UNISPACE III in developing countries;

(iv) To encourage all States and international organizations to strengthen their efforts in promoting the peaceful uses of outer space for the benefit and in the interest of all States, taking into particular account the interest of developing countries and countries with economies in transition, by facilitating programmes and activities between "space-faring" and "non-space-faring" countries, as well as among developing countries, and involving civil society, including industry;

2. *Recognize* the tremendous achievements of space science and technology to date, look forward with confidence to achieving even greater progress in the future, and stress the vital importance of attaining the goals and executing the actions outlined above and described in detail in the report of UNISPACE III;

3. *Emphasize* that the shared objective of sustainable development for all countries will require timely and effective action to achieve the stated goals and that such an endeavour will provide ample scope for space science and technology to play their proper role as major contributors to people's well-being;

4. *Recommend* to the General Assembly that it review and evaluate, within existing resources, the implementation of the recommendations of UNISPACE III after a period of five years, and thereafter as appropriate, and that the reviews be based on preparatory work carried out by the Committee on the Peaceful Uses of Outer Space, open to the participation of representatives of all Member States, and the specialized agencies of the United Nations system and observers;

5. *Recognize* that the promotion of bilateral, regional and international cooperation in the field of outer space must be guided by General Assembly resolution 51/122;

II

Recalling that 4 October 1957 was the date of the launch into outer space of the first human-made Earth satellite, Sputnik I, thus opening the way for space exploration,

Recalling also that 10 October 1967 was the date of the entry into force of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies,[6]

Decide, in order to contribute to the achievement of the objectives of UNISPACE III, in particular that of increasing awareness among decision makers and civil society of the benefits of the peaceful uses of space science and technology for sustainable development, to invite the General Assembly to declare, according to its procedures, "World Space Week" between 4 and 10 October for the yearly celebration at the international level of the contribution that space science and technology can make to the betterment of the human condition.

Annex

Recommendations of the regional preparatory conferences for the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space

1. In accordance with General Assembly resolution 52/56, the regional preparatory conferences for the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) were convened in Kuala Lumpur from 18 to 22 May 1998, in Concepción, Chile, from 12 to 16 October 1998, in Rabat from 26 to 30 October 1998 and in Bucharest from 25 to 29 January 1999, for the regions of Asia and the Pacific, Latin America and the Caribbean, Africa and western Asia, and eastern Europe, respectively. The regional preparatory conferences were designed to assist Member States in the regions concerned in formulating recommendations and action plans related to, *inter alia*: (a) enhancing understanding among Member States of the role and use of space technology in social and economic development; (b) problems associated with implementing space technology and space applications programmes; and (c) improving and facilitating regional and international collaboration. Through the discussions on issues related to the agenda of UNISPACE III, the regional preparatory conferences also enabled Member States to become familiar with the objectives of UNISPACE III and to identify issues of priority to each region in advance of the conference.

2. In accordance with the recommendations of the Advisory Committee for UNISPACE III on the text and structure of the Vienna Declaration, the Secretariat classified the recommendations of the regional preparatory conferences, as compiled in documents A/CONF.184/PC/L.5 and Add.1, into two major categories. Section A below contains the recommendations with global implications, and section B contains those with regional implications. The major headings under sections A and B below correspond to those of chapter II, section G, of the report of UNISPACE III.

A. Recommendations with global implications

1. Protecting the environment

Recommendations of the Regional Preparatory Conference for Africa and the Middle East

3. The following was recommended:

(a) In order to give adequate consideration to environmental and resource management issues in the regions of Africa and the Middle East, there should be direct participation and active involvement of those regions in international activities and programmes related to Earth observation;

(b) At present, there are four Earth observation ground receiving stations, located in Italy, Saudi Arabia, South Africa and Spain, that are able to receive data on several African and Middle Eastern countries. The owners of those stations and the countries that are within their footprints should study the feasibility and desirability of operating the stations on a regional basis (South Africa is proposing to make its station available for such a regional operation);

(c) Scientific and research institutions in both Africa and the Middle East should foster scientific collaboration with Earth observation satellite operators in order to ensure that future Earth observation remote sensing systems meet the specific and unique needs of the two regions;

(d) There are numerous space-technology-related application projects, both in the operational phase and in the planning phase, that are funded by donor countries and international organizations, including United Nations entities. In order to maximize the beneficial impact of those projects, it is critical that the concerned donors, organizations and the countries benefiting from the projects coordinate and harmonize such development projects and programmes. The United Nations, as well as the Economic Commission for Africa (ECA) and the Economic and Social Commission for Western Asia (ESCWA), should play a leading role in coordinating and harmonizing development projects;

(e) The United Nations, in conformity with the Principles Relating to Remote Sensing of the Earth from Outer Space[7] and other legal instruments governing space activities, should ensure that all countries enjoy equal access to data and other information from Earth observation satellites;

(f) The International Telecommunication Union (ITU) should ensure that experimental frequencies are reserved specifically for the purposes for which they are used at present. The specific frequencies to be reserved include, but are not limited to, the following: 18.6 and 18.8 GHz, used for the measurement of soil, moisture and vegetation; and the frequency band 174.8 and 191.8 GHz, centred on 183.3 GHz, used for vertical sounding of atmospheric properties, such as humidity.

Recommendations of the Regional Preparatory Conference for Asia and the Pacific

4. The following was recommended:

(a) In view of the contributions of remote sensing and related technologies towards the well-being of the global community, the promotion of international cooperation in the development and use of remote sensing technologies should be accorded priority in the agenda of UNISPACE III;

(b) The Committee on Earth Observation Satellites should give serious consideration to the standardization of spectral aspects of sensors, data formats and other characteristics of the ground segment, in order to contribute to the development of Earth observation systems, and especially to meet the emerging needs of countries in the region of Asia and the Pacific;

(c) Member States should follow a unified approach to developing a standard format for the acquisition, processing and handling of remote sensing data;

(d) Satellite operators should maintain reasonable continuity of their services.

Recommendations of the Regional Preparatory Conference for Latin America and the Caribbean

5. Action should be taken:

(a) To establish, during the decade 2000-2010, a comprehensive strategy for the use of space technology for risk evaluation and for prevention, mitigation and reduction activities in disaster management;

(b) To promote the use of space technology for the purpose of achieving a global understanding of climatic phenomena, such as El Niño events, and of taking appropriate prevention measures.

Recommendations of the Regional Preparatory Conference for Eastern Europe

6. The following was recommended:

(a) Activities involving scientific research and practical applications in the field of remote sensing by satellite should be strengthened;

(b) Cooperation between the national space agencies in eastern Europe and the World Meteorological Organization should be enhanced in order to meet the need for data on global change and to participate actively in the definition of the future Earth observing mission concept;

(c) National Earth observation programmes and existing cooperation mechanisms such as the Committee on Earth Observation Satellites and the Integrated Global Observing Strategy partnership should be strengthened.

2. Facilitating and utilizing communications

Recommendations of the Regional Preparatory Conference for Africa and the Middle East

7. The following was recommended:

(a) Member States should ensure that global telecommunications designers and operators take into consideration the interests and priorities of the local communities and the telecommunication authorities and relevant bodies of the countries where they operate;

(b) In conformity with the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies[8] and other related legal instruments, the United Nations and ITU should guarantee the equal rights of all countries in the access to and use of space. Geosynchronous orbital slots for countries and regions that do not yet have the capacity to use those slots should be reserved as a matter of right;

(c) ITU should facilitate the coordination of orbital slots between countries in Africa and the Middle East and international organizations.

Recommendations of the Regional Preparatory Conference for Asia and the Pacific

8. The following was recommended:

(a) Satellite operators and service providers should reduce the cost of systems and services for space communications in developing countries in the region. In that effort, the private sector has an important role to play;

(b) The international satellite organizations should take into account the needs and limitations of the countries in Asia and the Pacific in future space communications systems and applications. In that connection, entities such as the International Telecommunications Satellite Organization (INTELSAT), the International Mobile Satellite Organization (IMSO) and other space communications entities should provide communications satellite capacity with the aim of promoting regional space-based services.

Recommendation of the Regional Preparatory Conference for Eastern Europe

9. In view of the existence of tables identifying the purposes and characteristics of active satellites in the geostationary orbit and the services provided by those satellites, that information should be distributed as a background document at UNISPACE III.

3. Improving and using positioning and location capabilities

Recommendation of the Regional Preparatory Conference for Africa and the Middle East

10. The United Nations should ensure that there are no restrictions on the accuracy of data, information and technology of global positioning systems and other satellite navigation systems, or on the availability of such systems, in particular for use in civil aviation.

4. Furthering knowledge and building capacity

Recommendations of the Regional Preparatory Conference for Eastern Europe

11. The following was recommended:

(a) International organizations should assist Member States in the region in acquiring methodologies for remote sensing by satellite, including software packages;

(b) The Office for Outer Space Affairs of the Secretariat should create a data bank on commercial space projects in general and on commercial telecommunication system projects in particular. The data bank could be used to maintain information on such activities as telecommunication systems in low, middle and geostationary orbits. Such a data bank would enable each State to learn about the latest developments and meet its needs in that area and to invest its resources more appropriately.

5. Enhancing education and training opportunities for youth

Recommendation of the Regional Preparatory Conference for Africa and the Middle East

12. Member States should take advantage of the Space Generation Forum at UNISPACE III. The Forum, to be organized by the alumni of the International Space University, will provide the opportunity for aspiring, emerging and established "space-faring" countries to develop the necessary skills, knowledge and contacts among their young and promising space professionals for future advancement.

6. Spin-offs and commercial benefits from space activities: promoting technology development and exchange

Recommendations of the Regional Preparatory Conference for Africa and the Middle East

13. The following was recommended:

(a) The United Nations should ensure that no unnecessary restrictions are placed on Member States that are developing their own launch facilities, in particular when such facilities are in conformity with the criteria for the peaceful use of outer space;

(b) Member States should request advanced countries to eliminate discriminatory measures in the licensing of space technology to the regions of Africa and the Middle East.

7. Promoting international cooperation

Recommendation of the Regional Preparatory Conference for Africa and the Middle East

14. The United Nations should establish, as a matter of urgency, a special fund within the Office for Outer Space Affairs to assist in the implementation of the recommendations of UNISPACE III.

Recommendations of the Regional Preparatory Conference for Asia and the Pacific

15. The following was recommended:

(a) Member States should fully utilize existing mechanisms of regional and international cooperation such as the Regional Space Applications Programme for Sustainable Development in Asia and the Pacific of the Economic and Social Commission for Asia and the Pacific (ESCAP) and the Committee on Earth Observation Satellites. The coordination involving the United Nations Programme on Space Applications and ESCAP should be further strengthened;

(b) Given the wide diversity among the countries in Asia and the Pacific, which include many developing countries, the United Nations should play a more active role in the coordination of space-related activities in the region, with a view to fostering international cooperation;

(c) UNISPACE III should affirm that space-based services for search and rescue, disaster monitoring and management, and weather-related uses should be free of commercial considerations.

Recommendations of the Regional Preparatory Conference for Latin America and the Caribbean

16. The States of Latin America and the Caribbean, meeting within the framework of the Regional Preparatory Conference for Latin America and the Caribbean:

(a) Expressed their firm resolve to promote international cooperation in the field of space science and technology as a basic tool for achieving the sustainable development of the less developed countries;

(b) Conscious of the need to meet the specific requirements of each region, emphasized the importance of orienting cooperation programmes on the basis of the harmonization of compatible objectives and contributions in accordance with the human and economic capacities available in each State;

(c) Expressed their conviction that cooperation projects must assist in developing the potential of each State in terms of its human, technological and economic resources.

17. The following was recommended:

(a) Action should be taken to give priority to specific cooperation projects in the field of space that would make an effective contribution to developing the potential of States in terms of human, technological, economic and training resources, in the interests of achieving the best possible results;

(b) Action should be taken to facilitate the timely and effective use of the information obtained through space technology as a basic input into the decision-making process, in the public sector and in the private sector;

(c) Action should be taken to increase the interlinking of telecommunications, remote sensing and space information systems in order to maximize the effectiveness of initiatives directed towards the sustainable development of States.

Recommendations of the Regional Preparatory Conference for Eastern Europe

18. The following was recommended:

(a) The United Nations should provide adequate resources for the implementation of the recommendations of UNISPACE III;

(b) Member States in eastern Europe should be encouraged to actively cooperate and participate in the international scientific and technological research programmes on the International Space Station, as their involvement could provide major economic and social benefits for the region;

(c) Member States in the region should take advantage, through international cooperation, of the complementarity of satellite systems for increasing opportunities in space science, technology and applications;

(d) With reference to the issue of space debris, the United Nations should ensure that a good balance is achieved between the necessity to preserve outer space for future space activities and the need to maintain conditions for current space activities. Both space agencies and the global scientific community should play an important role in helping the United Nations to achieve that goal;

(e) UNISPACE III should discuss legal aspects of space activities, review and assess the current status of space law and promote its further progressive development based on the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. In studying those and other issues, the Legal Subcommittee of the Committee on the Peaceful Uses of Outer Space should continue to cooperate with other intergovernmental and non-governmental organizations dealing with space law.

B. Recommendations of the regional preparatory conferences for UNISPACE III with regional and national implications

1. Protecting the environment

Recommendations of the Regional Preparatory Conference for Africa and the Middle East

19. The following was recommended:

(a) The appropriate scientific and technical committees of ECA and ESCWA should cooperate closely to enhance capacity-building in remote sensing and mapping centres already in existence in the regions in the areas of human resources, infrastructure development, acquisition of equipment and policy regulations;

(b) The regions of Africa and the Middle East are not totally covered by Earth observation ground receiving stations. The regional commissions of the Economic and Social Council that are responsible for the two regions (ECA and ESCWA) should work with affected countries to ensure that the coverage gap is closed;

(c) Member States are encouraged to put in place prospective, proactive and participatory science and technology policies and to implement space strategies, including the necessary annual budget allocations, in order to derive maximum benefit and to contribute towards enhancing the standard of living of their people;

(d) Member States should facilitate and encourage the participation of the private sector in all aspects of space industry development and related applications;

(e) ECA and ESCWA should work with Member States in the two regions to determine the ability of the Member States to participate effectively in Earth observation projects.

Recommendations of the Regional Preparatory Conference for Asia and the Pacific

20. The following was recommended:

(a) Member States should enhance consultations among themselves in planning future Earth observation programmes. They should also fully utilize and enhance research and information networking to promote the exchange of data and research results in the International Geosphere-Biosphere (Global Change) Programme and related Earth studies;

(b) Policy and decision makers should be better informed about the immense potential of satellite remote sensing and related technologies for the effective management of resources and, in particular, for disaster prevention and mitigation;

(c) Member States in the region should formulate appropriate space-related policies and strive to play an effective role in the delivery of value-added services;

(d) In view of the existence of problems encountered in implementing regional cooperative efforts involving data exchange and technology transfer owing to differences in national policies and priorities, Member States should develop more workable and acceptable mechanisms to facilitate coordination and cooperation in that area;

(e) Any regional programme should include the exchange of data and the sharing of information derived from data analysis.

Recommendations of the Regional Preparatory Conference for Latin America and the Caribbean

21. Action should be taken:

(a) To identify and establish, through the competent national authorities, focal points for the exchange of information and dissemination of the results of regional and interregional projects, in the areas of environmental studies, natural resources and disaster management, in which the various sectors of society concerned with such issues participated;

(b) To promote the production of risk-microzoning maps (microseismicity, hydrometeorology, urban and rural pollution, interferometry etc.) through access to and use of satellite imaging and geographic information systems.

Recommendations of the Regional Preparatory Conference for Eastern Europe

22. The following was recommended:

(a) Regional systems for environmental monitoring of the Black Sea and the Caspian Sea, especially for oil slicks, ship traffic, ecology and climate change, should be developed, making use of remote sensing by satellite;

(b) Decision makers, at all levels, should be encouraged to learn about the practical application of remote sensing in the national development activities for which they are responsible.

2. Facilitating and utilizing communications

Recommendations of the Regional Preparatory Conference for Africa and the Middle East

23. The following was recommended:

(a) ECA and ESCWA should set up an interregional committee (for Africa and the Middle East) to coordinate and promote workshops and expert group discussions aimed at the formulation of regional policies and of coordinated positions at international forums and to increase public awareness of issues relating to satellite communications;

(b) African Member States should support and encourage regional communication establishments, such as the Regional African Satellite Communication Organization, in their efforts to provide and operate regional satellite communication programmes;

(c) African Member States should support the development of an inter-African connection for, among others, telephony, data, tele-education, telemedicine and the Internet. In this connection, African countries, the United Nations and other members of the international community are called upon to support fully and to contribute to the realization of the project on the cooperative information network linking scientists, educators, professionals and decision makers in Africa (COPINE), an initiative of the Office for Outer Space Affairs of the Secretariat.[9]

Recommendations of the Regional Preparatory Conference for Asia and the Pacific

24. The following was recommended:

(a) Member States should take advantage of emerging space techniques by "leapfrogging" into advanced telecommunications systems;

(b) Satellite capabilities should be exploited to maximize their use in assisting in rural development. The private satellite communications industry should also adequately deal with such urgent needs;

(c) The public and private sectors of industry should cooperate in the development of space communications technology and its applications. Each country in the region should provide the necessary conducive environment by enacting appropriate legislation in order to promote investments;

(d) Member States should, to the extent possible, share space as well as ground segment capabilities;

(e) Member States should be active players in the space communications industry and not just users of space communications technologies;

(f) Local telecommunications infrastructure should be developed using local expertise, with assistance from both regional and international organizations;

(g) The role of the Asia-Pacific Satellite Communications Council, as a regional forum for formulating a collective stand to deal with the issues of frequency planning and coordination, as well as training, should be strengthened by Member States in the region.

3. Improving and using positioning and location capabilities

Recommendations of the Regional Preparatory Conference for Eastern Europe

25. The following was recommended:

(a) Member States in the region should increase their awareness of satellite navigation by participating in or hosting workshops or conferences;

(b) Interested States in eastern Europe should seek participation in the European Geostationary Navigation Overlay System.

4. Furthering knowledge and building capacity

Recommendations of the Regional Preparatory Conference for Africa and the Middle East

26. The following was recommended:

(a) Member States of the regions of Africa and the Middle East are encouraged to support fully and to participate actively in the activities of the regional centres for space science and technology education that are being established under the auspices of the United Nations in Morocco, Nigeria and the Middle East, with a view to building indigenous capability in space science and technology in all countries in the regions concerned;

(b) Member States in the two regions are urged to formulate clear policies on science and technology, including space-related aspects, and to endow such policies with inalienable political will and an implementation programme so that African and Middle Eastern societies may reap the attendant dividends upon active participation in appropriate science and technology programmes;

(c) In spite of the tremendous advances that have been achieved in the applications of space technology in the last 20 years, socio-economic development in Africa is yet to be as much affected by this technology as in other parts of the world. One major reason for this undesirable situation is lack of commitment. In order to redress the situation, a joint African/Middle Eastern leadership conference, at the level of either heads of State or ministers, should be organized by the Office for Outer Space Affairs, with a view to increasing the awareness of space technology development and its impact on social and economic development, preferably before UNISPACE III;

(d) Member States should make effective use of their indigenous scientific personnel and give them every support, so that they can forge tangible research and development linkages and enter into joint ventures with institutions and industries that have acknowledged capabilities in space science and technology, as well as encourage the private sector to invest in such joint ventures;

(e) Member States should invest in the development of the necessary knowledge and skills in their citizens in different aspects of space science and technology, in particular through their participation in the development, design and production of small satellites, with a view to gaining an understanding of the technology and the subsequent use of such satellites for various socio-economic applications, bearing in mind the relatively low cost of designing, constructing, launching and operating small satellites. Programmes on small satellites could be carried out through regional collaboration;

(f) Member States should at all times take advantage of the opportunities available through a variety of international programmes, such as the United Nations Programme on Space Applications, and should respond promptly to requests of the Office for Outer Space Affairs, especially with regard to participation in meetings, conferences and training courses organized by the Office, so that they can keep abreast of the latest developments in space science and technology;

(g) Member States in the regions of Africa and the Middle East should mobilize efforts to formulate or strengthen national space policy within the context of their science and technology programmes. Such policies should integrate optimal use of space technology tools with a view to socio-economic development;

(h) The importance of sensitizing national policy makers to the applications of space technology cannot be overstressed. Multimedia tools should be used at the national level to make such campaigns attractive;

(i) In utilizing space applications for educational purposes, emphasis should be placed on the development of educators and trainers, who would then be in a better position to prepare appropriate curricula for distance education, flexible learning and continuing education;

(j) A virtual university allows flexibility to evolve in accordance with the changing needs of a region. It prevents duplication of effort and facilitates uniformity in training. It also provides expertise that may not exist in one particular region and can be shared with other regions. Recognizing that there are many providers of content for distance education, priority should be placed on creating the relevant infrastructure in order to gain access to the immense amount of pre-existing resources for education and training;

(k) Member States should take advantage of existing projects and experiences in the field of tele-education and virtual universities, so that African and Middle Eastern countries can be prepared for the information age;

(l) With the aid of new information technologies, Member States should participate actively in the exchange of space-related experiences and knowledge by creating networks of specialists within regions or countries.

Recommendations of the Regional Preparatory Conference for Asia and the Pacific

27. The following was recommended:

(a) Member States in the region, particularly developing countries, should work together in the development of microsatellites;

(b) Since microsatellites provide a new and affordable opportunity for regional cooperation and space capacity-building, countries in the region should be fully engaged in the development of low-cost microsatellite and mini-satellite programmes;

(c) Member States should implement public awareness programmes, especially in primary and secondary schools, focusing, *inter alia*, on the value of space technology in everyday life. The programmes should also target decision makers and planners and other potential users to make them aware of the relevance of space technology applications in various socio-economic sectors;

(d) The self-sustaining financial status of the Centre for Space Science and Technology Education in Asia and the Pacific is essential to the fulfilment of its goals and objectives. Member States should take full advantage of the educational facilities offered by the Centre. The Centre should continually adjust its curriculum and teaching facilities to respond to developments taking place in space technology, especially those directly related to the needs of the countries in the region;

(e) The Centre and other similar institutions and facilities in Asia and the Pacific should provide region-specific education and opportunities to share experiences to scholars in the region at an affordable cost and without posing many logistical problems;

(f) The development of self-learning tools such as electronic media and computer-based modules in education and training should be consistent with the requirements of user countries in the region;

(g) There should be political will at the national level to give the highest priority to education in general and space science education in particular;

(h) A network of educational facilities providing education and training in space science and technology at the postgraduate level should be developed to meet the increasing need in the region for adequately educated and trained human resources;

(i) Action must be initiated to promote intensive cooperation among Member States in the region to enable them to benefit from space technology applications by sharing experiences and expertise. In that connection, substantive joint projects provide a good basis for regional cooperation, the success of which will depend on enhanced national activities and programmes;

(j) In order for regional cooperation to succeed, higher levels of investment will be needed in the social sector, including in human resource development. Member States in the region should share their experiences in different areas of space technology for the development of human resources, through the exchange of technical information and education packages;

(k) In order to advance the state of space research and development activities in the region, Member States should allocate more funds to such activities.

Recommendations of the Regional Preparatory Conference for Latin America and the Caribbean

28. Action should be taken:

(a) To create and/or strengthen governmental institutional mechanisms for ensuring the satisfactory development of space activities and to promote the participation of all interested sectors, thus fostering cooperation with a view to contributing effectively to resolving socio-economic problems in Latin America and the Caribbean;

(b) To enhance, through regional, interregional and international cooperation mechanisms, the capacities of countries in the region by means of training in the field of space science and its applications in environmental management, within a balanced social and economic setting;

(c) To encourage, with the assistance, *inter alia*, of the United Nations Programme on Space Applications, the participation of professionals from the region in international research and development programmes;

(d) To foster the use and integration of space data and other information within the programmes and activities of public institutions in countries in the region, for the purpose of publicizing technological advances, with emphasis on the fields of satellite communications and microsatellites;

(e) To encourage and support regional and interregional coordination in the field of education with a view to permitting the development of and access to applications of space science and technology, thus permitting the exchange of teaching materials and experience within the field of education, including distance-learning programmes, for the benefit of all sectors of society;

(f) To promote the participation of countries in the region in education projects with a space-related component, such as education workshops within the scope of the Southern Cone Common Market (MERCOSUR), and to promote the organization of other regional workshops within the framework of the United Nations Programme on Space Applications.

Recommendations of the Regional Preparatory Conference for Eastern Europe

29. The following was recommended:

(a) Each State should increase the involvement of its qualified personnel in research and industrial development in current and future programmes for the utilization of space techniques and technologies;

(b) The training and education of staff, especially young medical personnel, such as physicians and nurses to be involved in telemedicine projects, should be coordinated. Interested States in the region should participate, to the extent possible, in existing telemedicine networks, such as the SHARED and EUROMEDNET projects, supported by the Italian Space Agency and the European Space Agency;

(c) Member States in eastern Europe should fully cooperate in space research and space exploration and should maintain the high standards already achieved in space science research, education and related applications;

(d) The science and technology policies of Member States in the region should promote the use of space technology for sustainable development;

(e) With the support of new information technology, Member States in the region should actively participate in the exchange of practical experience and knowledge in complementary sectors by creating networks of specialists within regions or countries;

(f) National institutions and organizations involved in space science, technology and applications should use the Internet to develop programmes for distance teaching in the field of Earth observation, particularly in such areas of application as meteorology, hydrology and environmental protection;

(g) The core institutions of the network of space science and technology education and research institutions for central eastern and south-eastern Europe should develop joint projects including both scientific and technological aspects, as well as educational and training aspects, on a multidisciplinary basis. The promotion of education at the primary and secondary levels should also be considered among the important goals of future activities of the network. Beyond a mutual exchange of information, alternative activities such as student contests and summer courses should be undertaken within the framework of the network;

(h) The core institutions of the network should develop a satellite communications infrastructure, including appropriate terminals located in each country at the core institution, for distance learning and the on-line exchange of information of regional interest;

(i) Member States in eastern Europe should develop a microsatellite programme devoted to operational uses such as hazard monitoring of the region, with long-term spin-offs in the promotion of space science, technology and applications. The results of the programme could significantly contribute to new research and development, including high-level education and training in space-related fields;

(j) The use of space applications for educational purposes should focus on, *inter alia*, developing programmes for educators and trainers that would put them in a better position to prepare appropriate curricula for flexible learning and continuous education.

5. Enhancing education and training opportunities for youth

Recommendations of the Regional Preparatory Conference for Latin America and the Caribbean

30. Action should be taken:

(a) To foster the creation of multidisciplinary committees that would promote education across the entire spectrum of space sciences in primary schools, secondary schools and universities and to generate training and research opportunities, in particular for professionals in remote areas;

(b) To identify potential sources of funding and international financing bodies to provide support with a view to including space science and technology in academic curricula at the different educational levels.

6. Information needs

Recommendation of the Regional Preparatory Conference for Eastern Europe

31. In order to support the necessary and meaningful exchange of information on space-related activities between States in eastern Europe, Member States in the region ensure the establishment and maintenance of a regional database, in cooperation with established national institutions and relevant international organizations.

7. Spin-offs and commercial benefits from space activities: promoting technology development and exchange

Recommendations of the Regional Preparatory Conference for Eastern Europe

32. The following was recommended:

(a) Development of small satellite projects should be considered as the best strategy for Member States in the region interested in developing the space industry, because of the reasonable cost and duration of such projects;

(b) As a consequence of the evolution of space-related technologies, the joint development, construction and operation of a variety of small satellites offering opportunities to develop indigenous space industry should be undertaken as a suitable project for enabling space research, technology demonstrations and related applications in communications and Earth observation. Member States in the region should seek the necessary support for such ventures;

(c) Given the importance of and growing trends towards the commercialization of space-related services, such as satellite telecommunication, the use of global location and navigation systems and Earth observation applications, Member States in the region should identify essential mechanisms for fostering the involvement of the private sector in space application activities;

(d) In order to promote spin-off benefits and effective space applications, particularly in the case of emerging "space-faring" countries in the region, Member States in the region should increase their capacity to understand the associated technologies and to place a high priority on their development at the national level. Each State should enhance its basic and advanced research capabilities in the relevant disciplines.

8. Promoting international cooperation

Recommendations of the Regional Preparatory Conference for Asia and the Pacific

33. The following was recommended:

(a) The formation of a regional space agency should be approached in a step-by-step manner, on the basis of comprehensive preparatory work;

(b) Future satellite programmes in Asia and the Pacific should be formulated on a goal-oriented basis, by all concerned, taking into account the needs of the region;

(c) There is an immediate need for adequate space-based communications, disaster monitoring and disaster evaluation facilities for the Pacific island States, which could use space-based communications systems to facilitate the exchange of relevant data. ESCAP should lead the initiative to assist the Pacific island States in that endeavour.

Recommendation of the Regional Preparatory Conference for Eastern Europe

34. Because scientific meetings have proved to be essential mechanisms for strengthening regional cooperation, Member States in eastern Europe should take the necessary steps to ensure the organization of such scientific meetings on a regular basis, as appropriate, among their established scientific and research institutions and professional organizations relating to space science and technology.

Resolution 2

Expression of thanks to the people and Government of Austria*

The Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III),

Having met in Vienna from 19 to 30 July 1999,

1. *Expresses its profound gratitude* to the Government of Austria for having made it possible for the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) to be held in Vienna and for the excellent facilities so graciously placed at its disposal;

2. *Requests* the Government of Austria to convey to the city of Vienna and to the people of Austria the gratitude of the Conference for the hospitality and warm welcome extended to all participants.

Resolution 3

Credentials of representatives to the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space*

The Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III),

Having examined the report of the Credentials Committee,[10]

Approves the report of the Credentials Committee.

* Adopted by the Conference at its 10th plenary meeting, on 30 July 1999.

II. Background and recommendations of the Conference*

Outer space is the province of all humankind and should therefore be used for peaceful purposes. In the twentieth century, humanity has made significant progress in the development and use of space science and technology to address human needs. At the threshold of a new millennium, the global community is faced with challenges to its sustainable development and is also presented with significant opportunities for scientific and socio-economic development. Global cooperation in space science and technology can help meet those challenges and opportunities.

Since the launch of Sputnik I in 1957, humankind has sent satellites into orbit to provide daily information on Earth's weather and data for use in the management of natural resources and disasters and for environmental monitoring and to provide communication linkages, which have shrunk distances between communities and may lead to greater interdependence among nations. Scientific satellites and orbital platforms have deepened humankind's understanding of the universe, of Earth's place in the universe and of interactions between Earth and the life-giving Sun.

The United Nations has accorded significant importance to the promotion of greater international collaboration in those areas. The Committee on the Peaceful Uses of Outer Space, established by the General Assembly in 1959, and the Committee's Scientific and Technical Subcommittee, as well as its Legal Subcommittee, have fostered international cooperation in different aspects of space science and technology and their applications, including those for sustainable development. The General Assembly has adopted several treaties and sets of principles that lay the ground rules for the peaceful and fruitful conduct of space activities.

Recognizing the need for a global dialogue on those key issues, the United Nations held two space conferences in Vienna, in 1968 and in 1982. Those conferences led to many new initiatives, including the creation of the United Nations Programme on Space Applications, the expansion of its mandate and the establishment of regional centres for space science and technology education. Such initiatives and others are aimed at building in developing countries the human and institutional capacities for understanding and use of space technologies for socio-economic development. Several United Nations agencies have also joined in the efforts to meet those objectives within their respective mandates.

And yet, many challenges remain. Today, continued population growth and unsustainable patterns of production and consumption are putting increasing pressure on the Earth's environment and on scarce natural resources. Each year, natural disasters cause damage in the billions of dollars and claim countless human lives. Improved space capabilities and international cooperation could assist in dealing with those issues and could also enhance economic and social progress. There is also a need to devise more effective mitigation measures against space debris and to improve humankind's understanding of the effects of solar storms.

To address those challenges, and to take advantage of new opportunities, the General Assembly decided in its resolution 52/56 of 10 December 1997 to convene the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) in Vienna from 19 to 30 July 1999, under the theme "Space Benefits for Humanity in the Twenty-first Century". The Conference was an invitation to the international community to take

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* The single-column text that precedes section A of this chapter was originally the summary of the draft report of the Conference, which was amended together with the draft report. (A/CONF.184/3 and Corr.1-3). The headings in that text correspond to those in section G of this chapter.

stock of the significant developments that had taken place since 1982, including geopolitical changes, numerous scientific and technological advances, the contributions of new "space-faring" nations and the important role of the private sector. Accordingly, the primary objectives of the Conference were:

(a) To promote the effective means of using space solutions to address problems of regional or global significance;

(b) To strengthen the capabilities of Member States, especially developing nations, to use the results of space research for economic and cultural development;

(c) To enhance international cooperation in space science and technology and its applications.

UNISPACE III presented a unique opportunity for the world's experts and decision makers to meet and exchange information and ideas to advance the human condition into the next millennium.

Harnessing the potential of space at the start of the new millennium

A. Protecting the environment

1. Scientific knowledge of Earth and its environment

Planet Earth is facing the increasing threats of rapid environmental changes, including climate change and its attendant consequences, deforestation, desertification and land degradation, further depletion of the ozone layer, acid rain and a reduction in biodiversity. Such changes would have a profound impact on all countries, yet many important scientific questions remain unanswered.

Satellites can provide the synoptic, continuous and long-term global observation needed to understand the Earth's system more comprehensively, in conjunction with the use of modelling technology, to address issues such as (a) the influence of the Sun on the Earth's environment, (b) global climate change and (c) impacts on the environment and human health caused by anthropogenic activities and changes in the ozone layer.

2. Environment and natural resources and remote sensing

Reliable weather forecasting and longer-term climate predictions have become an essential part of daily life on Earth. Weather forecasting, climate predictions, disaster management and the management of Earth's resources are areas where remote sensing is contributing successfully to the improvement of the human condition. Satellites are increasingly providing important information for early warning and management of the impact of disasters, as well as information that is useful in the management of agriculture, forestry, minerals, water resources and fisheries. All these applications need continuous data acquisition and will benefit from improvements in and adaptation of remote sensing technologies and associated data analysis.

Measures should be taken to maximize the benefit of remote sensing systems through increased availability and affordability of data and information products; improved provision of technical information, training and financial support for developing countries in order to assist in decision-making and the use of remote sensing data and derived information in the development process; and improved coordination among ongoing and planned programmes and initiatives to eliminate duplicated efforts and to identify gaps.

B. Facilitating and utilizing communications

Communications and broadcast satellites have progressed from small, low-power satellites with low-gain antennas to large complex platforms with high transmission power, precise pointing, a very high frequency reuse and longer design life. Such technological advances have led to a progressive emergence of new telecommunication services and applications. Newly proposed or enhanced satellite services include mobile telephony, data, imaging, video teleconferencing, digital audio, multimedia and global Internet access. Wide-ranging applications being planned include distance learning, corporate training, collaborative work groups, telecommuting, telemedicine, electronic commerce, direct-to-home video and satellite news-gathering, as well as the distribution of music, software, scientific data and global financial and weather information.

Rapid advances in communications and information technologies have had many positive effects, but have also widened the gap between those who can use the technologies to access more information more quickly and those who cannot. New satellite communications systems can reduce that information gap.

C. Improving and using position/location capabilities

There are currently two global navigation satellite systems (GNSS), the Global Positioning System (GPS) of the United States of America and the Global Navigation Satellite System (GLONASS) of the Russian Federation. The use of transmitted signals to determine position, velocity and time from these dual-use systems has been offered free of charge to civilian users. The services are used largely in the field of transportation and surveying, but new applications, such as in meteorology and geology, satellite navigation, telecommunications timing and geographic information systems (GIS), have emerged. With a view to further developing the capabilities of such systems, the United States is embarking on a major enhancement of GPS and implementing the Wide Area Augmentation System (WAAS), Europe is implementing the European Geostationary Navigation Overlay Service (EGNOS) System and Japan is implementing the Multi-functional-transport-satellite-based Satellite Augmentation System (MSAS). For Europe, the next stage will be a second-generation global navigation system, Galileo, which is in its initial definition phase. International acceptance of such systems for navigation and other civil application purposes depends on affordability, the guarantees of open access and continuity for civilian use and the enhancement of the system through overlay or augmentation. Building on the widespread use of the above-mentioned GNSS today, regional and global coordination is essential to achieve seamless multimodal satellite-based radio navigation, timing and position services for all users.

D. Furthering knowledge and building capacity

The ability to develop and use space science and technology depends critically on the availability of human resources with appropriate knowledge and skills. Research, education and training are the cornerstones for furthering knowledge and are part of the overall capacity-building process. In addition, capacity-building includes establishing policies, establishing the institutional framework and physical infrastructure, ensuring funding support and gaining experience, the latter by undertaking research and operational activities. A key element of the effort to build such capacities in developing countries is the establishment, under the auspices of the United Nations Programme on Space Applications, of the regional centres for space science and technology education. Those centres should be endowed by the United Nations with appropriate financial and other support.

E. Enhancing education and training opportunities for youth

Planning of space activities should be accompanied by appropriate long-term strategies for human resource development, with emphasis on the cross-cultural experience and interdisciplinary training of future decision makers and managers in space activities. While educational activities are already being undertaken for young people in some countries by space agencies, the United Nations and others could provide educational and training opportunities for students and young scientists and engineers. Efforts should also be strengthened to provide young people with opportunities to express their unique and innovative ideas and visions for space activities. Accordingly, UNISPACE III extended invitations to young space professionals to express their visions and perspectives of future space endeavours.

F. Information needs and the global approach

Information technology includes a cluster of technologies in the field of computing, software, microelectronics, telecommunications, databases and networking. Information systems are fundamental tools for organizing, handling and integrating data through appropriate algorithms and generating information in the form that is most suited to the intended user group. They are valuable for monitoring events, for research and applications, for education and training and for decision-making. Information infrastructure is an essential element of development in any country. Space technology is a potent tool for gathering information and for communicating it rapidly and efficiently over wide and remote areas.

However, many developing countries need to further develop their information infrastructure, thus improving their access to information as a basic resource for development. Therefore, as information is a basic resource for development, it should be a matter of priority for many developing countries to invest in building up their national information infrastructure. This can be facilitated by the use of appropriate space technologies and by the adoption of common standards, distributed networks and common user interfaces.

Furthermore, the resolution of environmental and other issues at the global and regional levels will require greater integration of national information networks into regional and global ones.

G. Spin-offs and commercial benefits from space activities: promoting technology development and exchange

Products and services derived from space technology have improved the quality of life all over the world in countless ways. Space research and development promotes and incorporates innovations in many high-technology areas, such as computer software and hardware, advanced electronics and materials, telecommunications, health sciences, remote sensing, launch services and satellite manufacturing. Other major beneficiaries from space technology investments and spin-offs include transportation, environmental monitoring, public safety and computer and information technology sectors, including various aspects of sustainable development.

Space agencies are increasingly entering into partnerships with the private sector for the attainment of their programme objectives. Furthermore, commercial firms have become the primary investors in certain parts of the space market, such as satellite telecommunications. Next to telecommunications, remote sensing, launch services and geographic information systems may be among the most significant areas for commercial space activities. Directly and indirectly, space technology is now used by thousands of companies worldwide to bring new products, processes and services to the world market and at ever lower, more affordable prices.

For developing countries, relevant space-related technologies can be used to address social and economic problems effectively. However, a number of significant barriers to technology transfer do exist and need to be surmounted for those countries to take full advantage of those possibilities.

H. Promotion of international cooperation

In its resolution 51/122 of 13 December 1996, the General Assembly reaffirmed the commitment of Member States to promote international cooperation in the exploration and peaceful uses of outer space for the benefit and in the interest of all States, taking into particular account the needs of developing countries. The fading away of cold war tensions has dramatically altered the way in which the "space-faring" nations conduct space activities. They and other countries have come to recognize both the advantages of working together to identify common goals and the need to optimize their financial and other resources. An example is the International Space Station, the largest project involving international cooperation in space to date. The countries participating in it have the opportunity to apply technologies connected with the presence of humankind in space and to carry out research, particularly in the field of medicine.

In view of their universal importance, environmental monitoring and disaster management may be two of the areas where the potential is greatest for enhancing international cooperation. In order to promote cooperation at all levels, the use of the following mechanisms should be enhanced: international intergovernmental and non-governmental organizations and arrangements, ad hoc inter-agency mechanisms, bilateral and regional agreements, programme-specific agreements and transnational commercial activities. In that regard, UNISPACE III takes special note of the initiative taken by the Integrated Global Observing Strategy Partnership to link users and providers of satellite-based and surface-based data about the Earth and to foster the development of information products that increase scientific understanding and guide early warning, policy-setting and decision-making for sustainable development and environmental protection.

International space law as developed by the United Nations through the Committee on the Peaceful Uses of Outer Space reflects the importance of and provides the framework for international cooperation. So far, the United Nations has drawn up and approved five treaties and five sets of legal principles on matters relating to the peaceful uses of outer space.[11]

To develop political support for international cooperation in space activities, there should be multilateral consensus to implement common space goals, identified, *inter alia*, by the General Assembly in its resolution 51/122, at the highest decision-making level. To enhance its role in promoting international cooperation in the peaceful uses of outer space, the United Nations should ensure that the agenda of the Committee on the Peaceful Uses of Outer Space and its subcommittees reflect the full scope of issues of relevance to contemporary space activities. Steps should also be taken to improve the coordination of space goals within the United Nations system. The full implementation of those activities by the United Nations and Member States will promote the peaceful and fruitful exploration and utilization of outer space for the betterment of this and future generations.

A. Historical perspective

1. The interest of humankind in space dates back to prehistoric times. Many historic monuments thousands of years old attest to civilizations that developed their own "cosmo-vision", with considerable scientific and astronomical knowledge.

2. Assisted by telescopes and other optical instruments, humans began to increase their knowledge about the motions of the planets and their understanding of the universe. They started to wonder about their place in the entire scheme of things and to think about the structure, and eventually the origin and the future, of the universe. The science of astronomy became one of the most intellectually stimulating branches of the human quest for knowledge and understanding.

3. The quest for knowledge of the universe was accompanied by a desire to break free from the confines of the planet and to step out into outer space. Following the invention of gunpowder and fire arrows a thousand years ago in China, the idea of travelling by means of rockets slowly crystallized in the human mind. At the end of the nineteenth century, a number of scientists, inspired by works of science fiction about space travel, dreamed about space exploration and began to work on rocket technology.

4. The development of rockets was accelerated by the desire to acquire more effective weapons during the Second World War. It was continued mainly through military research and development. Nevertheless, the first rocket to leave the planet was not used for military purposes. It was used to launch a satellite for the advancement of science on the occasion of the International Geophysical Year, 1957-1958. In October 1957, the successful launch of Sputnik I marked the dawn of the space age and the beginning of human efforts to ensure the peaceful uses of outer space.

5. During the early years of the space age, the desire to explore outer space was fuelled by the competition between the two space Powers, resulting in the rapid pace of human achievements in outer space. In April 1961, Yuri Gagarin became the first human being to orbit the Earth. In July 1969, the so-called race to the Moon culminated in the successful lunar landing by Apollo 11, when Neil Armstrong and Edwin "Buzz" Aldrin stepped onto the surface of the Moon. The rivalry increased the human capacity to build complex space systems, involving not only advances in science and technology, but also the improvement of system management capabilities.

6. Rapid progress in the development of science and technology systems, including management of large-scale scientific enterprises, made it possible to conduct closer observations of the planets, in both the inner and outer solar systems. To date, all the planets in the solar system except for Pluto have been visited by spacecraft. An international armada of scientific spacecraft was also sent to study Halley's Comet on its most recent visit to the inner region of the solar system, an event that occurs at intervals of about 75 years. Together with observations made through the Hubble Space Telescope, providing clear images of celestial phenomena, various missions sent to probe different aspects of the universe will continue to provide clues about the origin and the future of the cosmos and of humankind.

7. Significant progress in the development of space science and technology and their applications have enabled humans to exploit the last frontier, outer space. Efforts to utilize the space environment were further strengthened during the post-Apollo period. Space stations, such as Salyut, Mir and Skylab, and platforms have provided opportunities to conduct various research activities in orbit. Applications satellites have provided the capability to observe Earth from space and facilitated communications around the world, with momentous consequences for the economic and social development of humankind.

8. In the information age, communications satellites have contributed to the expansion of commercial activities, a promising sign for the growth of space industry in other fields. Launch services are increasingly being provided by the private sector, stimulating efforts to afford access to outer space at lower cost. An increasing volume and variety of remote sensing data and higher-resolution imagery are being disseminated by commercial distributors for various uses.

9. Space technology and its applications have also provided the means of obtaining, through the use of Earth observation satellites, essential data for scientific research on the state of planet Earth. Those satellites will assist humanity in assessing the consequences of industrial activities, thus making it possible to take corrective action to protect the fragile planet.

10. Scientific exploration of outer space, utilization of the near-Earth environment and observation of Earth have enhanced human awareness of the profound interdependence of all people on planet Earth. The global networks created by communications satellites have brought together people around the world, enabling them to exchange ideas freely and to discover their cultural diversity. Data and information on the global environment have demonstrated the vulnerability of the planet to human activities and have increased awareness of the need to join efforts to protect the planet for future generations.

11. The exploration and peaceful uses of outer space promote mutual understanding through cooperation to solve global problems on Earth and to expand human civilizations into outer space. International cooperation in outer space marked another milestone in 1998 with the beginning of construction of the International Space Station, a further step towards fulfilment of the dream of living in space and probing ever more deeply into outer space in the future.

12. Through space exploration, humanity will continue to search for the origin of the universe and for the means of ensuring the future of human civilizations. Through applications of space science and technology, humanity will seek to enhance the human condition, preserve the global environment and ensure global prosperity for coming generations.

B. The United Nations and the peaceful uses of outer space

13. The United Nations has been involved in space activities since the very beginning of the space age. In the midst of the cold war, there was a growing concern in the international community that space might become yet another field for intense rivalries between the superpowers or would be left for exploitation by a limited number of countries with the necessary resources. In 1958, the General Assembly established the Ad Hoc Committee on the Peaceful Uses of Outer Space, composed of 18 members, to consider the activities and resources of the United Nations, the specialized agencies and other international bodies relating to the peaceful uses of outer space, organizational arrangements to facilitate international cooperation in the field within the framework of the United Nations and legal problems that might arise in programmes to explore outer space.[12]

14. The Committee on the Peaceful Uses of Outer Space was established as a permanent body in 1959, with a membership of 24 States. Its membership currently consists of 61 States.[13] Following intense consultations among its members, the Committee agreed in March 1962 to conduct its work in such a way that it would be able to reach agreement without voting.

15. In response to a request by the General Assembly in 1961, the Committee has been serving as a focal point for international cooperation in the peaceful exploration and use of outer space, maintaining close contact with governmental and non-governmental organizations concerned with outer space matters, providing for the exchange of information relating to outer space activities and assisting in the study of measures for the promotion of international cooperation in those activities.[14] The work of the Committee has been assisted by its two subcommittees, the Scientific and Technical Subcommittee and the Legal Subcommittee, since they were established by the Committee in March 1962. Over the years, those bodies have established working groups on various issues of particular significance.

16. Since the establishment of the Committee and its subcommittees, the practice had been to maintain the same officers, elections taking place only on an ad hoc basis when an officer became unable to continue in office. The various functions had been distributed between the Group of 77, the Group of Western European and Other States and the Group of Eastern European States. In 1996 and 1997, against dramatic geopolitical changes in the post-cold-war period, the Committee reviewed its working methods, including the composition of its bureau. As a result, the Committee agreed to introduce the principles of equitable geographical representation and rotation in the composition of the bureaux of the Committee and its subcommittees, shortened the duration of sessions of those bodies and strengthened the process of setting the agenda of the Legal Subcommittee. The five offices of the bureaux of the Committee and its subsidiary bodies,[15] each having a term of three years, now rotate among the five regional groups, one office being allocated to each of the following groups of States: Africa, Asia and the Pacific, Eastern Europe, Latin America and the Caribbean, and Western Europe and Other.

17. Secretariat services to the Committee and its subsidiary bodies are provided by the Office for Outer Space Affairs of the Secretariat, which consists of two sections: the Committee Service and Research Section and the Space Applications Section. The Office is also responsible for the implementation of the United Nations Programme on Space Applications.[16]

18. The discussions and recommendations of the Committee have led to the formulation and adoption of the five multilateral treaties and five declarations and sets of legal principles (see paragraphs 361-376 below). In addition to the progressive development of the legal regime governing space activities, the work of the Committee has contributed significantly to the promotion of international cooperation in the field of space science and technology. Through the exchange of information on developments in space activities, the Committee has provided Member States with opportunities to identify areas for further cooperation. The Committee has also provided important guidance for the implementation of the United Nations Programme on Space Applications, which has contributed to increasing the capability of developing countries in the utilization of space

technology and its applications, through its educational and training activities, and has often served as a coordinator or facilitator for cooperation between developed and developing countries, through its technical advisory services.

19. The work of the Committee has also led to the convening of three United Nations conferences. As early as 1959, the General Assembly decided to convene, under the auspices of the United Nations, an international conference for the exchange of experience in the peaceful uses of outer space and requested the Committee to work out proposals with regard to the convening of such a conference.[17] During the following years, the Committee conducted preparatory work and the Conference on the Exploration and Peaceful Uses of Outer Space was convened in Vienna from 14 to 27 August 1968 to examine the practical benefits of space exploration and the basis of scientific and technical achievements, as well as the opportunities available to "non-space-faring" States for international cooperation in space activities, with special relevance to the needs of developing countries.[18]

20. One of the results of the Conference was the establishment of a post of Expert on Space Applications, whose full-time task is to promote practical applications of space technology. One of the first recommendations made by the Expert on Space Applications to the Committee was the establishment of the United Nations Programme on Space Applications. In the following year, the Secretary-General was requested to allocate a budget for the implementation of the Programme.

C. The Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space

21. In November 1978, the General Assembly adopted the recommendations of the Committee relating to the convening of a second United Nations Conference on the Exploration and Peaceful Uses of Outer Space and to the arrangements for its preparation.[19] The Committee was designated as the Preparatory Committee for the Conference and the Scientific and Technical Subcommittee was designated as the Advisory Committee to the Preparatory Committee.[20]

22. The Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE 82), held in Vienna from 9 to 21 August 1982[21] and attended by representatives of 94 Member States and 45 intergovernmental and non-governmental organizations, considered the state of space science and technology, applications of space science and technology, international cooperation and the role of the United Nations. The recommendations and conclusions of UNISPACE 82, adopted by consensus, are contained in the report of the Conference.[22]

23. The General Assembly, in December 1982,[23] endorsed the recommendations of UNISPACE 82 pertaining to international cooperation in the exploration and peaceful uses of outer space,[24] one of the most significant consequences of which has been the strengthening and expansion of the United Nations Programme on Space Applications. The Assembly decided that the Programme should promote greater exchange of actual experiences with specific applications and greater cooperation in space science and technology between developed and developing countries, as well as among developing countries, and stimulate the growth of indigenous nuclei and an autonomous technological base in space technology in developing countries. In order to achieve those goals, the Programme was requested to develop a fellowship programme for in-depth training of space technologies and applications specialists and to organize regular seminars on advanced space applications and new system developments for managers and leaders in space applications and technology development, as well as for users. The Programme was also directed to disseminate, through panel meetings and seminars, information on new and advanced technology and applications and to provide technical advisory services on space applications projects. An International Space Information Service was also created to facilitate access to data banks and information sources.

24. Following the recommendations of UNISPACE 82, the United Nations Programme on Space Applications translated the elements of its expanded mandate into operational activities in space science and technology, in particular for the benefit of developing countries. During the period 1971-1997, the Programme organized 143 workshops, training courses and meetings of experts, which benefited approximately 7,500 participants. Following up on the recommendations of some of the workshops, the Programme focused on education and training and in particular on establishing regional centres for space science and technology education, affiliated to the United Nations, in each of the regions covered by the regional commissions.

25. In 1987, the Working Group of the Whole to Evaluate the Implementation of the Recommendations of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space was established by the Scientific and Technical Subcommittee. The objectives of the Working Group are to improve the execution of activities relating to international cooperation, in particular those included in the

United Nations Programme on Space Applications, to propose concrete steps to increase such cooperation and to make such cooperation more efficient.

26. The recommendations made by the Working Group of the Whole since 1987 have focused the attention of the international community on a number of issues of importance to promoting the access to and use of space technology by all Member States, in particular for the benefit of developing countries. At its 1997 session, in concluding its evaluation of the implementation of the recommendations of UNISPACE 82, the Working Group noted that it had refined or interpreted several of the recommendations to make them more specific and to facilitate their implementation. As a result, significant progress had been made, especially in the enhancement of international and regional cooperation in the continued development of worldwide space activities and the promotion of a greater exchange of actual experiences. Concrete results had been achieved in the following areas: the organization of a fellowship programme of in-depth training courses and workshops on advanced applications of space science and technology; preparation of a series of technical studies relating to specific areas of space science, space technology and their applications; and the establishment of regional centres for space science and technology education. The work of the Working Group had also led to more appropriate allocations from the United Nations budget for the expanded activities of the United Nations Programme on Space Applications. Although many positive actions had resulted from the more than 200 recommendations made by UNISPACE 82, it was still felt that many others remained unaddressed. That situation was considered to be not conducive to constructive work by the Committee.

27. The Working Group of the Whole was instrumental in the conceptual development and planning of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) and contributed effectively to the detailed preparatory work on various matters, including the objectives, form, venue, date, participation, provisional agenda, financial aspects and additional components of the Conference.

D. Enabling environment for space exploration and utilization

1. Important and growing role of space activities

28. Since the beginning of the space age, space exploration and exploitation have yielded tremendous scientific as well as economic and societal benefits for humankind. Space science provides a wealth of information about the processes that formed the universe, the planetary system, the Sun and Earth itself. Using powerful telescopes, scientists are probing back in time to the very origin of the universe, just moments after the big bang. Humanity is now exploring Mars, Jupiter and Saturn from close range. Current satellites with sophisticated instrumentation will send data back to Earth from which scientists will map the surfaces of the planets and determine the composition of their atmospheres and other geophysical parameters. With such data, energy exchange mechanisms for planetary atmospheric models are being developed and refined.

29. Space technology and its applications have been widely recognized as one of the major instruments for enhancing human ability to understand the environment and manage natural resources and for providing effective communications across long distances and to rural areas. That ability has promoted economic, cultural and social development, in particular for developed countries, and provided the possibility for those countries to accelerate their development process.

30. Earth observation satellites provide an important and unique source of information for studies of the Earth's system. There are currently over 45 satellite missions operating and some 70 more missions, carrying over 230 instruments, are planned for operation during the next 15 years by the world's civil space agencies. These satellites provide measurements of many parameters critical to monitoring the Earth's system. Planned missions will provide a significant increase in data and information over that provided by the satellites currently in operation. Data from existing and future satellites will be used to address issues of social and economic importance in such areas as land-use management, the management of renewable and non-renewable resources, disaster management, global health and agricultural and fisheries management. Thus, an extremely valuable tool is already available and will be greatly improved over the next decade. The elements of that tool, however, require international coordination, clear definitions of the problems to which they can be applied and, above all, a much broader awareness on the part of its potential users, in particular, developing countries.

31. Although still considered an emerging technology in commercial terms, remote sensing has evolved from traditional applications, such as cartography, hydrology, surveying and monitoring of natural resources, to more consumer-oriented applications, such as disaster preparedness, insurance claims adjustments, marketing, delimitation and appraisal of real estate properties and precision farming. Value-added services offered by the private sector in converting the satellite images to meaningful information for

the user domain is a growing market, with an estimated value of 600 million United States dollars ($) over the next five years.

32. Satellite communications systems, including those developed nationally by governmental or commercial entities as well as through international organizations, such as the European Telecommunications Satellite Organization (EUTELSAT), the International Mobile Satellite Organization (IMSO), the International Organization of Space Communications (Intersputnik) and the International Telecommunications Satellite Organization (INTELSAT), have introduced improved techniques and new technologies. The emerging new services would provide more efficient solutions, in both developed and developing countries, for dealing with issues of regional and global concern, such as improving opportunities for education, ensuring access to adequate medical services, increasing the effectiveness of disaster warning and relief operations and developing adaptation or mitigation strategies in relation to climate change.

33. Satellite communications will further develop as an economic engine for both developed and developing countries. The world market for launchings and the operation of satellites for fixed communications and broadcasting alone for the period 1997-2005 is conservatively estimated at between $60 billion and $80 billion. The estimated value of ground station, terminal market and end-user services of those satellites for the same period amounts to an additional $200 billion to $300 billion. While satellite launchings and operations are limited to "space-faring" States and large companies, participation in ground-segment activities is open to a much broader range of actors, including those in developing countries.

34. Meteorological and Earth observation satellites form a truly international network that views the Earth on a continuous basis. They provide the data for short- and medium-term weather forecasts (contributing to better planning of agricultural strategies and of a host of daily activities), while the advance warning they give on hurricanes and typhoons has dramatically reduced losses in terms of infrastructure and human life in the large number of countries that are prone to such disasters.

35. Satellite positioning systems such as the Global Positioning System (GPS) and the Global Navigation Satellite System (GLONASS), originally deployed for strategic military purposes, now provide non-encrypted signals, free of charge, for civilian applications such as air, land and nautical navigation. GPS receivers allow pilots, drivers and other users to locate objects to within 100 metres. The employment of user navigational equipment with joint GPS and GLONASS receivers makes it possible to further enhance the dependability and accuracy of the system. Through the use of differential global positioning techniques, positions can be determined to within 1 metre. That ability is already resulting in greater safety, lower costs and greater productivity for the end-user. In 1994, GPS services and equipment for mapping and surveying and other applications generated combined revenues of $500 million. Currently, steps are being taken to introduce GLONASS end-user equipment into the global navigation services market. Those applications and the benefits derived from their use are expected to grow exponentially in the coming decade.

36. Providing an estimated $77 billion in revenues and employing more than 800,000 people worldwide in 1996, the global space industry has become one of the largest industries in the world. Commercial utilization of space hardware, including telecommunications facilities, and the development of infrastructure elements, such as the manufacture of launch vehicles, satellites and ground equipment, currently represent 53 per cent of the industry, with the balance coming from government financing. In 1996, for the first time, commercial revenues surpassed government expenditure.

37. In order to maximize the benefits of space technology and its applications, in particular for developing countries, at least two interrelated general issues relating to the utilization of advanced technology for economic and societal development should be borne in mind. The first issue concerns promoting the technology to be utilized and understanding the associated problems encountered in its use; the other concerns ensuring the effective utilization of the knowledge of advanced technology for sustainable development activities. Consideration of those issues would enhance overall understanding of the technical, technological and managerial issues as well as the policy implications involved in the use of space technology, thus generating greater scientific, economic and societal returns from space exploration and exploitation, which have already been confirmed in many areas of human endeavour.

2. New international context

38. Since 1982, when UNISPACE 82 took place, there have been a number of new developments in space science and exploration and in space technology. Applications and uses of space technology have rapidly forged ahead, with new technologies and techniques spawning both greater use and increased effectiveness of existing applications, as well as creating new applications worldwide. The number of countries with space capabilities has increased and there has also been rapid growth in the number of countries that utilize space technology. Major advances have been made in better

space-based observations of the Earth's atmosphere, oceans, land surface and biosphere.

39. A major trend, indicative of the success of space technology, is the increasing commercialization of certain applications and the privatization that has emerged. That trend has brought in the entrepreneurial drive and the market acumen of the private sector, giving a further impetus to the growth of space applications. At the same time, the growing market has spurred further initiatives and investment in the development of technology. The public sector is establishing partnerships with the private sector in various phases of the research and development process, giving leverage to the resources of both partners and promoting commercial activities with strong economic growth.

40. The biggest change, however, has been in the geo-political context. The world has moved from an era of confrontation to one of cooperation, with growing commercial competition. Clearly, the change in the geopolitical context goes beyond space and affects a whole range of relationships between States. It does have an important impact on space, however, which is likely to manifest itself through many more cooperative/collaborative projects.

41. There are many areas where collective efforts should be made to achieve common objectives of humankind. One of those objectives is to maintain optimal interactions with nature. Since the beginning of civilization, humankind has lived in a competitive relationship with nature. While human interdependence with the environment is widely acknowledged, the relentless pursuit of progress, comfort and security has resulted in constantly increasing stress on the environment, at both the local and global levels. Consequently, the life-sustaining environment of Earth is undergoing a more rapid transformation than ever before. The rapid growth of population, with the resulting expansion of human activities, in particular industrial activities, and the increasing demands to meet the basic needs of people continue to have an adverse impact on the environment. Consequences include the overexploitation of natural resources and the degradation of both the environment and living conditions. There is a growing concern worldwide for land and coastal degradation, air and water pollution, loss of biodiversity and deforestation. Explosive population growth combined with the limited availability of land could cause haphazard urban growth, resulting in the further aggravation of living conditions, exemplified in the proliferation of slums and diseases. Some of the climate changes, such as global warming and depletion of the ozone layer, that could ultimately lead to an ecological crisis affecting the entire biotic species on the planet are considered to be caused, at least in part, by anthropogenic activities.

42. While humans have developed the capacity to alter the state of the surrounding environment, they themselves are still vulnerable to the forces of nature. The damage caused by natural phenomena to people and the productive infrastructure of countries has risen steadily. Besides human and economic losses, disasters can also destabilize social and political structures. The phenomenon known as El Niño, an abnormal state of the ocean-atmosphere system in the tropical Pacific, has important consequences for weather conditions worldwide and could result in global losses of billions of United States dollars and countless human lives. Unusual climate extremes, such as ice storms, floods and drought, could also cause billions of dollars worth of damage per year. Worldwide, the health of more than a billion people is affected each year by vector-borne diseases. Some of those diseases cause chronic suffering and disability. Many vector-borne diseases are sensitive to weather variability and global climate change. Improved satellite monitoring of the atmosphere, land surfaces, coastal zones and oceans have already demonstrated their value in the prediction of malaria, cholera and other diseases.

43. The challenges posed by the need to reduce the impact of human activities on the environment and to minimize the damage wreaked by natural hazards on societies are being faced by people in all parts of the world. Scientific and technological developments in the twentieth century have increased the human capacity to take collective action at the global level and to ensure human prosperity into the twenty-first century.

44. Space science and technology, together with advances in information technology, have had a profound impact on the day-to-day life of common people. Distances have shrunk and satellite communications have led to the emergence of a greater interdependence, where voice, text, graphics and complex instructions can be transferred from one place to another, over large distances, within an extremely short time. Developments in communications science and technology have changed the character of business, national and international transactions, revolutionized economics and banking, transformed the entertainment industry and touched many facets of people's day-to-day life. Satellite-derived data have made it possible to detect the onset of calamities, to monitor the changes that are happening on the face of Earth and to gain an insight into the complex state of the planet. The prediction of weather and changes in climate systems has also helped in the implementation of appropriate agricultural practices, disaster relief, damage mitigation and the forewarning of catastrophic climate events.

45. The challenge lies in increasing cooperation at the international level and sharing technologies and applications, thus maximizing the benefits accruing from the use of space technology. One critical sphere for international cooperation is the use of space techniques for environmental monitoring and protection. There is now international recognition of the seriousness of the problems of environmental pollution, soil degradation and deforestation, as well as of the issues associated with global climate change. Following the adoption of Agenda 21[25] at the United Nations Conference on Environment and Development, held in Rio de Janeiro from 3 to 14 June 1992, a number of initiatives have been taken, including the use of space science and technology for monitoring the environment. International scientific assessments by the Intergovernmental Panel on Climate Change and the third session of the Conference of the Parties to the United Nations Framework Convention on Climate Change, held in Kyoto, Japan, from 1 to 10 December 1997, highlight actions that need to be taken with a view to implementing the United Nations Framework Convention on Climate Change.[26]

46. The evolution of science and technology since UNISPACE 82, the new political climate, reduced public spending and the large number of new participants, including several developing countries and the private sector as major players, require that policy and decision makers in the public and private sectors, in particular in developing countries, take stock of the current importance of space technology applications. Space technology will have important effects on the quality of life of the average person, both in economic and social terms. There will be significant opportunities for economic and social development arising from the projected trends in the growth and development of the space industry. Space activity will become a world economic engine in the twenty-first century, with many opportunities, in particular for developing countries. Space technology can also contribute to reducing the gap between developed and developing countries.

47. In summary, the new context provides a positive framework for the continuing development of space technology and its more extensive applications in existing and new fields. At the same time, the increased commercialization and privatization of space activities has brought in new dynamism, new investments and greater market responsiveness. The new context is also conducive to the further growth of international cooperation in space. The issues dealt with, the discussions held and the recommendations made by UNISPACE III should be placed in that context.

E. Genesis of and preparations for the Conference

48. At its 1992 session, the Committee on the Peaceful Uses of Outer Space noted the proposal that a third UNISPACE conference should be organized in 1995, preferably to be held in a developing country. That proposal was made with a view to consolidating the momentum provided by activities conducted on the occasion of the International Space Year during 1992 and to refining follow-up actions and mechanisms further in order to broaden the scope of international cooperation as well as to promote increased participation of all developing countries in space activities. Based on the recommendation of the Committee, the General Assembly, in its resolution 47/67 of 14 December 1992, recommended that Member States might discuss, during the 1993 session of the Committee, the possibility of holding a third UNISPACE conference.

49. At its 1993 session, the Scientific and Technical Subcommittee, through its Working Group of the Whole, noted the above recommendation of the General Assembly. The Working Group noted that there had been considerable advances and changes in space technology and applications since 1982, as well as many changes in the geopolitical and economic situations affecting space programmes around the globe, and recommended that it could be useful to examine the feasibility of a third UNISPACE conference. In that regard, the Working Group also recommended that the Committee, in addressing the question of such a conference as recommended by the General Assembly, consider the objectives and goals of the conference, as well as questions of organization, venue, timing, financial implications and other matters. The Working Group noted the proposals that a third UNISPACE conference should be held in a developing country in the near future, that it could be held in 1995 and that the Working Group could serve as preparatory committee for it.

50. At its 1993 session, the Committee on the Peaceful Uses of Outer Space observed that the most important step was to define a set of sharply focused objectives for such a conference and that the goals set for it might also be achieved through other means, such as intensification of work within the Committee.

51. During the following years, various ideas and proposals were submitted by Member States, the Chairman of the Committee and its secretariat, upon requests by the

Committee and its subsidiary bodies. Those ideas and proposals concerned, *inter alia*, the objectives and agenda of UNISPACE III, various means of achieving the objectives of the Conference and their financial implications.

52. On the basis of the recommendation of the Subcommittee, the Committee at its 1996 session agreed that a special session of the Committee (UNISPACE III), open to all States Members of the United Nations, should be convened at the United Nations Office at Vienna in 1999 or 2000. The Committee agreed with the Subcommittee on the set of objectives and also agreed that every effort should be made to limit the cost of UNISPACE III in order to keep it within the existing resources for the Committee and its secretariat by reducing or curtailing the duration of the sessions of the Committee and its subsidiary bodies during the year of the Conference. Those agreements of the Committee were endorsed by the General Assembly at its fifty-first session. Based on the recommendations of the Committee, the Assembly, in its resolution 51/123 of 13 December 1996, also requested the Committee and the Scientific and Technical Subcommittee to act as Preparatory Committee and Advisory Committee for UNISPACE III, respectively, and the Office for Outer Space Affairs to act as the executive secretariat.

53. Following intense work within the Working Group of the Whole, which was requested by the Advisory Committee to assist its work at its 1997 session, consensus agreement was finally reached on the agenda of UNISPACE III. At that session, the Advisory Committee made a number of additional recommendations concerning the date, participants, additional components and financial aspects of UNISPACE III. At its 1997 session, while endorsing those recommendations, the Preparatory Committee agreed upon the procedure to prepare the draft report of UNISPACE III.

54. The General Assembly, in its resolution 52/56 of 10 December 1997, agreed that the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) should be convened at the United Nations Office at Vienna from 19 to 30 July 1999 as a special session of the Committee on the Peaceful Uses of Outer Space, open to all States Members of the United Nations.

F. Purpose and objectives of the Conference

55. The purpose of UNISPACE III was to review and highlight the significant advances of space science and technology that had taken place since 1982 with a view to promoting their greater use in particular by developing countries, in all areas of scientific, economic, social and cultural development. At the same time, the Conference provided a unique forum in which States Members of the United Nations, organizations of the United Nations system, intergovernmental and non-governmental organizations with space activities and the space-related industries could be involved in developing a blueprint for international cooperation in space-related activities for the beginning of the twenty-first century. UNISPACE III brought together, for the first time, all interested parties and relevant actors.

56. UNISPACE III, whose theme was "Space benefits for humanity in the twenty-first century", had the following primary objectives: promoting effective means of using space technology to assist in the solution of problems of regional or global significance; and strengthening the capabilities of Member States, in particular developing countries, to use the applications of space research for economic, social and cultural development. The other objectives of UNISPACE III were as follows:

(a) To provide developing countries with opportunities to define their needs for space applications for development purposes;

(b) To consider ways of expediting the use of space applications by Member States to promote sustainable development through the involvement of a larger number of developing countries in international research programmes such as the International Geosphere-Biosphere Programme and the World Climate Research Programme;

(c) To address the various issues related to education, training and technical assistance in space science and technology and their applications aimed at the development of indigenous capabilities in all States;

(d) To provide a valuable forum for a critical evaluation of space activities and to increase awareness among the general public regarding the benefits of space technology;

(e) To strengthen international cooperation in the development and use of space technology and applications.

G. Harnessing the potential of space at the start of the new millennium

1. Protecting the environment

(a) Scientific knowledge of Earth and its environment

(i) Status: environmental and Earth sciences

57. The Sun is a variable star that provides all energy for living things on Earth. That energy is also the principal driving force of the atmosphere and ocean circulation systems and the climate of the Earth. The energy from the Sun comes in the form of radiation, for instance, the visible illumination that is necessary for plant photosynthesis, and of energetic particle streams. To understand the influence of the Sun on the Earth's environment, it is necessary to trace the flow of radiation and charged particles from the Sun and to determine its effects on the coupled magnetosphere-ionosphere-atmosphere of Earth, especially the stratospheric ozone layer.

58. The ultraviolet irradiance of the Sun is the dominant energy source for the Earth's upper atmosphere. Small changes in the atmosphere (for example, in total ozone) can produce significant differences in the ultraviolet radiation reaching the Earth's surface. Increasing ultraviolet radiation is known to cause increases in the occurrence of skin cancer and can affect microbiological systems by damaging or altering their genetic structure.

59. In order to determine solar influences on global change on Earth, it is critical to monitor far from Earth the total solar irradiance and its spectral distribution, the structures and composition of the middle and upper atmosphere over many solar cycles, solar wind, the energetic particle input into the Earth's magnetosphere and coronal mass ejections.

60. The Earth's magnetosphere and atmosphere are closely linked to the atmosphere and heliosphere of the Sun. Variations in the solar atmosphere, including flares and ejection of charged particles from its corona, and their interaction with the Earth's magnetosphere and upper atmosphere are governed by physical processes that are known only in part.

61. The variable interaction of the Sun with the Earth's magnetosphere, ionosphere and upper atmosphere can create potentially damaging environments for space assets that provide weather forecasts, radio communications, television, navigation and other important services. An example of a casualty of space weather is the recent temporary failure of Anik E2, a communications satellite, after being bombarded by high-energy electrons triggered by the Sun.

62. The possibility of unprecedented global climate change exacerbated by human activity is a subject of considerable international concern. That concern has been expressed through the United Nations Framework Convention on Climate Change. For several years the Intergovernmental Panel on Climate Change has been issuing periodic scientific assessments of global climate change and its possible impact. The Intergovernmental Panel estimates that global surface air temperatures will increase significantly over the next 100 years. The likely consequences of such warming include changing patterns of precipitation and temperature, a rise in the sea level and altered global distribution of freshwater. The impact on human health, the vitality of forests and the productivity of agriculture is likely to be significant.

63. Global climate is a consequence of complex interactions between the solar energy input to Earth, the atmosphere (and atmospheric composition), the oceans, the hydrological cycle, the land surface and vegetation, the cryosphere (snow and ice fields, ice sheets and glaciers) and the geosphere (including continental topography and tectonic changes, volcanic eruptions and the rotation of Earth).

64. The past history of Earth demonstrates that the climate has changed many times through very cold and warm periods as a result of orbital changes of Earth, solar fluctuations, volcanic eruptions or other natural factors. The current concern is that human activity could be an equally strong factor in causing climate change, at a rate much more rapid than that experienced before. Thus, the adaptation time for humans and plant and animal life to a changed environment might be too short.

65. Recent climate history shows that there has been a global warming of about 0.5° C over the last 100 years. Corresponding changes have been observed in the rise of the sea level in coastal areas. The warming is thought to result from increasing concentrations of greenhouse gases such as carbon dioxide, injected into the atmosphere during the burning of fossil fuels for energy and transportation, methane, emitted by an expanding agriculture and a growing number of livestock, oxides of nitrogen and possibly fertilizers, as well as chlorofluorocarbons, used in air-conditioning. Chlorofluorocarbons also destroy the ozone layer, thereby allowing increased ultraviolet-B radiation to penetrate the atmosphere.

66. Ozone is the only greenhouse gas that strongly absorbs solar radiation in the ultraviolet part of the electromagnetic spectrum in the stratosphere. Stratospheric ozone protects the

Earth's surface from harmful solar ultraviolet-B radiation and plays an important role in controlling the temperature structure of the stratosphere. Some hypothesize that a reduction in stratospheric ozone could also modify surface temperature.

67. Stratospheric ozone depletion is now evident all around the world especially at high latitude. The Antarctic ozone hole is the most conspicuous manifestation of ozone depletion. Recently, ozone depletion has also been observed in the Arctic winter and spring. There is compelling evidence that ozone depletion can be ascribed to the increased atmospheric burden of human-made chlorine and bromine compounds. International regulations have been established to phase out the production of such compounds, and they have begun to diminish. However, the decrease will be slow and it will be necessary to observe stratospheric ozone to determine whether the recovery from depletion will take place as expected.

68. Technological advances over the past several decades have contributed substantially to improvements in transport systems, agricultural food production and distribution systems, water availability and power generation and distribution, in addition to recent enhancements in computerization to meet the needs of the information age. In retrospect, such progress has been achieved at considerable cost to the environment. The dilemma is therefore how to maintain sustainable economic, social and technological development without further undermining the integrity of the environment.

69. In addition to human activities, there are natural causes that also have adverse effects on the global environment. Such causes include forest fires, volcanic eruptions, earthquakes, tsunamis, hurricanes, cyclones, typhoons, floods, drought and phenomena such as El Niño.

70. Human activities and natural phenomena can now be observed and their effects on the global environment detected from outer space with the use of satellites. The preservation of the near-Earth space environment has also become important to protect those useful tools to diagnose the state of the Earth and is critical to the future exploration and use of outer space. A growing number of space activities are increasingly at risk because of the production of human-made space debris. Currently, more than 8,000 catalogued objects more than 10 centimetres in diameter, and an even larger number of smaller objects, are orbiting the Earth, yet only about 500 can be considered operational spacecraft. Collision with any of them could lead to damage or even functional loss of operational spacecraft. One such collision of a catalogued object with a satellite was recently documented.

71. Methods for monitoring the space debris environment involve ground-based optical and radar observations, space-based detectors, as well as investigations of microscopic damage of the surface of objects retrieved after long-term exposure to the space environment. Assessing the present and future risk to operational space objects by the space debris environment has to rely on the use of models because observations do not cover the whole range of particle sizes and spatial distribution. Mitigation techniques include protection against the impact of space debris or collision avoidance and measures to avoid the creation of space debris, since economically feasible methods for clearing debris in space currently do not exist. Special attention should be paid to the geostationary satellite orbit (GSO) for the following reason: there is no natural mechanism to remove space debris from the GSO, and they pose a risk to a large number of operational spacecraft.

72. The Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space agreed that international cooperation was needed to expand the scientific and technical basis for appropriate and affordable strategies to minimize the potential impact of space debris on future space activities. In 1995, the Subcommittee adopted a multi-year work plan to focus on debris measurement techniques, mathematical modelling and characterization of the debris environment and measures to mitigate the risk of space debris. The multi-year work plan was carried out in collaboration with the Inter-Agency Space Debris Coordination Committee and the International Academy of Astronautics from 1996 to 1998 and the Subcommittee finalized its technical report on space debris in February 1999.

73. Space objects, including space debris, are also contributing increasingly to the light pollution of the space environment, adversely affecting ground-based astronomical observations. The passage of an artificial space object across the field of view of an astronomical telescope can degrade both photographic and photometric studies. The phenomenon is not new, but with the launch of multi-satellite systems that can create frequent short-duration flashes of intense light, the light pollution is increasing. In addition, there have been proposals for the launch of large solar reflectors for illumination and transmission of energy and even projects for advertisements and celebration purposes using large space objects that reflect a significant amount of light. The International Astronomical Union (IAU) and the Committee on Space Research (COSPAR) are strongly opposed to such projects using space objects for advertisements and celebration purposes, which would change the outer space environment and hamper astronomical observations. Attention

should be given to preserving or restoring astronomical observation conditions to a state as close to natural as possible by any practicable means.

74. The launch of reflectors for the illumination of parts of the Earth's surface also has a potential negative impact on biological diversity. Research should be undertaken prior to the launching of any such reflectors.

75. In the twenty-first century, the planet Earth could face the potential hazard of rapid environmental changes, including warming of the climate, rising sea level, deforestation, desertification and soil degradation, depletion of the ozone layer, acid rain and a reduction in biodiversity. Such changes could have a profound impact on all countries, greatly threatening the existence, reproduction and development of human beings and their prosperity on Earth, yet many important scientific questions remain unanswered.

(ii) Issues and objectives

76. The observational requirements arising from the need to understand more fully the Earth's system and to initiate corrective steps based on that increased understanding are wide-ranging and involve many different measuring techniques and associated data-processing systems. Satellites are capable of providing the synoptic, wide-area view required to put *in situ* measurements in the global context needed for the observation of many environmental and climatic phenomena.

77. To improve understanding of the influence of the electromagnetic radiation of the Sun on the Earth's environment, it will be necessary to pursue the following issues and objectives: (a) continued observations and long-term monitoring of solar spectral irradiation and improving the observations and understanding of solar variability; (b) modelling the dynamics of the Sun and its fluctuations; and (c) assessing the interaction between solar fluctuations and the Earth's climate, as well as quantifying, through observations and models, solar influences on both short-term (seasonal to inter-annual timescales) and long-term (10-30 year) climate change. To improve understanding of the relationship between charged particle fluxes from the Sun and the Earth's environment, it will be necessary to pursue the following: (a) investigating solar system plasmas and the electric current systems and magnetic plasmas associated with them; (b) improving the observation and understanding of the physical processes governing the Earth's thermosphere, magnetosphere, ionosphere and upper atmosphere; (c) developing a detailed, theoretically grounded understanding of the physical processes that constitute the Earth-Sun connection and improved forecasting of space weather; and (d) characterizing the dynamics, properties and structure of the solar wind as it interacts with the local interstellar medium to form the heliosphere.

78. Organizations around the world are encouraged: (a) to investigate further the technical and economic feasibility of space solar power over the next few years; (b) to stimulate international cooperation and data-sharing regarding space solar power; and (c) to give due consideration to space solar power matters, for example, as they concern health, the environment, spectrum management, orbit allocations and other topics.[27]

79. To improve understanding of global climate change, it will be necessary to pursue the following issues and objectives: (a) characterizing and documenting long-term climate variability and trends through systematic global observations of the atmosphere, oceans, land surface/biosphere and cryosphere of the climate system and the external forces that affect it; (b) understanding the nature of key parameters that give rise to change in the climate system and identifying the causal factors of observed climate variations and feedback processes that govern the response of the climate system; and (c) assessing the predictable aspects of long-term climate variability and changes, including their regional impact, through the combined application of observation and global models.

80. To improve understanding of change in the ozone layer and its effects on the environment and human health, it will be necessary to pursue the following issues and objectives: (a) characterizing the global distribution of ozone, chemically active trace constituents and related meteorological parameters; (b) understanding the processes responsible for the chemical transformation of trace constituents and the role of aerosols in affecting atmospheric chemistry; and (c) quantitatively modelling the trace constituent composition of the troposphere-stratosphere system through the combined application of observations and global models.

81. To improve understanding of anthropogenic impacts on the environment and human health, it will be necessary to pursue the following issues and objectives: (a) monitoring atmospheric/tropospheric pollutants, aerosols and other chemical species; (b) observing and monitoring the discharge of rivers into inland lakes and coastal zones; (c) understanding the interaction between the by-products of technology and the environment and modelling their impact; and (d) observing and monitoring natural effects on the global environment.

(iii) Specific action programmes

82. A number of international activities are being carried out to utilize satellite data to assess and monitor conditions on Earth, such as DIVERSITAS, the International Geosphere-Biosphere Programme, the International Human Dimensions Programme on Global Environmental Change and the World Climate Research Programme. Several international programmes are also in place to coordinate global observing systems, including the Global Climate Observing System (GCOS), the Global Ocean Observing System (GOOS) and the Global Terrestrial Observing System (GTOS). The Committee on Earth Observation Satellites (CEOS), consisting of 20 national space agencies and space-related international organizations, has also initiated discussions with the three global observing systems and their sponsoring organizations, including the International Group of Funding Agencies for Global Change Research, to create a partnership for the development and implementation of an Integrated Global Observing Strategy (IGOS) aimed at providing an overarching strategy for Earth observation and global monitoring, allowing organizations involved in the collection of data to extend their contribution, assisting user groups and decision makers, in particular those from developing countries, and providing enhanced scientific understanding at the national, regional and international levels.

83. The international activities identified above should take into account the following recommendations made during UNISPACE III:

(a) Homogeneous, calibrated and validated databases of surface parameters (both land and ocean) of the last two decades should be established and made available, with a view to providing a documented historical perspective of the Earth's evolution;

(b) The above-mentioned databases should be used to support improved global change models;

(c) The continuous acquisition of high-quality remote sensing surface data should be ensured;

(d) The needs of the users, including developing countries, should be taken into account.[28]

84. It was recommended that:

(a) The United Nations continue its work on space debris;

(b) The entire international "space-faring" community be invited to apply debris minimization measures uniformly and consistently;

(c) Studies be continued on possible solutions to reduce the population of in-orbit debris.[29]

85. Member States should continue to cooperate, at the national and regional levels and with industry and through the International Telecommunication Union (ITU), to implement suitable regulations to preserve quiet frequency bands for radio astronomy and remote sensing from space and to develop and implement, as a matter of urgency, practicable technical solutions to reduce unwanted radio emissions and other undesirable side effects from telecommunication satellites.[30]

86. Member States should cooperate to explore new mechanisms to protect selected regions of Earth and space from radio emissions (radio quiet zones) and to develop innovative techniques that will optimize the conditions for scientific and other space activities to share the radio spectrum and coexist in space.[30]

(b) Environment and natural resources and remote sensing

(i) Status: environment and natural resources and applications of remote sensing

87. Human activity has altered the condition of Earth by reconfiguring the landscape, by changing the composition of the global atmosphere and by putting stress on the biosphere. Although there are many ongoing efforts to redress the situation, there continue to be strong indications that natural change is being accelerated and distorted by human intervention. In its quest for an improved quality of life, humanity has become a force for change on the planet, building upon, reshaping and modifying nature in unintended and often unpredictable ways.

88. Development decisions require accurate and comprehensive information, for instance on soils and land use, water resources and agricultural and other resources. Such information would make possible an evaluation of their potential uses and interdependencies and their likely responses to different types and levels of use. Crop or stock suitability, irrigation methods and run-off potential are typical parameters that need to be assessed for a given series of locations with particular climates, soils, ecosystems and alternative land uses.

89. Present-day applications of satellite data are widespread and cover research and operational and commercial activities. Those activities are of interest both in the global context and in the regional, national and local contexts, where Earth observation data are successfully applied in support of a range

of different application areas. Several applications involve weather-related phenomena, disasters or the management of Earth's resources. The relevance of remote sensing in those areas is described below. Within the context of the United Nations Principles Relating to Remote Sensing of the Earth from Outer Space,[31] the commercialization of satellite remote sensing mirrors the commercialization of satellite communications. Accordingly, the commercialization of satellite remote sensing is increasing the range and capabilities of services available to users, while at the same time decreasing the costs of remote sensing systems and services, which is a welcome trend.

a. Applications in weather and climate forecasting

90. The weather and climate at any given location are a result of complex interactions between local, regional and global aspects of atmospheric circulation and dynamics, which in turn are affected by the interactions of the atmosphere with the oceans, the land surface and vegetation and the cryosphere.

91. Since many weather and climate phenomena are directly related to the economy and well-being of society, weather forecasting has been a crucial requirement of societies around the world for centuries. Weather forecasts are currently initiated through global models, which in turn provide boundary conditions used in high-resolution regional models to assist forecasters in providing specific local details of weather systems, such as temperature, wind and precipitation.

92. Major emphasis is being placed on the development of seasonal to inter-annual prediction capability because of the lead times required for the management of natural and industrial resources such as agriculture, water supply and energy production and distribution. Accurate forecasting of weather systems is of particular importance in preventing or reducing damage due to natural disasters. All the prediction models require global observational data for their daily initialization.

93. Forecasting of deep ocean circulation, in the same way as that of atmospheric circulation, becomes a realistic goal on the scale of a decade. This is a major challenge for optimizing humankind's use of the ocean, in particular navigation and fisheries management, given the decisive role that the ocean plays in the evolution of meteorological conditions and climate. A system for the observation of the oceans is required, and observation from space will be one of its main components.

94. *In situ* and space-based observations are made globally approximately every three hours as part of the World Weather Watch observations of the World Meteorological Organization (WMO) and are transmitted to processing centres that establish weather forecasts for periods ranging from 24 hours to about a week. For longer periods, extended-range forecasts are also made. The Coordination Group for Meteorological Satellites provides a coordination mechanism for cooperation between the operators of the meteorological satellites in both geostationary orbits and low-Earth orbits (LEOs) and also provides direct interaction between users and satellite operators. For predictions on a seasonal to inter-annual timescale to capture phenomena such as El Niño, atmosphere-ocean coupled models need to be used. They require substantially more observations of the Earth's system for their initialization and time integration.

95. Inter-annual variability in the coupled atmosphere-ocean system, as exemplified by the well-known El Niño/Southern Oscillation phenomenon and its corresponding cold phase, La Niña, has global impacts. It is now known that human activities are increasingly recognized as a potential factor forcing change in the global system by altering the chemical composition of the atmosphere and the oceans, as well as the character of the land surface and vegetation cover. Of particular interest is the potential regional impact of such changes on coastal areas, freshwater resources, food production systems and natural ecosystems.

96. Over the past 10 or more years, substantial improvements have been made in Earth observation technology and in constructing sophisticated computer models of the Earth's system. Currently, predictions are routinely made of detailed weather anomalies, as well as inter-annual climate variability and global climate change. Improving the accuracy of those predictions requires more comprehensive global observations of key variables, better calibration procedures and, importantly, the uninterrupted maintenance of observing systems over long periods of time. In that connection, special efforts are required to ensure the continuity of monitoring systems and the incorporation of proven research or experimental observing technology into stable operational platforms.

97. Future satellite missions will make improved and better calibrated observations of the above-mentioned and other parameters. Examples of such satellite missions are the Indian National Satellite (INSAT-2E) mission (India), the Advanced Earth Observing Satellite (ADEOS-II) mission (Japan), the Resurs F-1 and Nika-Kubany missions (Russian Federation), the EOS-AM/EOS-PM and CHEM missions (United States of America), the NPOESS/EPS mission (United States/Europe), the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) mission (United States), the Envisat mission (European Space Agency (ESA)) and the Cosmo Skymed mission (Italy). The

intercalibrated[32] instruments will also collect data on the concentration and distribution of greenhouse gases, aerosols, ozone, atmosphere chemistry and solar radiation, which are needed to improve global climate change models.

98. Ongoing satellite missions make or help derive key global observations of atmospheric structure and dynamics, sea-surface temperature, surface parameters, precipitation, land-surface characteristics, including biodiversity, and selected atmospheric chemical species via geostationary and polar-orbiting platforms. Examples of those satellite systems are the Geostationary Meteorological Satellite (GMS) system, the Geostationary Operational Envrionmental Satellite (GOES) system, the Geostationary Operational Meteorological Satellite (GOMS) system, the INSAT and Meteosat systems and the METEOR and National Oceanic and Atmospheric Administration-Advanced Very High Resolution Radiometer (NOAA-AVHRR) series of meteorological satellites, the Earth observation series of satellites, including Fengyun (China), the Indian Remote Sensing Satellite (IRS) (India), the Land Remote Sensing Satellite (Landsat) (United States), Satellite pour l'observation de la Terre (SPOT) (France), Resurs-01 (Russian Federation), Sich (Ukraine), Okean (Russian Federation/Ukraine) and the international Priroda programme, as well as the TOPEX/Poseidon (France/United States) ocean circulation mission and the Tropical Rainfall Measuring Mission (TRMM) (Japan/United States). Recently, ERS-1 and ERS-2 (ESA), SIR-C/X-SAR (Germany/Italy/United States), the Japan Earth Resources Satellite (JERS-1) (Japan) and RADARSAT-1 (Canada) have made it possible to map the Earth's surface through clouds or at night in the locality concerned, while providing new information on geological features, topography, atmospheric structure, sea ice, deforestation, bathymetry, coastal zones, oceanography and agricultural assessments, among other things. Areas in which radar satellites are particularly effective include determination of global wind and wave fields at high spatial and temporal resolution over ocean areas, as well as global ocean dynamics and climatic instabilities. Operational meteorological missions are part of the World Weather Watch space-based subsystem.

99. During the first decade of the next millennium, well over 30 new Earth observation satellites are expected to be launched. These will provide an unprecedented capability to monitor, on a global basis, nearly all aspects of the Earth's climate system. In order to take advantage of those observations, a parallel effort is required in data access, data analysis and modelling. In particular, improvements in high-resolution data are required in regional and local application projects. Several scientific issues remain to be addressed with regard to the observation and parameterization of processes in conceptual and mathematical computer models of the global Earth system and its interactive component subsystems. Of particular importance are the quantification and representation of hydrological and biogeochemical cycles in models. The modelling of biogeochemical processes, which involve the cycling of nutrients and carbon by and through land and ocean ecosystems, is less developed than the models dealing with the physical atmosphere and the ocean.

100. In the area of space studies of the Earth and its environment, there are services and studies on satellite applications of an inter-institutional and multilateral nature, among others, which are being carried out in Latin America and the Caribbean, such as: (a) monitoring of agro-climatic and hydrologic conditions for agriculture in South America; (b) development of a unified methodology for monitoring desertification, being conducted by countries of the region in cooperation with the United Nations Environment Programme (UNEP); (c) research in land use and land cover change, being conducted by countries in Central America and by the National Aeronautics and Space Administration (NASA) of the United States; (d) ocean biology, being conducted by Latin American countries and NASA; (e) monitoring the dynamics of glaciers and the Andean tropical snow-capped mountains, in collaboration with the United Nations and ESA, as well as the study of the dynamics of the pole in the southern hemisphere; (f) monitoring of ozone, with the participation of countries of the region, NASA and the International Development and Research Centre (Canada); (g) a global forest mapping project being conducted by the National Space Development Agency (NASDA) of Japan, NASA and the European Community, with the support of the National Institute for Space Research (INPE) of Brazil; and (h) remote sensing services being provided, at the subregional level, by the Cotopaxi ground receiving station in Ecuador and the Centre for Integrated Surveying of Natural Resources (CLIRSEN) for a total of 25 countries in Latin America and the Caribbean that are within the 2,500 km actual diameter footprint of the station.

b. Applications in disaster management

101. Every year there are hundreds of natural disasters that afflict populations in many countries on all continents. In 1996 alone, there were 180 reported natural disasters, of which 50 were major, requiring international assistance. In the past 10 years, there have been 64 very large disasters with extremely serious consequences, such as the floods that occurred in China in 1991, 1996 and 1998, hurricanes Andrew, Luís, Marilyn and Mitch, the El Niño phenomenon

of 1998, and the European-Mediterranean floods of 1997, among others. The economic losses in the past 10 years are estimated at approximately $400 billion.

102. Through the implementation of effective public policies and thanks to scientific and technological developments, there has been a decrease in the number of fatalities worldwide. Possibly the most notable use of such technology is provided by the early detection and warning given by meteorological satellites in the case of typhoons and hurricanes, for example, the Tropical Cyclone Programme of WMO.

103. While developed countries suffer greater economic damage in absolute terms, the impact on developing countries is more severe in relative terms. The gross national product lost as a result of natural disasters is estimated to be 20 times greater in developing countries than in developed countries. It is more cost-effective, particularly in developing countries, to promote the use of space technology to take preventive action to mitigate the impact of disasters than taking emergency relief action after the disasters. It is necessary to create a culture of self-protection as a basis for taking such a cost-effective approach.

104. Disaster management includes the following elements: (a) disaster mitigation, which involves hazard mapping, risk assessment and presentation of information for the elaboration of land use legislation; (b) disaster preparedness, which involves forecasts and early warning; (c) disaster relief, which includes action taken to mitigate the effects of the disaster after it occurs, such as assessment of the damage and delivery of health care, food and other supplies; and (d) disaster rehabilitation, which involves long-term measures that begin during the relief phase.

105. Space technologies can play important roles in early warning and management of the effects of disasters. However, an operational disaster management support service that uses the capabilities of space systems can only be achieved through the joint use of satellite communications and remote sensing images, including services and other products of space systems, with other non-space sources providing ground information. For this purpose, it is necessary to promote adequate coordination among the technical and research organizations in charge of evaluating risk and the organizations responsible for attending to emergencies, through the use of telecommunications.

106. As natural disasters often destroy or severely disrupt terrestrial telecommunication networks, remote sensing and communication satellites have found a vital role to play in supporting or making possible disaster management activities, including the emergency gathering and dissemination of news and the provision of back-up communications for the continuation of government and business activities.

107. Data from meteorological and Earth observation satellites provide essential information for hazard mapping, risk assessment, early warning and disaster relief and rehabilitation. Such data are particularly useful when combined with ground-obtained data and information and integrated into geographic information systems (GIS) for analysis and modelling of complex scenarios. Thermal infrared remote sensing images obtained by meteorological satellites may contribute to the study of seismic mechanisms, and therefore be helpful in the prediction and forecast of earthquakes.

108. Many techniques using Earth observation data are being used effectively to manage natural disasters, but more effort is needed to make disaster prediction a reality and to plan responses. In addition, considerable international cooperative efforts are needed to use remote sensing data and information from other sources to develop indicators of disaster-prone areas and mitigation strategies and scenarios. More research is also needed to integrate new data sources and to exploit them effectively.

109. Navigation and positioning satellite systems are another promising tool for disaster prediction, warning and relief activities. With ground positioning receivers and through repeated measurements, it is possible to determine relative motions of parts of Earth to within a few millimetres. That could make it possible to assess and map earthquake risk and predict volcanic eruptions and landslides. The use of optical and/or radar images for stereoscopic and interferometric viewing are also useful for that purpose.

110. A sinking ship, a fallen airplane or even a person lost in the wilderness represents a different type of disaster. They are distress situations in which receiving immediate assistance can mean the difference between life and death. The International Search and Rescue Satellite System (COSPAS-SARSAT) is an international search and rescue system based on receivers on board meteorological satellites that relay signals from transmitters activated in distress situations to a network of ground stations. The signals are processed to determine the geographical location of the transmitter. Since 1982, COSPAS-SARSAT has saved the lives of over 10,000 people worldwide. Canada, France, India, the Russian Federation and the United States provide the space segment for the system, which is supported on the ground by many countries.

111. Recognizing the need for a global effort to reduce the impact of natural disasters, the international community proclaimed the International Decade for Natural Disaster

Reduction, beginning on 1 January 1990.[33] The General Assembly has subsequently adopted annual resolutions on the issue of disasters, notably resolutions 52/200 of 18 December 1997 and 53/185 of 15 December 1998, aimed at mitigating the effects of natural disasters such as El Niño. Among other natural catastrophes covered by the Decade, locust infestations, in particular in Africa, have a severe impact on disaster-prone countries and should be controlled through better use of space techniques through international cooperation. As the Decade reaches its conclusion, there is evidence that enormous synergy has been established in the disaster management community throughout the world. The Office for Outer Space Affairs, in cooperation with ESA and the secretariat of the Decade, has organized regional workshops (in China in 1991, Zimbabwe in 1995 and Chile in 1996) to raise awareness, among policy makers and managers of civil defence and protection bodies, of the usefulness of space technology in support of disaster management. The regional workshops and the International Conference on Early Warning Systems for the Reduction of Natural Disasters, held in Potsdam, Germany, in 1998, made recommendations on the need to incorporate the use of space technologies into disaster management planning and operational activities. In order to meet the objectives of the Decade, the Advanced Land Observing Satellite (ALOS) project of Japan was endorsed by the Subcommittee of the Scientific and Technical Committee for the International Decade for Natural Disaster Reduction as an international and regional project of the Decade to contribute to strengthening risk assessment capabilities by producing natural hazard maps of east Asia. The ALOS project will be launched by 2002.

c. Applications in management of resources

112. Satellite remote sensing offers several advantages over alternative means of data collection, such as airborne and ground surveys. The advantages relate to the lower cost of data acquisition, the speed and relative ease with which satellite images can be obtained and the high frequency of coverage, strengthened by the recent advent of high-resolution remote sensing satellites. While remote sensing makes a significant contribution to fulfilling information needs, its role is complementary to other means of spatial data acquisition.

113. The archived remote sensing data represent a valuable source of consistent information that permits retrospective (time-series) studies, such as those determining the origin of marine pollution or the rate of depletion of a specific resource. Archives of satellite images can now be readily consulted from remote locations, as a result of the growth of information systems and the Internet.

114. GIS is used not only as a database for the storage and retrieval of spatial information, but also as an interactive management tool for analysing alternative strategies for resource allocation. The digital format of images and the synoptic coverage of remote sensing satellites facilitate processing of the images into products meeting a variety of needs. Such a characteristic allows the elaboration of value-added GIS-ready products meeting the specific needs of various groups of users from the same set of source images, thereby making possible economies of scale.

115. Maps are needed for a wide range of planning and development activities. However, in developing regions and even in some developed countries, such maps are scarce or outdated, in part because of the high cost of preparing them using traditional approaches. The availability of satellite remote sensing images is modifying the way in which maps are prepared and subsequently used. The images themselves are ortho-rectified, annotated and used as maps. Such maps provide more updated information content and are more readily understood by a wide variety of end-users.

116. The wide perspective of satellite images has allowed geologists to map subtle regional geological features (such as faults, lineaments and geomorphological or lithological contacts) that would not otherwise be easily observed from the ground. The mapping of such features facilitates exploration for minerals as well as for groundwater, both of which are key resources for development.

117. In agriculture, remote sensing is used to supplement conventional sources of information in establishing agricultural statistics and determining areas of arable land. Optical imagery with low to high spatial resolution from multiple dates as well as radar imagery is used in the identification of crops. Radar imagery is particularly useful in areas such as the humid tropics and northern Europe, where frequent cloud cover may obscure the land surface.

118. Monitoring of crops on individual farms using high-resolution imagery helps to identify areas under stress because of lack of water, in need of fertilizer or affected by disease before the plants begin to show visible evidence of such a state. That facilitates optimal distribution of water, thereby making savings possible as well as improving crop yields. It also helps to avoid excessive application of fertilizer, with its potentially harmful effects on the environment.

119. Multi-date satellite imagery of crops is used in conjunction with other information, for example, meteorological and soil data, to develop models for forecasting yield several weeks before harvesting. That application can be of considerable value to developing countries. Forecasts are

useful in making timely arrangements for the storage, import, export and efficient local distribution of agricultural produce. Low production forecasts (for example, as a result of drought) would allow time for remedial measures to be implemented. Such is the basis for programmes such as the Famine Early Warning System of the Food and Agriculture Organization of the United Nations (FAO), which benefits a number of countries in Africa.

120. The onset of drought in a given year can be predicted by comparative analysis of the trends in satellite-derived vegetation indices for that year relative to the trends in a normal year. Early warning has allowed authorities in some developing countries to mitigate the effects of drought through redistribution of food supplies for humans and fodder for livestock. The FAO early warning system for Africa, the African Real-Time Environmental Monitoring Information System (ARTEMIS), as well as the appropriate actions taken by INPE of Brazil related to climate studies in specific regions of the country, are based on that capability.

121. Space applications have much potential for use in other areas related to agriculture and the environment. Remote sensing techniques are very important for real-time detection of forest fires, quantification of burnt areas and monitoring of the regeneration of affected areas. Such techniques are also valuable in identifying the deforestation process and in measuring the rate at which it occurs, in particular in large forest areas. Likewise, the use of remote sensing techniques is very useful in determining processes that cause desertification and the related loss of agricultural areas, which together have also an impact on biodiversity.

122. Coastal zone management benefits from satellite information on factors such as water quality, suspended sediment and sea surface temperature, which can be used to monitor river outflow and track oceanic features. Oceanographic applications include provision of accurate information on likely fishing grounds (based on sea surface temperature), monitoring of coastal dynamics, ocean wave forecasting for ship routing, measurement of the topography of the sea floor for off-shore exploration and monitoring of oil slick pollution. Radar satellites also make possible improved sea ice and iceberg monitoring for offshore activities and ship routing in polar regions.

123. Many organizations, in both developed and developing regions of the world, increasingly recognize the valuable contributions that satellite remote sensing can make to the management of marine and coastal areas. A notable example among such organizations is Indian Ocean Marine Affairs Cooperation (IOMAC). Through a number of technical consultations and projects using space technology applications, IOMAC assists participating States and institutions in the Indian Ocean region in formulating appropriate development policies and taking specific actions concerning environmental monitoring, such as the monitoring of the health of the Indian Ocean and coastal regions, and sustainable development planning for the management of marine resources. Its activities include a programme for the countries of the region to analyse archived data in a compendium of space information that would be progressively updated and disseminated to those countries.

124. Rising worldwide demand for potable water to supply the increasing world population has heightened the need for assessment and management of water resources. Remote sensing satellites provide data on several key hydrological variables (for example, rainfall, soil moisture, evaporation and snowfall) using a scale that is appropriate for assessment. A satellite-based approach to assessment of water resources is especially important in regions of the world where adequate hydroclimatological networks do not exist.

125. Many of the components of the hydrological cycle, such as drainage features and channel networks, quantities and quality of water flows, fractures, lineaments and human-made features, can be mapped or determined quantitatively from images obtained from satellites far better and more quickly than through ground-based methods. Remote sensing data are used to measure snow extent and snow water equivalent, as well as to estimate rainfall. The extent of floods can be mapped directly using radar and optical imagery, while the volume of run-off within watersheds can be estimated indirectly. Other parameters of importance in hydrological investigations, such as soil moisture, evapo-transpiration, vegetation, land use and land cover, can also be estimated or mapped using satellite remote sensing techniques.

d. Applications in disease control and health services

126. Data from remote sensing satellites, in combination with other information, have been used successfully to monitor the environmental preconditions for the emergence and outbreak of infectious diseases. The next generation of research and operational Earth observation satellites, along with studies on empirical relationships between infectious diseases and environmental change, will provide increasingly accurate information for early warnings of impending global health issues. Early warnings are a prerequisite to developing mitigation measures aimed at reducing the effects of infectious diseases.

127. Member States, in coordination with international organizations such as the World Health Organization (WHO) and the World Bank, are conducting activities to establish

relationships between environmental parameters that can be sensed by satellites, such as water, temperature and vegetation cover, the occurrence of disease vectors (e.g. mosquitoes, ticks and flies), disease reservoirs (e.g. deer and rodents) and patterns of human settlements, migration and land use. Based on those relationships, predictive models can be developed to aid public health efforts to control specific diseases. Studies are under way to integrate remote sensing into disease surveillance systems, with the goal of developing early warning systems for infectious diseases such as malaria, cholera, hantavirus and Rift Valley fever. Through an international cooperative effort, involving a space agency, international organizations and non-governmental organizations, investigators from Brazil, Cameroon, China, Egypt, Kenya, Mali, Mexico, Peru, Ukraine and Venezuela are being trained in health applications of space-related technologies. Remote sensing and GIS are most effective when used to eradicate endemic disease through the identification of disease reservoirs and disease vectors. Programmes at the regional level should be established to prevent the re-emergence of diseases.

128. States should raise awareness about the possibilities of remote sensing technology and the action required to meet the need for education at the highest level. In that context, the involvement of trained personnel, such as statisticians and epidemiologists, is an efficient and necessary way to speed up the process of capacity-building.

129. Telemedicine applications are increasingly being used in emergency and disaster situations involving health hazards. WHO uses mobile satellite communications for epidemic control, most notably in Africa, as part of its rapid epidemic response kit to combat diseases such as river blindness or fast-spreading health hazards such as ebola. Slow-scan video communications for medical consultations are also possible via moderate-speed satellite data links and were used, for example, after a recent major earthquake in Armenia.

(ii) Issues and objectives

130. Among the major information needs for many developing countries are those required to support decision-making in important sectors such as natural resources (including agriculture, forestry, minerals, water and fisheries), the environment, human resources (including education and health services) and prevention and mitigation of natural disasters. Successful remote sensing applications in those sectors have resulted in a number of direct and indirect benefits to society.

131. The ability to monitor changes in vegetation and land use in the major production regions of the world is important and remote sensing offers perhaps the best technique. New satellite remote sensing systems provide improvements in special spatial, spectral or temporal resolution. As more satellites are placed in orbit, imagery over a geographical location may be accessible at shorter time periods.

132. An issue relating to the use of Earth observation data concerns the wide variety of satellites offering data with diverse formats and calibration details, with each satellite requiring specific technical upgrades for data reception. The associated access fees and the hardware and software add-ons for data product generation require financial commitments. Standardization of reception hardware and data-processing software tools is an area where cooperative activities can play a major role. There is also a need to address the use of the increasing number of ground receiving stations in a cooperative framework to ensure the availability of all data to all countries with minimal investment. Such availability is linked to prices of data and policies for sharing data and information.

133. Another issue faced by users of Earth observation data, in particular those in developing countries, is the quantity and location of the data. An abundance of data does not necessarily mean that the data are available in a timely manner in all situations, since locating them may be a problem. Even if data are available, their usefulness depends on proper interpretation and analysis. Given the plethora of data available, without sufficient experience it is often difficult to select the right data to maximize the benefit to be derived from the data sets. The Brazilian Amazon Surveillance System, SIVAM, is a good example of a large integrated system for collecting Earth observation data and distributing them to users. Other related issues are the storage and archiving of data, linked to a disposal policy over time, the obsolescence of hardware and software and data-pricing policies, all of which create constraints to a broader use of the data.

134. The cost of remote sensing data is another issue of concern, in particular to most developing countries. For a number of years there has been increasing marketing of the products derived from space-borne remote sensing, with marked interest being shown by the private sector. This has reduced the need for governmental subsidies. The cost of acquiring satellite data is justified if their use affords measurable advantages in connection with the project in question, such as savinG time, reducing cost or making available detailed information that would not be obtainable by any other means. Despite a downward trend in the cost of

remote sensing data, it is still considered too high by most developing countries and efforts should be made to promote further the availability of data for such countries at an affordable price.

135. Operational satellites providing low-cost data make it possible to monitor on a daily basis the status of land and water resources and crop performance. The continuous availability of free or low-cost data for resource mapping on a global scale is an urgent priority for environmental monitoring.

136. Another issue involves the final use by policy and decision makers as well as by programme managers of the information derived from satellite data. Earth observation satellites provide essential data on conditions on Earth, allowing experts in the remote sensing field to assess the regional and global environment. While such data can provide evidence of the seriousness of environmental and health problems caused, for example, by poor management of land and water resources, infectious diseases and pollution, such information from satellites needs to be translated into specific actions in order to solve the persisting problems. Data from Earth observation satellites can give early warning of natural disasters, but specific actions should then be taken by civil protection authorities to prevent and mitigate the effects of such disasters.

137. Given the transboundary nature of disasters, international cooperation between operators, data providers and users of relevant space assets should be enhanced in order to provide the best possible service to improve rescue efforts and the assessment of rehabilitation measures. It is recommended that the timely release of data and services offered by space assets should be one of the major focuses of such cooperation.

138. The continuing availability of satellite data is essential to increasing the credibility and value of the information provided by satellites. Policy and decision makers as well as managers of programmes concerned with environmental and developmental problems need to know that they can depend, on an operational basis, on the information derived from the data. The successful use of data in terms of quality of the final product and of a cost-benefit analysis is an important milestone that would eventually lead to their routine use in planning and management activities. Further efforts should be made to enhance and ensure access, on a continuous basis, to various sources of satellite data and to demonstrate their usefulness.

139. There is also a need to explore ways and means further to coordinate ongoing international efforts to make scientific observations of Earth. A number of international initiatives have already been taken to examine various aspects of the global environment. To maximize the use of resources allocated to the monitoring of the Earth's environment, it may be useful to review information needs that have not been met by any ongoing monitoring initiative and to consider integrating some of the activities implemented within the framework of various initiatives. To do so, it is crucial to ensure the compatibility of the data exchanged.

140. To improve understanding of weather and climate phenomena and their effects on the environment and human activities, it will be necessary to pursue the following objectives:

(a) Development of remotely sensed observations and their use together with *in situ* observations to monitor, describe and understand the dynamics of the atmosphere, including climate system variability on all timescales ranging from a few hours to months, seasons and inter-annual periods of fluctuation;

(b) Ensuring that the observations thus collected are in a form conducive to integrated data assimilation by forecast and prediction models; a primary aim is to improve the capability to predict socio-economically important weather and climatic events;

(c) Improvement of the coverage (in surface area and in terms of additional parameters and variables that are needed) for the calibration, intercalibration and validation of current and planned satellite and remote sensing observations;

(d) Improvement of remote sensing data retrieval algorithms so that the geophysical parameters derived are more representative of direct measurements;

(e) Improvement of the input of globally observed satellite measurements directly into global models;

(f) Encouraging open access for all countries to data and simulation models used in international studies conducted by the specialized agencies of the United Nations system.

The above-mentioned activities need to be undertaken in a coordinated manner by all relevant organizations within the United Nations system and their respective member States.

141. The potential contribution of space techniques to disaster management is theoretically well accepted. However, civil protection authorities and other concerned bodies do not yet make extensive use of the techniques. There is thus a need to initiate activities that will assist civil protection authorities in identifying appropriate space technologies to support disaster management and to enable them to acquire practical experience in the use of space technologies.

(iii) Specific action programmes

142. There should be encouragement of support for the efforts of the Integrated Global Observing Strategy (IGOS) Partnership[34] to achieve a coherent articulation of the requirements for data from Earth observing systems and to stimulate the coordinated development and integration of remote sensing and *in situ* data collection systems. The rapid improvement in the quality, frequency and resolution of satellite data acquisition must be matched by a comparable strengthening of the complementary surface observation and "ground-truthing" activities. The reinforcement of a full range of data collection programmes and of the institutional structures for processing, archiving, integrating and assessing environmental data from all sources is essential to building the reliable long-term timeseries of data necessary for global change research on critical environmental problems. Special attention should be given to strengthening the potential of developing countries in research, operationalization, data collection and analysis and application to fill critical gaps in global data sets and their utilization to increase local knowledge of changes in and pressures on environmental resources. This process is essential to combine its current and planned space capabilities with those on the ground and in the oceans and should involve international bodies and national agencies and organizations, including industry.

143. IGOS needs to be user-driven, responsive and open to the needs for information for environmental policy formulation and decision-making. As observing systems for environmental data collection prove their usefulness, Governments are encouraged to support the transition from research and development programmes to operational environmental observing programmes with appropriate institutional arrangements and budgetary support. The systematic assessment of user needs and of the ability of satellite instruments to meet those needs should be continued and extended. Commitments will be needed from space agencies to meet the resulting requirements and also from users to maximize the use of satellite-derived inputs in their modelling and decision-making processes.

144. As one of the steps towards an integrated global strategy, the United Nations should support initiatives such as those of CEOS and the German Aerospace Center (DLR) to develop a CEOS information locator system on the Internet, which users in developing countries could use to find information about Earth observation data. The system should provide for the easy and inexpensive location, collection and sharing of data, as well as the interoperability and management of the users' own data. The possibility of converting such a network information database into a structured international framework for cooperation, combining satellite data with ground-based or other data, should be explored, taking into account the confidentiality of any strategic information.

145. The Office for Outer Space Affairs, in cooperation with relevant departments of the United Nations system, the specialized agencies, space agencies, authorities responsible for national receiving stations and value-added companies, should initiate a programme to promote the use of Earth observation data for planning and managing programmes and projects by user institutions in developing countries. The programme could identify ongoing national and regional projects in the areas of natural resource management, environmental monitoring and sustainable development that could benefit from the use of optical, infra-red or radar data and improve their effectiveness.

146. The goal would be an improved policy, decision and management process in participating institutions on the basis of timely and accurate information derived from satellite data. The programme would strengthen the capability of institutions to use satellite-obtained data in support of projects and programmes in areas of economic and social improvement. The selection criteria for participating projects would include a funding guarantee for all non-remote-sensing aspects and the ability, either by themselves or through a cooperative arrangement with a local institution, to utilize satellite data. Participants would report to their decision makers the results of their use of satellite data, including a cost-benefit analysis.

147. A needs assessment should be conducted by the Office for Outer Space Affairs and its partners to identify the type and coverage of satellite images required by each participating project. Those images and the software packages necessary to process them would be acquired for each project. A short training course to acquire hands-on experience with the actual images and software that they would receive would be organized for those who work on the projects.

148. The training courses to be organized, one per developing region per year, could be included in place of one of the yearly training activities of the United Nations Programme on Space Applications. The capabilities of the regional centres for space science and technology education could also be used for that purpose. Additional costs due to the specialized materials and possibly travel expenses for expert lecturers needed by the courses would be minimal.

149. The costs involved for the United Nations would be primarily in terms of staff work-months that could be covered within existing resources of the Office for Outer Space Affairs

by a rearrangement of priorities in work assignments with modest additional costs. The time-frame for the activity would be three years. In consultation with the participating institutions, the Office would report to the Scientific and Technical Subcommittee on the progress made. In developing and implementing the programme described in paragraphs 145 and 146 above, the Office for Outer Space Affairs should continue to support the activities of institutions with which it has successfully organized collaborative activities in the past, such as IOMAC, and encourage further collaboration with those space-related institutions, especially those in developed countries, and with funding institutions.

150. The international space community, including the United Nations system, space agencies and international organizations such as CEOS, non-governmental organizations and space-related industries should initiate a comprehensive programme to promote the use of satellite communications and Earth observation data for disaster management by civil protection authorities, in particular in developing countries. The goal would be to encourage civil protection institutions to utilize space technology in all relevant aspects of their work and to promote their participation, in an incremental manner, in international initiatives such as a possible global disaster monitoring system. The programme should build on the experience and accomplishments of completed and ongoing activities, such as those organized by the United Nations in cooperation with ESA (see paragraph 111 above), and should also bear in mind the relevant resolutions adopted by the General Assembly on prevention of natural disasters. The programme should also build on work done at the regional level, in particular through the preparatory conferences for UNISPACE III, and should be in line with relevant recommendations of UNISPACE III.

151. The programme should include activities such as those indicated below, which might initially be implemented through pilot projects:

(a) Identification of the data products corresponding to the requirements of the user (civil protection authority), concerning, for instance, information content, delivery time, means of dissemination and support, as well as formats;

(b) Establishment of a user request procedure;

(c) Consolidation and validation of the answering procedure by data providers;

(d) Validation of the procurement, interpretation and distribution of data and products through emergency preparedness training programmes;

(e) Establishment and validation of products and services for prevention, crisis and post-crisis activities in relation to user requests;

(f) Validation of the overall pilot project activities in close cooperation with the users.

152. As part of the programme, the Office for Outer Space Affairs, in collaboration with the secretariat of the International Decade for Natural Disaster Reduction and other interested institutions, would organize working meetings, on a regional basis, of civil defence and protection managers with providers of space technology and services to define areas where common efforts are advisable (for example, regional databases) and others where actions by individual institutions are necessary. The meetings would also serve to identify specific needs of civil protection institutions that could be met through the use of space technologies. On the basis of those specific needs, the programme would provide technical assistance to acquire appropriate space technology and know-how, leading in some cases to pilot projects to demonstrate and test the technology. The working meetings could be organized within the framework of the United Nations Programme on Space Applications and that of the regional centres for space science and technology education.

153. An additional consideration is that the International Decade for Natural Disaster Reduction will culminate in 2000 with a meeting that, among other things, will stimulate new actions to achieve the goals of the Decade. The meeting could build on the results of the International Conference on Early Warning Systems for the Reduction of Natural Disasters (see paragrah 111 above). The Conference, which was attended by 325 participants from 73 countries and 21 international organizations, evaluated what had been achieved during the Decade and elaborated recommendations for future scientific and action programmes. The Office for Outer Space Affairs would ensure that disaster-related recommendations made by UNISPACE III are considered and taken into account in the recommendations adopted at the final event of the Decade and that some specific actions, such as the initiation of pilot projects, are included. Finally, as space technologies, especially global communications and Earth observation satellites, play a crucial role in providing essential information for hazard mapping, risk assessment and early warning, as well as for disaster preparedness, relief and rehabilitation, and as the International Decade for Natural Disaster Reduction is coming to an end, there is a need to continue to take advantage of new progress in space techniques and operational activities together with the synergy established in the disaster management community; moreover, natural disasters of increasing magnitude are becoming a fact of life.

Building upon the considerable experience gained over the past decade, the General Assembly should be invited to extend the International Decade for Natural Disaster Reduction for one more decade in order to reduce and mitigate the effects of natural disasters throughout the world, in particular in developing countries.

154. The questions of access, dissemination and archiving of Earth observation data are growing in importance. Because issues of data policy and, in particular, pricing policy present obstacles to the effective utilization of Earth observation data, a greater clarity in statements of data policy by the supplier organizations would be helpful to the development of the Earth observation sector. The advantages and disadvantages of different pricing models should be explored and assessed against the opportunities to use Earth observation data for specific applications, including disaster management and global observations. The experience of those organizations which have already established Earth observation data policies, such as NASDA of Japan and ESA, should be harnessed by national and international Earth observation programmes.

155. Assessments are required continuously to guide rational and effective decision-making for environmental, health, social and economic policy formulation, implementation and evaluation at the local, national, regional and global levels. To improve the global capability for keeping the environment under continuous review, national and international action is required in the following fields:

(a) Investment in new and better data collection, in the harmonization of national data sets and in the acquisition of global data sets;

(b) Enhanced capabilities for integrated assessment and forecasting and analysis of the environmental impact of alternative policy options;

(c) Better translation of scientific results into a format readily usable by policy makers and the general public;

(d) Development of training courses and workshops for scientists from developing countries on the use of satellite data for monitoring the environment and modelling change.

156. To reach its full potential for operational applications in terrestrial, environmental and disaster monitoring, satellite remote sensing must ensure the high revisiting rate needed for applications in support of sustainable development. That could be achieved through coordination of orbital parameters in order to ensure a high revisit capability. Such coordination is encouraged to the extent possible and could be facilitated through CEOS, in collaboration with the Office for Outer Space Affairs, relevant non-governmental organizations and industry.

157. Through the United Nations Programme on Space Applications, the Office for Outer Space Affairs should increase the awareness of national policy and decision makers, scientists and person concerned with the protection of the environment and establish a comprehensive list of distributors of data from Earth observation satellites, as well as of analysed information, including the models used, and make the list available to Member States.

158. The work of FAO in integrated use of GIS and remote sensing technology for conducting environmental analysis with a view to assisting policy and decision makers should be further supported and communicated to benefit developing countries.

159. In order further to coordinate ongoing and planned initiatives relating to Earth observation, it would be useful to prepare a comprehensive list of such initiatives taken at the national, regional and global levels. To minimize duplication, where appropriate, participation by other nations that are willing to make contributions to the achievement of the goals of those initiatives should be encouraged.

160. An appropriate mechanism should be developed for synergistic cooperation and coordination between the Committee on the Peaceful Uses of Outer Space, with its secretariat, the Office for Outer Space Affairs, and other international bodies working in the space field, including the Commission on Sustainable Development, UNEP, the Global Environment Facility, FAO, the United Nations Educational, Scientific and Cultural Organization (UNESCO), WMO and WHO, in particular on critical issues such as global warming, climate change, human health problems and sustainable development, and with CEOS on the coordination of satellite missions.

161. There should be wider and more effective communication of the lessons learned on the use of Earth observation for sustainable development in developing countries, including India's Integrated Mission for Sustainable Development and technical cooperation among developing countries (TCDC) activities such as the cooperation between Brazil and China aimed at the launching of their own Earth observation satellite, the China-Brazil Earth Resources Satellite (CBERS).

2. Facilitating and utilizing communications

(i) Status: communications and broadcasting

162. The economic growth rate of the developing regions will be significantly accelerated by affordable tele-

communication services. Satellite communications systems complement and could replace terrestrial infrastructure and have technical and/or economical advantages over terrestrial infrastructure in terms of being able to provide telecommunication services in rural and remote areas. Broadband satellite services are ideally positioned to allow those regions to leap directly into modern infrastructures. Satellite communications could also be the key technology to bring developing countries to participate in the process of building up the global information infrastructure (GII) (see paragraph 278 below).

163. In the past decade, satellite communications and broadcasting have changed significantly in terms of capacity service offerings, lower space segment (satellites, launchers and control stations), a ground segment (end-user terminals and networks) and ground equipment costs. The technology has progressed rapidly from small, low-power satellites with low-gain antennas to large complex platforms with high transmission power, precise pointing, a very high degree of frequency reuse and longer design life. Ground terminals have evolved from 30-metre antennas to small and even hand-held units. Along with the advances in technology has come the progressive emergence of new telecommunication services and applications.

164. Optical fibre technology has vastly increased the capacity and cost-effectiveness of land lines, especially for high-capacity and interactive use. However, satellite systems still have certain advantages over fibre-optic systems, including: (a) mobility—mobile users cannot be connected to the fibre network directly; (b) flexibility—terrestrial infrastructure is extremely expensive to restructure; (c) cost-effective solutions for rural and remote connections—it is not cost-effective to deploy high-capacity fibre networks in areas with low-density traffic and difficult topography; and (d) wide-area services—terrestrial communication system can be reached only within the limited area (at one time) directly. Thus, satellites and wireless technologies will be important in the future implementation of GII.

165. Newly proposed or enhanced services via satellite include voice, data, video, imaging, video teleconferencing, interactive video, digital audio and video broadcasts for entertainment and other uses, multimedia and global Internet access. A wide range of applications are planned, including distance learning, corporate training, collaborative workgroups, telecommuting, telemedicine, electronic commerce, wireless backbone interconnection (that is, wireless local area network and wide area network), direct-to-home video and satellite news-gathering, as well as the distribution of music, software, scientific data and global financial and weather information. Satellite-based systems are also indispensable for disaster prevention and emergency relief communications services. Those capabilities make it possible, in particular for developing countries, to find solutions to problems of global and regional significance and to support development.

166. Satellite communications systems are uniquely suited to strengthening the development and extension of distance education. Through such advanced applications as the Internet and two-way interactive video conferencing, local primary and secondary schools, universities, libraries, corporations, work sites and multi-purpose information centres could access data and other information on a wide range of subjects to enrich their programmes.

167. There is a need to promote the sharing of best practices and experiences in tele-education among countries (a) by organizing well-structured regional and international seminars and (b) by promoting and supporting the documentation of experiments and projects and ensuring the dissemination of reports on those experiments. There is also a need to promote research and studies on the planning, configuration and use of tele-education systems that utilize new and emerging information and communications technologies. The focus of such systems should be on female education, literacy and universalization of elementary education.

168. Widespread access to medical facilities for both critical and preventive care is limited in many countries because of geographical constraints and other factors. Satellite technology has tangible applications in telemedicine that could help to extend access to health-care professionals throughout the developing world. Telemedicine applications have been used in emergency situations, for instance during the conflict in Bosnia and Herzegovina, where a 24-hour hospital assistance service was provided. Recognizing the powerful link between medical care and satellite communications, several international health organizations already exchange health and medical information for research, education and other purposes.

169. There is growing awareness of the need to study the feasibility of tele-education and tele-health systems for training relevant professionals by providing universal access to means of information retrieval such as the Internet.

170. Communications for rural areas constitute a particularly essential element in development efforts. In rural and remote areas, where resources for education and health services can be suboptimal, access to advanced telecommunications facilities could lead to the development of shared resource centres or community access points. Equipped with satellite terminals, the multi-purpose community centres could serve

as principal access points for broadband communications. In many instances, those centres could be located within schools or hospitals and shared by multiple users.

171. Satellite communications are also vital in disseminating timely information on improved agricultural practices, agricultural products, prices of commodities, integrated pest management, public assistance measures, banking and credit services—most of which are directly relevant to the development of rural areas and should therefore be treated as matters of the highest priority. Nevertheless, in spite of relatively low costs, in many instances the setting up of space communications segments for rural communities will still be commercially unattractive.

172. Recent technological developments have enabled the development of a new type of satellite communications system using earth terminals that are small and relatively inexpensive to manufacture. The new systems are generally known as global mobile personal communication by satellite (GMPCS).

173. GMPCS represent a new possibility in personal telephony, including global mobile faxing, messaging data and even broadband multimedia, providing connectivity via small, hand-held phone sets, computer terminals or laptops. They are based on constellations of satellites capable of providing telecommunication services directly to end-users anywhere in the world.

174. Nearly 800 of the projected 1,100 communications satellites over the next 10 years will be for mobile systems. During the past five years, the worldwide growth rates for mobile telephony have hovered at an astonishing 50 per cent per annum and some countries are now actually doubling their mobile subscriber base every year.

175. Apart from enhancing the way in which business is conducted, the satellite communications sector is in itself of utmost significance to the world economy. The world market for satellite communications is distributed between a space segment and services. With the expansion of direct-to-home television and digital audio broadcasting services and the introduction of personal communications and multimedia services, the ground segment is expected to grow by millions of users per year. The total global market for satellite communications over the period 1996-2006 has been estimated at over $600 billion.

176. Over the next decade, as a result of the convergence of telecommunications, informatics and audio-visual media technologies, the telecommunications sector will undergo fundamental change. New markets will emerge and market demand will increase owing to the opening of markets to free competition and the globalization of telecommunications equipment, network and services markets and the increasing role of the private sector in telecommunications, in conjunction with the widest application of the relevant 1997 agreements of the World Trade Organization. Those factors are fuelling demand for telecommunications infrastructure, and satellites will often be the most cost-effective solution to meet the needs of growth, in particular in developing countries.

(ii) Issues and concerns

177. Radiocommunications systems are the fastest-growing sector of the telecommunications industry. Other radio-based services such as paging, subscriber radio and television delivered by satellite and global positioning systems are also enjoying rapid growth in many world markets. With increasingly sophisticated systems for navigation, air and maritime safety, new laptop-computer-based mobile data systems, proposed services such as GMPCS and dozens of other new applications still being developed, the allocation of frequencies in the radio spectrum has become a pressing issue. The issue led to a fundamental review of the planning and coordination framework of ITU, which resulted in the adoption of important decisions at the World Radio-communication Conference in 1997.

178. The revolution in information technology, combined with that in communications, has led to a tremendous increase in capacities for information collection, storage, processing, retrieval and distribution. While that has had a great many positive effects, it can also widen the gap between those who use the technology and those who do not in terms of the amount and timeliness of the information to which they have access. Although there is evidence that the same technological tools can be used to actually narrow the information gap, steps need to be taken to address the issue of that gap between countries.

179. One vital necessity, if the information gap is to be reduced, is universal access to communications and information sources. That involves ensuring access to broadcast signals and to telephony. Technology can now provide television signal and telephone connectivity to any person on Earth, practically irrespective of the location. Methods of translating that possibility into reality are an important issue that needs immediate worldwide attention.

180. Access to low-cost telecommunication services will be a factor as essential to economic development in the twenty-first century as cheap power was to the industrial revolution in the twentieth century. It is estimated that to meet such a

challenging task globally by terrestrial means, 25 years and between $1,000 billion and $3,000 billion would be needed to connect the globe with fibre optics. This is where new satellite communications technology could be most useful, in particular in rural areas with low-density traffic of less than 200 subscribers per square kilometre, and may be the means by which developing countries obtain ample, low-cost access to high-density broadband telecommunications links.

181. The work carried out by ITU in allocating and coordinating the frequency bands for the various space radio communication services by satellites on geostationary and non-geostationary orbits needs to be fully supported. ITU efforts towards developing an efficient and more equitable distribution of frequency spectrum-orbit resources need to be encouraged. Taking into account technological innovations, more equitable access to and use of such resources by developing countries should be ensured. There is also a need to protect the limited frequency bands allocated for scientific and research and development purposes.

182. Radio broadcasting is the most ubiquitous means of communications in the world. There are over 2 billion radio sets in existence and over 100 million sets are sold every year. A leading company in the space industry is attempting to bring low-cost but high-quality digital radio broadcasting to 3.5 billion people, relying on a digital audio broadcasting system that works by routing a radio signal through a very small aperture terminal (VSAT) up to a geostationary satellite. The satellite retransmits the signal, which is picked up by millions of portable radio receivers.

183. The new global digital radio broadcasting infrastructure being created will enable broadcasters and advertisers to reach under-served, emerging markets in the world. With a new type of radio needed to receive programmes from satellites, people throughout the world will be able to receive digital audio broadcasting of unprecedented quality and diversity.

184. The proliferation of low-Earth orbit (LEO) communication satellites, designed to provide high-quality global personal communications services, have advantages over geostationary satellites in that such satellites would not have the associated problems of long propagation delays and high-latitude coverage limitations. However, LEO satellites usher in a new technology element and the need to maintain multiple technology services could present challenges for developing countries.

185. With regard to tele medicine, there is a need for WHO, ITU and the United Nations, through their appropriate working groups, to define and promote a flexible technical and legal infrastructure, adaptable to health services in different economic and cultural environments.

(iii) Specific action programmes

186. The following specific actions should be taken:

(a) Promotion of the establishment of the necessary legislative and regulatory frameworks to facilitate investment in the telecommunications sector;

(b) Provision of assistance to developing countries in assessing how space technology can help meet their information and communication needs;

(c) Facilitation of the sharing of experience between countries in the use of satellite broadcasting and communications for educational and development purposes and organizing training courses in satellite communications;

(d) Implementation of a study of the feasibility of international and regional cooperative systems for satellite-based broadcasting and communications for development, taking into account the needs of developing countries;

(e) Promotion of the development of rural infrastructure for communications through international cooperation;

(f) Urging of government agencies to take appropriate steps to establish communication services for the benefit of rural communities.

3. Improving and using positioning and location capabilities

(i) Status: navigation and positioning and /location using satellites

187. Global navigation satellite systems (GNSS) are space-based radio positioning systems that provide 24-hour three-dimensional position, velocity and time information, in any weather conditions, to suitably equipped users anywhere on the surface of Earth, as well as airborne and space users. Such systems use satellites as reference points to calculate positions accurate to within metres or, with advanced techniques, to within a centimetre. COSPAS-SARSAT (see paragraph 110 above) makes it possible to determine the position of a mobile object fitted with a tracking beacon when the object is in a distress situation. Intended mainly for the study and protection of the environment, the Argos system, developed by the Centre national d'études spatiales (CNES) of France and placed on board the NOAA series of meteorological polar-orbiting satellites of the United States, makes it possible to

determine the position of a mobile object anywhere on the surface of Earth (see paragraph 110 above).

188. There are currently two GNSS: GPS of the United States and GLONASS of the Russian Federation (see paragraph 35 above). Since their inception, the use of some of the signals from those two existing military navigation satellite systems has been offered free of charge to civilian users. GPS is fully operational, consisting of 24 operational satellites and active spares in orbit. GLONASS is now operating with 15 operational satellites. At the same time, GLONASS is undergoing improvements to enhance its capabilities and orbital segment. Several approaches are now under consideration that would use GLONASS as a basis for a future international global navigation satellite system.

189. GPS receivers have been miniaturized and their costs drastically reduced, making the technology more accessible. GPS technology has matured into a resource that goes far beyond its original design goals of enabling more accurate long-distance navigation. GPS receivers are now used by scientists, sportsmen, farmers, soldiers, pilots, surveyors, hikers, delivery drivers, sailors, dispatchers, lumberjacks, firefighters and people in many other professions in ways that make their work more productive, safer and easier. GPS equipment is being built into cars, boats, planes, construction equipment, film-making gear, farm machinery and even laptop computers.

190. While navigation satellite and positioning services are most widely known for applications in the field of transportation, the future of global navigation systems appears promising, as new applications will continue to be created as a result of technological evolution. The social and economic benefits of the navigation systems are enormous. Precise timing, location and navigation are integral parts of an evolving global information infrastructure. The signals provided by GNSS enable continuing improvements in the productivity of national and regional infrastructure such as transportation, telecommunications, oil and gas, agriculture and financial networks, in developed and developing countries. Research on new applications of GNSS technology shows promise in such areas as earthquake monitoring grids, which may become a valuable tool in earthquake prediction, and satellite atmospheric measurements using GNSS signal occultation techniques, which may one day be an important input to weather prediction.

191. To improve the positioning information of the current GPS, the United States has embarked on a GPS improvement programme that will add another signal to each GPS satellite and will enable easier civilian access to one of the existing military signals. Currently, civilian users of GPS who need accuracy greater than that provided by the single-frequency Standard Positioning Service (SPS) use dual-frequency semi-codeless receivers as well as differential techniques involving GPS and radio transmissions from a known reference base station. However, as the GPS enhancement programme progresses, users will have free use of three signals with similar code structures. With a total of three signals available for civilian use in the future, GPS services will provide more accuracy by allowing easier corrections for atmospheric distortion, greater robustness by protecting against the effects of narrow-band interference, and easier use by allowing more rapid receiver acquisition of signals from the available satellites. Similar activities are now under way with respect to GLONASS.

192. In addition, the United States, Japan and Europe will install augmentation systems that will provide integrity information as well as correction factors that will aid single-frequency users. The Wide Area Augmentation System (WAAS) of the United States, the European Geostationary Navigation Overlay Service (EGNOS) system and other augmentation systems will use geostationary satellites to broadcast augmentation information over their respective regions, will be designed to be compatible and interoperable with each other and will represent a big step towards providing a seamless global augmentation capability. These systems will also enable independent integrity monitoring of GPS to provide increased international confidence in using the space-based signals.

193. A United States Coast Guard GPS augmentation system for increasing the safety and efficiency of shipping in United States ports and inland waterways is also now being expanded around North America. Systems for similar purposes are being set up around the world. For urban areas and mountainous terrain—where GPS signals may be difficult to receive—industry is developing new GPS pseudosatellites, or "pseudolites", that can provide additional signals on the ground to ensure that GPS service is always available. These maritime systems and "pseudolites" represent opportunities for initiative by developed and developing countries alike to exploit GPS and strengthen their local infrastructure at low cost.

194. To improve the positioning information of the current GPS and GLONASS civil signals, the European Commission, ESA and the European Organization for the Safety of Air Navigation (Eurocontrol) have together begun to implement EGNOS as an initial global satellite positioning system. EGNOS is based on a regional augmentation of GPS and GLONASS and will employ navigation payloads on geostationary satellites. Europe has initiated the development

of the Galileo project, which is a second-generation independent satellite navigation system.

195. Galileo, a civilian system developed through the initiative of the European Union and ESA, is intended for use in many disciplines, from agriculture to transportation, and will meet civil aviation navigation requirements for all phases of flight, from en route to precision approach and landing—the strictest of all satellite navigation user requirements. Benefits of more accurate positioning information for civil aviation include a reduction in the number of accidents, better navigation in all weather conditions and better traffic management. Acceptance of GNSS as a basic navigation aid by civil aviation, however, will be influenced by the guaranteed and reliable open access to enhanced positioning information. Currently, most civilian GPS users do not have access to the more precise positioning signal available to military and authorized civilian users, although the GPS civil signal is available to all users free of charge.

(ii) Issues and concerns

196. With the availability of high-resolution images from satellites, precision of locations is required to sub-metre levels. Currently, through sophisticated techniques involving differential measurements, such precision is achievable from the positioning satellite systems. In the coming years, there will be a critical need to establish user-friendly, precise transformation and linkages between the images, GNSS observations and their input into GIS databases.

197. A major technical issue associated with the use of GNSS is the fact that cross-correlation between the data that GNSS employs to national data would require the establishment of a geodetic network based on GNSS observations. That becomes very relevant when satellite images, in particular high-resolution images, need to be referenced to national map bases. The cross-correlation and establishment of a different geodetic network means additional investments, both in resources and in time. A key to lowering the cost of implementing these databases is adoption of common world standards for GIS that enable quick and easy translation of GNSS observations into national map databases. Private industry is working to develop common geospatial standards through open, voluntary groups such as the OpenGIS Consortium.

198. Although some Governments have already approved the use of GPS in aviation, the performance of GPS and GLONASS does not meet all requirements of civil aviation in all countries and needs to be enhanced through the implementation of system overlay or system augmentation.

199. A number of questions also need to be addressed before a new type of satellite navigation system can be deployed on a global or regional basis.

(iii) Specific action programmes

200. The radio frequency bands in which all GNSS operate should be kept free of interference from other radio emissions that could degrade performance of GNSS user equipment. There are issues before ITU that will be attended to at the World Radiocommunications Conference in May 2000 that could have significant impact on the utility of GNSS to all countries in the future. It is essential that the radio frequency bands used by GNSS be kept free of interference for all Earth, air and space users.

201. A large degree of regional and global cooperation is essential to achieving a seamless multi-modal satellite-based radio navigation and positioning system throughout the world. In that context European entities have started coordination contacts with several countries and organizations, with two objectives: firstly, to examine the possible extension of the EGNOS coverage to other countries or, alternatively, to ensure its compatibility with other regional augmentation systems; and secondly, to study forms of cooperation in view of the development and implementation of second-generation systems.

202. Further international coordination and consultation is necessary to ensure compatibility between existing and planned navigation and positioning systems while maintaining open access to the satellite signals. At the same time, the technical issues related to using the positioning signal in Earth observation applications require work by groups of technical experts. Countries interested in using signals from GNSS should indicate their support for keeping the relevant frequency bands free from interference or reallocation by commercial interests. A resolution of support should be communicated to the International Civil Aviation Organization (ICAO), the International Maritime Organization (IMO) and ITU as the key international bodies concerned with international transportation safety and spectrum management.

203. To ensure global civil safety, countries operating GNSS should commit themselves to not intentionally switching off the navigational signals in use or reducing the quality of those signals.

204. In defining the terms of access to global navigation satellite signals, due consideration should be given to the provision of a continuous basic service to global civilian users on a free-of-charge basis.

4. Furthering knowledge and building capacity

(i) Status: space science and space exploration

205. The ability to develop space science or even use space technology depends critically on the availability of human resources with appropriate knowledge and skills. Space research and education address both the understanding of basic space sciences as well as the fundamentals that lie behind the use of space technology for various applications. In a complementary role, training addresses how a technology is used. Thus research, education and training are the cornerstones for furthering knowledge and are part of overall capacity-building.

206. Perhaps the primary benefits of the new age of discovery relate to the impact made on the way in which humankind views its own global habitat in the context of the solar system and the universe beyond. The recognition that human beings are not the centre of the universe but are part of a greater natural order represents a dramatic change in human attitudes towards the world around them. The new appreciation of the interdependence of human beings and their natural environment has inspired a vast expansion of interest in, and study of, the natural environment, including other planets, stars and the universe as a whole.

207. The United Nations, through the Office for Outer Space Affairs, and ESA have jointly organized a series of workshops on basic space science since 1991. The implementation of the recommendations of those workshops has strengthened the scientific infrastructure in developing countries. One of the proposals from the workshop participants is the concept of a world space observatory, a small satellite mission focusing on the ultraviolet part of the electromagnetic spectrum, with international participation, including that of developing countries.

208. In addition to the many basic research areas indicated in paragraphs 57-86 above, knowledge needs to be advanced further in several other space-related areas. In particular, protection and preservation of the space environment should be the subject of constant attention and continued research. For instance, there is a need for further understanding of the orbital debris population (including the size range of debris, its composition and its distribution by orbital altitude) in order to assess the debris hazard to spacecraft in all orbits and to enable decisions to be made on mitigation measures to reduce future hazards.

209. Studies on near-Earth objects received an important impetus with the discovery of the iridium anomaly at the cretaceous-tertiary boundary. No other event has so clearly demonstrated the influence of minor objects on the evolution of terrestrial life. The introduction of studies based on the fossil record has broadened the interdisciplinary and international nature of planetary science, encompassing fundamental concepts of Earth's history, mammalian evolution and contemporary natural hazards both on Earth and in space.

210. The impact of comet SL-9 fragments on the planet Jupiter in 1994 and the recent discovery of asteroid 1997 XF 11 reminded the international community of the existence of about 1,700 suspected near-Earth objects larger than 1 kilometre in diameter that have not yet been discovered with astronomical telescopes. Some space agencies have already taken initiatives in the detection and characterization of near-Earth objects by acquiring data from spacecraft and ground-based observations and creating an inventory of such objects. Non-governmental organizations, such as IAU, also coordinate activities for the detection of near-Earth objects at the international level.

211. Promoting scientific literacy worldwide is one of the great challenges for the new millennium. Much of the quality of life and economic growth now depends on scientific and technical awareness and the ability to incorporate new knowledge and devices into the economy and lives of individuals.

212. The study of space science and planetary exploration is critical to further knowledge in the basic research areas referred to above. In a broader sense, it can make very important contributions to the future well-being of humanity, for the following reasons: (a) it is a basic element of education; (b) it leads to and facilitates international cooperation; (c) it leads to technological development; (d) it promotes the participation of young scientists and engineers in space-related fields; and (e) it enhances understanding of the past and develops a vision for the future.

213. Within space science, astronomy has long been a pacesetter in encouraging education in science and the development of scientific literacy, in communicating science and mathematics to the public, and in motivating children to learn those subjects. Through the World Wide Web, other Internet services and the mass media, the findings of space science and planetary exploration as well as the economic and social benefits that eventually derive from them can now be made more readily available to all people.

214. Strategies for enhancing international cooperation in space should be explored and implemented, starting from the earliest phases of strategic planning.[35]

215. Space exploration should be widely used to provide motivating educational processes and materials. All people should be involved in the adventure and discovery of space

exploration and the search for life elsewhere through, *inter alia*, education about the position of humankind in the cosmos and its implications for humanity. Everyone should also be involved in the formulation of the goals for and implementation of space activities.[35]

216. In terms of education, the space sector will always need young graduates in space-related fields from all levels of university education in a wide range of disciplines, including science, management, law, engineering, economics, architecture, communication, medicine and finance. Space agencies, commercial firms and international organizations involved in space emphasize that many young specialists should complement their training by acquiring the tools that will enable them to increase their efficiency in an interdisciplinary, international and consequently intercultural environment.

217. A strong and well-developed conventional system of education, from the primary level to the university level, can provide a good foundation for introducing or carrying forward work related to space science and technology. A number of space agencies and institutions prepare, on a continuing basis, audio-visual material to strengthen the science, technology and mathematics components of existing curricula at all educational levels. Many such institutions organize training courses on various subjects. Some of them are also involved in providing adequate educational support for teachers.

218. IAU, COSPAR and other international organizations should help to collect and systematize information on experience with the build-up of education in astronomy and basic space science, at various levels of formal and informal education, in countries with differing conditions. That information could help interested States to assess their current situation and to develop realistic national goals and expectations, as well as effective long-term educational strategies, adapted to local conditions.[36]

219. International organizations such as IAU and COSPAR should help to develop an inventory of teaching methods and material that have proved effective in various countries at all levels of formal and informal education, up to and including the graduate level. The inventory should include methods and material for the training and professional development of teachers, introducing multicultural and multidisciplinary elements as necessary. The materials should be disseminated to interested States and communities worldwide and adapted to local conditions as appropriate in collaboration with other partners.[36]

220. Collaboration should be established between the regional centres for space science and technology education, affiliated to the United Nations, and IAU, COSPAR and other scientific organizations to strengthen components of their curricula that involve astronomy and basic space science and thus increase the attraction and effectiveness of their programmes in basic, environmental and applied space sciences.[36]

221. All States should recognize that, for space scientists and engineers to serve effectively in the technical, economic and social development of their country, they need suitable employment and adequate research tools, as well as appropriate training. Developing partnerships with industry and increasing the public's appreciation of science should be considered important steps towards achieving those goals.[36]

222. A large amount of educational material, essentially covering all aspects of space science and technology, is being continuously developed. Examples of institutions that prepare such materials include INPE of Brazil, the British National Space Centre, CNES of France, the China National Space Administration, ESA, DLR, the Indian Space Research Organization (ISRO), NASA of the United States, NASDA of Japan, the Russian Aviation and Space Agency and several other space agencies. Although the material is developed primarily to meet national needs, as a result of cooperative arrangements much of it is benefiting a large number of countries.

223. Educational material is also developed by other institutions including international organizations such as CEOS, COSPAR, the International Council for Science (ICSU), the International Astronautical Federation, IAU, the Planetary Society, organizations in the United Nations system and other professional scientific organizations throughout the world that promote the benefits of space science and technology.

224. In addition to education and training of human resources, capacity-building involves developing experience and practice in conducting research programmes or operational applications of selected technologies. That involves setting policies, establishing institutional frameworks and physical infrastructures, ensuring funding support for the chosen activities and access to external sources of data and information, as well as establishing technical cooperative links with institutions having expertise in the selected areas of research or applications.

225. Experience indicates that as education in the basic disciplines becomes more widely available, the transition from such education to space applications can be brought about by project work, by on-the-job training and experience, by workshops and by joint project partnerships.

226. The Office for Outer Space Affairs, through the United Nations Programme on Space Applications, has undertaken an initiative aimed at establishing regional centres for space science and technology education, affiliated to the United Nations, located in developing countries. The centres are based on the concept that by pooling limited material and highly qualified human resources, developing countries could have education and training centres, of an international-level quality, that will prepare indigenous personnel in the use of space science and technology, in particular those applications relevant to national development programmes such as remote sensing and the use of geographic information, satellite meteorology, space communications and basic space science.

227. The Centre for Space Science and Technology Education in Asia and the Pacific, affiliated to the United Nations, was established in 1995. The first node of the Centre is hosted by ISRO and offers short-term training courses and nine-month education courses, followed by a one-year follow-up project, in remote sensing and GIS, satellite communications, satellite meteorology and the global climate and space science. By the end of 1998, the Centre completed five courses and had about 80 student alumni. The Centre hopes to become a nerve centre in Asia and the Pacific by undertaking specific research projects and consultancy services to the Member States in the region and by providing high-quality education in areas of space science and technology development. To utilize all the potential of the region, interested countries in the region and the Office for Outer Space Affairs are encouraged to undertake further consultations, with a view to creating the network of similar nodes that will constitute the Centre.

228. The African Regional Centre for Space Science and Technology—in French language and the African Regional Centre for Space Science and Technology Education—in English language, both affiliated to the United Nations, were established in Morocco and Nigeria, respectively, in 1998. The centres will develop their education, training and research programmes and begin their implementation during the course of 1999.

229. The Government of Egypt expressed its willingness to establish and host a centre for space science and technology in the Arabic language that would be affiliated to the United Nations.

230. Plans for the establishment of a regional centre for space science and technology education in western Asia are being finalized.

231. Brazil and Mexico were selected as host countries for the regional Centre for Space Science and Technology Education in Latin America and the Caribbean, affiliated to the United Nations. The agreement establishing the Centre was signed by the two Governments and was subsequently ratified by their respective parliamentary bodies in 1997.

232. In the case of central, eastern and south-eastern Europe, discussions among the Governments of Bulgaria, Greece, Hungary, Poland, Romania, Slovakia and Turkey led to the establishment of a network of space science and technology education and research institutions. Experts from those countries agreed to work with the Office for Outer Space Affairs, with the support of Italy, to undertake a study on the technical requirements, design, operation mechanism and funding of the network.

233. In support of the centres, the Office for Outer Space Affairs brought together a group of research and education specialists and requested them to prepare international-level curricula in the areas of remote sensing and GIS, satellite meteorology, satellite communications and basic space science. The curricula prepared by that group were sent for peer review to individuals representing a broad geographical and scientific cross-section. The curricula are intended to provide a benchmark for all the regional centres.

(ii) Issues and concerns

234. Strengthening and supporting the activities of the regional centres, established at the initiative of the United Nations pursuant to General Assembly resolution 45/72 of 11 December 1990, call for concerted effort by various agencies with a view to sustaining, *inter alia*, their educational activities, infrastructure development and the institutional and organizational framework.

235. National and regional centres should be strengthened with the support of industrialized countries and that of all Member States.[37]

236. The development of human resources has to be supplemented by the development of adequate physical infrastructure. The first step in doing so is to define needs, which depends in turn upon the overall needs of the country concerned and the defined or likely role of space science and technology in meeting those needs.

237. While needs and possibilities will vary from country to country, experience indicates that it is best to begin with the infrastructure required for applications, for example, computers and equipment for analysis of remotely sensed imagery, and then to move on (if required) to data reception facilities. Such an approach also helps to produce the quickest returns from investment in such infrastructure and helps to develop and expand local skills.

238. Financing of physical infrastructure is an area where international assistance may be needed. Multilateral agencies can play a major role in providing such financing and in ensuring the inclusion of space-related infrastructure in development projects, for example, by including a satellite broadcasting component in an education project. Efforts should be undertaken at the national level to create awareness about the need to integrate such infrastructure facilities providing support to elements of other larger projects in the development field.

239. Potential users of space technology often need technical advice in identifying the type and appropriate level of technology to include in their programmes. The risks involved for the decision maker are that the chosen technological solution may be insufficient for the problem, and therefore a failure, or that it may prove more sophisticated than was required, resulting in a poor cost-benefit ratio. Such a situation is particularly likely to occur in many developing countries.

240. Space-related organizations with educational activities are turning increasingly to the Internet, and in particular the World Wide Web, for their outreach. But the Web is not yet worldwide, and Internet access is still limited in some developing countries. While there are programmes that aim at enlarging electronic access for developing countries, printed materials continue to be a requirement.

241. Operating with less formalism and fewer constraints, and with more limited agenda, non-governmental organizations can serve both as advocates and as team-builders for international cooperation, both at the level of working scientists and at that of the general population. Emphasis should thus be placed on the potential of non-governmental organizations to serve as catalysts in education and public information.

242. The efforts made by space agencies in observing near-Earth objects can be further strengthened by coordinating activities with non-governmental organizations and individual researchers at the global level. Non-governmental organizations, notably IAU, can play an important role in those efforts and in providing the general public with accurate information on near-Earth objects.

243. Political and financial support for the development and use of space science and technology is enhanced by improving public awareness, understanding and appreciation of the benefits derived from space. Although every institution involved in space conducts activities of dissemination of information to the public, the results are not fully satisfactory. Higher priority needs to be given to such activities.

244. In order to influence the opinion of policy makers and to increase international cooperation in the sphere of basic space science, the Office for Outer Space Affairs, in cooperation with interested States and space-related institutions, could coordinate the establishment of a network to provide access to information on national activities, their planning and prospects over the medium and long term, as well as information on ongoing projects and links to the results of those which have been carried out.

(iii) Specific action programmes

245. Existing activities, such as the successful series of United Nations/European Space Agency workshops on basic space science, organized in the period 1991-1999, should continue to be supported.[38]

246. It is recommended that appropriate incentives for teachers be created and that cooperation between secondary-level teachers be encouraged through specialized meetings, forums, summer schools and special networks. The recognition of university-level degrees should be examined in order to facilitate exchanges of students between universities and training centres, as well as to propose courses in the field of space applications. It is also recommended that joint courses and diplomas be encouraged in space science and technology.[37]

247. Space agencies, space centres and industry should contribute to the expansion of the various areas of space applications for education, such as remote sensing, communications, planetology and orbitography. In that respect, each new space programme should establish, within its project specifications, educational and training objectives. In order to do so, engineers, researchers and education specialists should together study the financial investment involved, the content of the information and data to be gathered and their dissemination. Communication and dialogue between space agencies, universities and industry, directly or through special associations, should increase.[37]

248. The Office for Outer Space Affairs, jointly with each regional centre for space science and technology education, should lead an international effort that would include space agencies, specialized agencies of the United Nations system, intergovernmental and non-governmental organizations and the private sector, to build up the quality of education programmes and the long-term viability of the centres. Such an international effort could be strengthened by redirecting some of the cooperation activities that the Office already conducts, as for instance with ESA, the International Society for Photogrammetry and Remote Sensing and the Planetary

Society, or by adding other cooperation activities with new co-sponsors.

249. New initiatives, such as those of IAU and COSPAR aimed at organizing, together with the regional centres for space science and technology education, workshops on more specific topics, should be encouraged.[38]

250. The regional centres should receive the recognition, once earned, of their value in preparing human resources that can support economic and social development programmes. That recognition should assist the development of a self-sustaining funding mechanism for each centre based primarily on support from the region, donor countries, international organizations and private industry. Member States for which the regional centres have been established should, therefore, fully support and participate actively in the programmes of the centres. Awareness-raising efforts by alumni would be a key element in achieving that goal.

251. Possible action in direct support of the education programmes include the following:

(a) Promoting the establishment of cooperative agreements between the centres and the types of entity mentioned above. The educational areas and form of cooperation would be the subject of arrangements, at the university level, on a mutually acceptable basis, whereby researchers and lecturers could be exchanged, technical advisory support provided for graduates conducting pilot projects in their home countries and short-term courses and workshops designed and organized to develop capabilities of the participants beyond the basic introductory level;

(b) Promoting the acquisition by the centres of audio, visual and available on-line educational materials;

(c) Assisting the centres in achieving a significant representation of regional and international lecturers;

(d) Assisting the centres in directing some of their activities to areas of regional and international concern;

(e) Establishing a special fund or mechanism to support the centres and the participation of individuals from the regions in the education and training programmes of the centres.

252. Other actions to strengthen the infrastructure and operation of the centres could include the following:

(a) Assisting the centres in preparing cost-sharing proposals to funding institutions for initial operations;

(b) Assisting the centres in establishing contacts with industry that would lead to partnerships in areas of common interest;

(c) Assisting the centres in designing an effective means of disseminating information about their accomplishments, at the regional and international levels, so as to build up the requisite support to ensure their long-term viability;

(d) Assisting the centres in utilizing educational materials and training possibilities available through the Internet and World Wide Web, as well as in exchanging materials and programme experiences among themselves.

253. The costs involved for the United Nations would be primarily in terms of staff work-months, which could be covered within existing resources of the Office for Outer Space Affairs with some additional modest costs. The time-frame for the activity would be three years. In consultation with the participating institutions, the Office would report to the Scientific and Technical Subcommittee on progress made.

254. The United Nations has been effective in distributing information and enhancing communications for scientists and educators in developing countries. It could also lead initiatives to distribute educational material incorporating the latest information and results from space exploration. The support of national space and science agencies, educational organizations and non-governmental organizations for the development and distribution of the material is crucial.

255. Interested countries could provide expertise and participate in missions and other space activities, not only through educational programmes, but also by contributing to and developing space mission databases, instruments and components, by providing co-investigators in scientific or engineering teams and by manufacturing or production efforts. To that end, the various "announcement-of-opportunity" invitations to participate in research or pilot projects that are regularly issued by space agencies should be widely disseminated.

256. In addition to its emphasis on space applications, the United Nations could develop programmes of information and training, based on the results of and activities in space science and planetary exploration, for the benefit of developing countries. Workshops and symposia to assist scientists in responding to opportunities to participate in a space mission, as well as to benefit educators and others interested in the broader issues related to space science and planetary exploration, could be convened within the framework and resources of the United Nations Programme on Space Applications.

257. A staff member of the Office for Outer Space Affairs could perform the functions of a clearing house to facilitate the participation of scientists and engineers from developing

countries in major space-related international projects and programmes. Workshops and symposia for scientists and educators from developing countries should continue to be organized to facilitate their participation in space science missions and benefits. Such workshops should examine and build upon the results of previous events and continue to draw on the international professional community as represented, for instance, by IAU and COSPAR.

258. Greater coordination of observations to inventory and characterize near-Earth objects, with the involvement of non-governmental organizations, individual researchers and amateur astronomy groups, including those in developing countries, should be undertaken. The space agencies that already have activities to observe near-Earth objects and IAU should play a leading role in establishing a coordination mechanism for such observations, as well as for public notification should an object posing a significant hazard to Earth be discovered.

259. It is recommended:

(a) That the United Nations take the initiative of inviting all Member States to support research into near-Earth objects (asteroids and comets) through the establishment of national or regional "spaceguard" centres to promote education and information on near-Earth objects;

(b) That every effort be made to provide financial support for near-Earth object research, both theoretical and observational (from ground and space), and especially for the encouragement of exchanges and training of young astronomers from developing countries;

(c) That the United Nations support and promote greater involvement of scientists and observatories with the capability to observe the southern hemisphere skies.[39]

260. The Office for Outer Space Affairs, within the framework of the United Nations Programme on Space Applications, could organize international meetings of leading researchers in the fields of astronomy, planetary science, astrophysics, palaeontology, astronautics and space law on near-Earth objects on a regular basis, for example, every two or three years.

261. It is recommended that efforts be undertaken to improve education on space subjects by using space tools, namely, satellite-based observation (e.g. satellite images) and communication systems. In fact, it is becoming increasingly cheaper and easier to obtain access to space-related databases, freely accessible World Wide Web sources on Earth observation and courses for teachers on remote sensing through a satellite network than by other means of transmission. This is true both for developed countries, which often face high telecommunications charges, and for vast, sparsely populated areas or developing countries.[40]

262. Since knowledge of the benefits brought by space activities depends on well-trained teachers, it is recommended that initial and in-service teacher training in the field be made part of long-term strategies for human resource development. Space programmes are multidisciplinary by nature (environmental subjects, biology, geography, physics, astronomy, telecommunications, information technologies etc.), global in their scope and local in their applications. They provide an ideal basis for those multidisciplinary projects which stimulate teachers, help to build bridges across disciplines and borders, provide on-the-spot in-service training and broaden students' horizons.[40]

263. It is recommended that the United Nations and UNESCO urge the relevant decision-making bodies in ministries of education to formulate national policies for education and basic space science as the best way to meet the needs and demands of present and future generations.[40]

5. Enhancing education and training opportunities for youth

(i) Status: the importance of space education and training for youth

264. Continuous development of human resources is crucial to ensuring the scientific and technological as well as economic, social and cultural development in any country. Human activities in some fields are characterized by rapid developments in science and technology, expanding beyond national boundaries with significant social, economic and cultural impacts on the global society. For those activities, strategies for developing human resources should be based on broad and long-term perspectives for future directions of human activities. Developing such strategies would require international cooperation in enhancing educational opportunities for future generations in order to enable them to meet the diversifying needs of future societies.

265. As stated in Article 55 of the Charter of the United Nations, the promotion of international educational cooperation is one of the important objectives of the United Nations. Through the programme on the peaceful uses of outer space, the United Nations continues to provide educational and training opportunities to learn about space science and technology and their applications, in particular by carrying out activities of the United Nations Programme on Space Applications. Some of those activities could also

benefit young people, who will be future policy and decision makers.

266. Some space agencies organize activities for young people in their countries, motivating them to study more about space science and technology and to think about working and living in space. There are also non-governmental organizations of young people interested in space activities, such as the Young Astronauts Club, which not only organizes space-related activities for young people but also helps them make contact with their counterparts in other countries. Such educational activities not only help encourage future scientists and engineers to pursue their career in space-related fields but also contribute to increasing the overall scientific scholastic aptitude level. Some activities organized by space agencies and non-governmental organizations in some countries can be considered as models for educational and training activities for young people in other countries.

267. Many initiatives taken in space activities require much time to achieve their objectives, from the development of the mission concept to the accomplishment of the missions defined. Planning of space activities should therefore be accompanied by appropriate long-term strategies for human resource development. In view of the increasing international cooperation in space activities and the growing importance of socio-economic benefits of space applications, educational activities for future decision makers and managers should emphasize the importance of cross-cultural experience and interdisciplinary training.

268. In that regard, the activities of the International Space University have proved to be successful. At its annual summer session, about 100 young people of about 25-35 years of age from many parts of the world receive 10 weeks of interdisciplinary training, studying the basics of various aspects of space activities, ranging from space manufacturing to space law and learning to work together in a cross-cultural environment. The University now offers a one-year master's programme and organizes short-term courses for young professionals. Its educational activities are also expanding to include more participants from developing countries. One of the main objectives of the University is to train future leaders in the space community. It has been particularly successful in that regard, with its growing network of alumni active in various space agencies and space-related research institutes, international organizations and industries.

269. During the last 10 years, the European Centre for Space Law, in collaboration with several universities in ESA member States, has been organizing summer courses on legal problems related to space activities. Every year, about 40 law students attend the courses. Thus, the courses contribute to the development of legal training in the field of space activities.

(ii) Issues and objectives

270. The participation of young people in the educational and training activities of the United Nations Programme on Space Applications is still limited. While the United Nations should continue to provide educational and training opportunities for policy makers, scientists and engineers who would have direct and immediate impacts on the socio-economic development in developing countries, the United Nations, in collaboration with other relevant organizations within the United Nations system, could provide educational and training opportunities for students and young scientists and engineers who will become future space leaders around the world. The education and training should include space science and technology and its applications. This would contribute to developing the human resources necessary to ensure the continued utilization of space applications for economic and social development.

271. As the younger generation will be affected by the plans currently being developed for space activities, efforts should also be made, whenever possible, to provide young people with opportunities to express their ideas and visions for such activities. The international space community could also benefit from their unique and innovative ideas, which are not bound by the established policies and official positions of Member States or international organizations. At the same time, if encouraged to participate in an international forum where a blueprint for international cooperation for space activities is prepared at the intergovernmental level for the coming century, young people could be motivated to turn the blueprint into reality.

272. In the light of the above, the Preparatory Committee at its 1998 session agreed that the Space Generation Forum should be organized as one of the components of the Technical Forum of UNISPACE III. A round table aimed at increasing the awareness at the political level of the usefulness of integrating space techniques and applications into European curricula would be planned by the European Association for the International Space Year (EURISY). For graduate students and young professionals, the International Space University's alumni associations would organize meetings to be held parallel with UNISPACE III, with the aim of presenting to the decision makers in the current space programmes the visions and perspectives of young space professionals around the world concerning future space endeavours.

273. It is also desirable for some inter-European ventures on Earth observation for primary and secondary school purposes to be made known, through the United Nations, to other countries beyond Europe, thereby developing satellite image material and enriching the World Wide Web databases on Earth observation that are currently being created, as recommended at the EURISY meeting on the integration of Earth observation into secondary education, held in Frascati, Italy, from 25 to 27 May 1998. This will also foster among students an interest in individual research, the ability to visualize abstract concepts and the development of skills in using information technology-based tools.[40]

274. On the basis of the EURISY and other cross-border initiatives, the creation of an international partnership for cooperation in space education along the lines of IGOS is suggested to address this matter worldwide.[40]

(iii) Visions and perspectives of youth

275. The 160 participants of the Space Generation Forum were from 60 nations. Their expertise covered all fields of space, including science, technology, law, ethics, art, literature, anthropology and architecture, and many other fields relevant to space. All participants spoke only as concerned individuals, guided by their conscience and a belief in the power of space to change the human condition in positive ways. Participants expressed the hope and the conviction that the common future of persons living on Earth ought to proceed ethically, with an understanding of the long-term consequences of their action, and with all people walking forward together as one. All the recommendations of the Space Generation Forum presented to the Conference (A/CONF.184/C.1/L.11 and Corr.1) are contained in annex II to the report of UNISPACE III. The Space Generation Forum proposed that the recommendations be the subject of continuing consideration.[41]

6. Information needs and the global approach

(i) Status: information systems for research and applications

276. Information systems are fundamental tools for organizing, handling and integrating data through appropriate algorithms and for generating output in the form most suited to the intended user group. Information technology includes a cluster of advanced technologies in the fields of computing, software, microelectronics, telecommunications, databases and networking. Thus information technology in this wide sense includes not only information-relevant processing technologies but also telecommunications and electronic information transfer technologies. The emergence of space technology as a potent tool for information gathering and for rapid and reliable communications over long distances and to remote areas has been a major contribution to the information technology sector. At a time when resources are scarce, space and funding agencies are trying to avoid duplication and gaps and to obtain the maximum return for their investment. Governments and international organizations have naturally been concerned that programmes that originated quite logically at many times and places in response to different needs should not remain fragmented and uncoordinated where synergies are possible. It is particularly apparent that both a strategic framework and a planning process are needed to bring together remotely sensed and *in situ* observations, from both research and operational programmes. For those reasons, the IGOS initiatives are a timely development.

277. The changing scenario of the information technology industry and the proliferation of computers has changed the scope of information processing, whether in terms of applications or for technology support. Computers are currently not only able to process text and numbers, but also digital maps and images, both by themselves and along with tabular data, and to merge them together to provide a new perception: the spatial visualization of information.

278. Information infrastructure has become an essential element of the development of every country. In the global sense, the concept of GII is being conceived on the basis of the vision of open connectivity and information access. The thrust of GII is open access, universal service, a flexible regulatory environment, competition and private investment. The fundamental principle underlining a national information infrastructure is the "right to know" and the "right to information" tenet. The right of access to public domain data, consumer data, citizens' rights, universal access and financial data underpin the need for developing a national information infrastructure.

279. Information systems are the core of global and national information infrastructure. While it is not essential to organize multiple information systems for the global and local levels, what is needed is an abstraction and exchange mechanism for the aggregation of information from lower to higher levels. Many countries have national infrastructure for information where the access to information is recognized as a basic right. However, many developing countries need to develop and strengthen their information infrastructure to make better use of information as a basic resource for development.

280. For effective planning and development, a variety of data on physical and natural resources, human resources, social practices and economic aspects are required. Databases

organized around GIS cores are essential elements of the information systems and the emphasis in the future will be on organizing spatial databases using GIS. Space images will be the most important form of input for the GIS databases, as they record the continuum of changes in the environment. The modelling and integration capabilities of GIS allow quick and reliable analyses of "what-if" scenarios of real and possible situations and generate visualizations of queries that users specify.

281. An important asset of GIS is their data handling capacity. Firstly, they allow the input of data of different origin, content and format. Secondly, they offer to the operator wide flexibility in manipulating the data and displaying it in a user-appropriate form. Finally, they permit the integration of data in a value-added product, the information content of which is higher than the individual items of data and is customized to meet user needs. The power of those tools depends not only on their technical characteristics, but also on the quality of input data and in particular on the capability of keeping the database up to date by including new data. Earth observation from space provides a coherent, objective and regular source of input data for information systems.

282. Information systems are therefore of value for monitoring purposes, for event observation and for planning and prevention activities. They are valuable tools for both research work and application activities, and eventually in decision-making.

283. Information systems are also needed for education and training as they facilitate the transfer of know-how from developed to developing countries and institutions—a prerequisite for sustainable development. All levels of training need to be considered and ensured for technical specialists, data interpreters, students and professors, decision makers and project managers. Furthermore, on-the-job training and course follow-up activities are necessary.

284. Prime databases have now become accessible through the World Wide Web, creating a demand for compatibility of Web databases and for universal access. In turn the new technology has brought with it calls for standardization and low-cost tools.

285. As various new information systems have been developed, the protection of intellectual property rights has become one of the most debated issues, as reflected in the discussion of international action to ensure worldwide protection of intellectual property in databases. Various legislative initiatives have been proposed regarding intellectual property rights.

(ii) Issues and concerns

286. An important step in solving problems of global and regional significance is to identify the issues relevant to major global problems and concerns such as ozone depletion, coastal changes, climate change, extreme weather phenomena, reduction in biodiversity, desertification, deforestation and land-oean-atmosphere interactions, in particular extreme climate phenomena such as El Niño and La Niña, in which space technology could contribute to the understanding and solution of problems.

287. At the local or national level, the emphasis would be on using high-resolution satellite images to provide solutions for the issues of direct relevance to the local people—crops, water, land use, urban growth, routing of facilities, pollution and so on. A common factor in all those problems is the need to have integrated information systems existing in a distributed manner but linked through powerful networks able to serve as the "backbone" for national developmental and global research activities. All countries should strive to reach that objective.

288. For most of the research and developmental application needs related to environmental issues, the sources of information are the same, namely, field observations, ground measurements, remote sensing data taken by airborne and space-borne sensors, ancillary inputs from archives and databases and additional information based on experience and from statistics. However, although many data products are being created by government, university and other research groups, the products are often difficult to find, fragmented and poorly documented, or they are unavailable in a suitable medium or an easily readable format.

289. For the universal access to information, standardized and regularly serviced metadata for data access, search and exchange are important. Further development and training on the use of information locator engines for easy search and access, such as the information locator system of the Committee on Earth Observation Satellites (CEOS) (see paragraph 144 above), are also essential.

290. As policy makers turn their attention to designing a sustainable development approach to management of the problems of Earth and its resources, data and information are urgently needed in a readily accessible and easily understandable form. The usefulness of spatial information (information in map form) for decision-making and its inputs for spatial area-based planning and development should be generally recognized.

291. When discussing the compilation of data and their inclusion in information systems for the benefit of human

development, the two key issues to be considered are that user requirements must first be defined and that there should be continuity with respect to both data and services.

292. The United Nations, Member States and space agencies are invited to provide active support to the following initiatives:

(a) To recognize the importance of geospatial data and other information in resolving the important environmental, economic and social issues faced by humanity;

(b) To recognize the importance of and interaction between geospatial data and space technologies such as communications, Earth observation and geo-positioning;

(c) To facilitate the development of fundamental and useful geospatial data in a form that could be used in many applications;

(d) To encourage the sharing of geospatial data; metadata, in particular, should be made as widely available as possible;

(e) To encourage industry in an appropriate way to collaborate in the development and implementation of spatial data infrastructure;

(f) To communicate, collaborate and participate in the many networks existing at the national, subregional, regional and global levels;

(g) To recognize the importance of training, transfer of technology and capacity-building in support of the management of the application of those technologies.[42]

293. Another issue concerns the protection of intellectual property rights. With the increasing sophistication of data-processing techniques used in observation systems, more organizations, including commercial organizations, will be supplying the observation systems, data-reduction capability and value-added products. The intellectual property issues relating to environmental information are complex and changing, requiring careful policy attention. Consideration should be given to the possibility of developing a set of appropriate measures to protect intellectual property rights without limiting opportunities to make the resulting data and information available not only for the primary uses, but also for all other beneficial purposes such as research, bearing in mind that the issue of intellectual property rights comes under the jurisdiction of the World Intellectual Property Organization (WIPO).

(iii) Specific action programmes

294. In order to establish an all-encompassing information infrastructure consisting of the components indicated below, countries should take necessary actions at the national level, bearing in mind the need to coordinate those actions at the international level:

(a) *Databases.* The key elements of the infrastructure are the databases and developing databases for different purposes and users (private, public, scientific and government) and constructing them is the major task to be accomplished in a systematic development of infrastructure. Databases should contain information on the progress of space science and technology and its applications, on space-related education and training facilities and on experts and organizations working in those fields. In most countries, the emphasis will be on converting the massive amounts of analog data to computerized databases;

(b) *Network.* The basic element in the operation of an information system is the backbone on which information travels from one point to another. With rapid advances in technology, network configurations are evolving to provide high-bandwidth connectivity using fibre optics and various technologies to reach data transmission rate capacities of up to 100 megabits per second and more, communication networking of up to 2 megabytes per second with very small aperture terminals and high-speed satellite broadcast delivery. The network backbone will therefore have to be a mix of satellite and terrestrial communications. The advantage of satellite communication is its regional reach and its ability to serve miniature hubless very small aperture terminals and direct-to-home delivery of information services. Developing countries are encouraged to take advantage of the emerging technologies in the development of national information and communication infrastructure;

(c) *Standards.* Standards for databases (formats, exchange of data and interoperability) and networks (gateways and protocols, communication equipment and software) are an important element of information systems. Standards enable applications and technology to work together. The significant work in the area of standards, formats and databases by CEOS should be encouraged and adopted by other agencies where possible and relevant. Users must be closely involved when standards are developed, since the final product should be user-friendly, available at reasonable cost and have a long usage life. The adoption and use of standards also require resources. The adoption of standards can be slow, in part because those who reap the benefits of standards are often not those who have borne the cost of creating and implementing them. Governments can encourage the adoption of standards by requiring their use;

(d) *User interface*. With regard to the design of information systems, much depends upon the type of user who is intended to have access to the system and the upper-end level of applications or services available on it. For some applications, penetration will have to reach the household level and capabilities will include on-line access to video applications, such as for education programmes using the Internet;

(e) *Cooperative information network linking scientists, educators, professionals and decision makers in Africa (COPINE)*. The effort of the Office for Outer Space Affairs in setting up a satellite-based network for the COPINE information initiative for many African countries is recognized. COPINE has emerged as a potential development tool and it is necessary to translate the initiative into a practical programme. Participating countries are encouraged to embark on the implementation of COPINE. In addition, the role envisaged for COPINE in sustainable development warrants that it be financed, in particular for countries in need, through funding mechanisms of the United Nations and other international agencies. A COPINE-like initiative should be extended to other developing countries.

295. The availability of clear and updated information on technical issues and application results is essential if the full benefit is to be derived from the use of space science and technology. Participation in thematic workshops and conferences and access to the international e-mail network and the Internet should also be supported.

7. Spin-offs and commercial benefits from space activities: promoting technology development and exchange

(i) Status: commercial and spin-off activities

296. Space activities incorporate some of the most important areas of high technology: computer software and hardware development, sophisticated electronics, telecommunications, satellite manufacturing, life sciences, advanced materials and launch technology. Space activities also involve some of the most significant issues of international trade and policy: global markets, gaining access to remote areas, government-subsidized competition and international standardization and regulation.

297. Products and services derived directly from space technology as well as indirectly from the large number of its spin-offs contribute in many ways to improving the quality of life of society. Some benefits are provided directly by the technology, as in the case of telemedicine, tele-education and emergency communications. Other benefits are found in thousands of spin-off products that have resulted from the application of space-derived technology and are used in such fields as human resource development, environmental monitoring and natural resource management, public health, medicine and public safety, telecommunications, computer and information technology, industrial productivity, manufacturing technology and transportation.

298. The commercialization of some space activities has been a highly positive development. Through numerous joint ventures, commercial systems and services are creating, for example, expanding constellations of communications satellites. Those constellations of satellites have relied successfully on the international private sector to provide financial investment and to manufacture, operate and market satellites and services. Remote sensing and other areas have also depended on, and received, private sector investment in some cases.

299. Satellite telecommunications constitute the most mature segment of the space market. According to some studies, for the period 1996-2006, approximately 262-313 communications satellites with a market value of between $24 billion and $29 billion will be placed in geostationary orbit. To estimate the full potential market, the corresponding figures for non-geostationary orbit satellite constellations for mobile telephony and multimedia applications would have to be added.

300. The development of a launch vehicle capability is an activity that had originally been initiated by Governments before it was transferred in large part to enterprises for manufacture and commercialization, which have created a lucrative commercial market. The satellite launch market, estimated at $45 billion over the period 1998-2007, is increasingly being driven by commercial satellite operators in all orbits. The market is still dominated by launch services into the geostationary orbit, which require heavy launchers. New applications, such as digital television, multimedia, rural telephony, digital audio broadcasting, mobile services and high-bit-rate data delivery services will be provided by larger satellites and will continue to drive market growth.

301. While space agencies and research institutions, both academic and governmental, are expected to double the demand for small expendable launchers, driven primarily by the boom in small to nano-satellites, the demand for launchers from the commercial sector will be even larger and will be driven by larger constellations using heavier satellites to increase productivity. This is expected to continue to be the

trend for satellites placed in low, medium and geostationary Earth orbits. Another trend in launch requirements to all orbits is less costly launch prices with expendable launchers, as well as reusable launchers, and other future launch technology expected to contribute to that outcome.

302. Next to telecommunications, remote sensing and geographic information systems (GIS), as well as satellite multimedia, may be among the most significant commercial applications. With the launch of 20 new remote sensing satellites expected by the year 2002, data-collection capabilities will increase considerably. The new systems will provide users with higher spectral and spatial resolutions. That will be combined with an increase in cost-effective computing power and data compression capability. At the same time, applications will be more adapted to specific user needs and more user-friendly.

303. GIS will become an essential tool for analysing data as well as presenting information for market and geopolitical analysis and for diverse applications such as environmental studies and disaster management planning. It is projected that the GIS market could reach approximately $5 billion in sales by the year 2000.

304. Commercial activities for the provision of information services will emerge as a key sector for private investment, with the anticipated demand for information growing between threefold and fourfold. Development of value added to satellite images, their input into GIS databases, modelling and integration for scenario analysis and recommendation of specific actions will be major factors in determining the involvement of the private sector. Commercial remote sensing satellites are planned to offer high-quality data and services to specific user segments. The commercial viability of the data services and their cost are still to be determined.

305. In 1997, the various segments of the yearly worldwide civil Earth observation market have been estimated as follows: between $580 million and $620 million for the satellites, including both meteorological and remote sensing spacecraft; between $230 million and $250 million for satellite launches; $60 million for sales of raw data; between $280 million and $300 million for terrestrial equipment for receiving, storing and processing satellite data; and between $830 million and $850 million for data distribution, processing and interpretation services and value-added products and services. Most users of data and services are currently in the government and public sectors, followed by private companies and universities. Within the next 10 years, depending on the development of some promising market segments (such as real estate, utilities, legal services, insurance, precision farming and telecommunications), the market is expected to grow by a factor of 3-5.

306. The market for GPS equipment alone went from about $0.5 billion in 1993 to $2 billion in 1996 and is expected to reach between $6 billion and $8 billion in 2000. Civil ground applications, already at almost 90 per cent of the total market, will keep increasing (automotive navigation systems, geodesy, GIS, precision engineering and emerging fields such as precision agriculture[43]). The success is due to the dramatic increase in the accuracy of GPS and to the steep drop in prices of equipment. GPS is thus becoming an enabling technology fuelling the market by offering accurate, real-time positioning data to be integrated with other types of information.

307. The use of GPS has become a true spin-off and its future growth will rely more and more on the consumer market. In fact, GPS services are expected to complete the transition from a stand-alone device to a standard feature integrated into a variety of multifunctional products such as wireless personal communication devices, leading to a drastic reduction in prices.

308. Not all developments of space technology find their applications on Earth. Still being developed, space manufacturing involves the use of the near-zero gravity and vacuum environment of space for the production, processing and manufacture of materials for commercial purposes. That is a very broad definition, which includes such industrial and research activities as the zero-gravity production of medical supplies, metal alloys, plastics or glass; the processing and analysis of organic matter; and the study of the physiology and behaviour of humans, animals and plants in the unique environment of space.

309. Clearly, prospects for the practical utilization of outer space and space technology will depend to a great extent on the advancement of life sciences, including the entire range of disciplines such as space medicine, physiology, psychology and biology. For example, the system of medical support developed by Russian specialists to provide for manned space flights has made it possible to increase to one and a half years the length of time that crews can remain in space with no damage to health and with their fitness for work remaining at a satisfactory level. Research conducted over many years on a variety of issues by one of the State research centres of the Russian Federation, the Institute for Biomedical Problems, *inter alia*, within the framework of broad-based international cooperation, on board the Salyut and Mir orbital stations, during flights of specialized non-manned biosatellites under the Bion programme and in ground-based simulation experiments has made it possible to enhance substantially knowledge of a range of fundamental problems relating to

medicine, physiology and biology, such as mechanisms by which the human body adapts to various environmental factors, the general mechanisms at work in the regulation of physiological functions, the problem of radiobiology and the principles underlying the concept of "physiological norms" and "transitional state" (pre-latent stage of pathology), as well as to develop on that basis effective ways and means of optimizing of the physiological and psychological condition of the human organism. Data of this kind are of exceptional interest for practical health-care purposes.

310. New materials will become possible simply because the absence of gravity allows for the creation of perfectly even and consistent mixtures of materials with vastly different masses and densities. Such alloys would have physical properties that could not be duplicated on Earth and could lead to the production of much faster computers, smaller and much more powerful batteries that could power future electric cars, and many other new products.

311. Space might also provide an optimum location for orbiting platforms to be used to transmit energy via optical mirrors and microwave technology. Solar energy or energy from remote sources on Earth could then be directed to the locations where it is needed.

312. Space technology now represents an immensely valuable bank of know-how that is used by thousands of companies worldwide to bring new products, processes and services to the world market at more competitive prices. Such indirect effects of space technology applications, which in the past were considered by-products of research and development, are seen increasingly as primary effects and as a meaningful element of industrial policy. Non-space industrial sectors are more demanding of new technology, new processes and new materials to remain competitive in their fields. The origin of much of the new spin-off technology can be found in the space industry.

313. Technology transfer and spin-off programmes (that is, programmes that have enabled products and processes to emerge as secondary applications of space technology) developed by national and international space agencies now demonstrate a market-oriented approach based on demand and well-identified market segments. Thus, space technology no longer appears to be a luxurious product and process, but rather a reservoir of potential solutions for industry.

314. The simultaneous acquisition, adaptation and assimilation of high-technology knowledge, while perhaps desirable, are not always feasible. Many countries have to overcome constraints in their efforts by adopting strategies that differ according to their political and socio-economic environment and stage of economic development. Scenarios for technology development and exchange vary from questions of "What kind?" and "Where?" to "How much?" Accordingly, many countries are developing strategies not only for applying foreign technologies, but also for initiating the necessary process of securing technological training and self-reliance. Developing countries in particular face constraints in their efforts to move ahead in the high-technology area of space, mainly because of the limited financial resources available, lack of access to basic facilities, lack of knowledge about the technology and limited educational training facilities.

315. The transfer of technology encompasses all activities that culminate in the acquisition of new knowledge as well as its adaptation and further development by the recipient. As far as space and space-related technologies are concerned, some of the areas of greatest importance for developing countries involve technologies that are already considered operational technologies in developed countries, the use and development of information technologies being two such areas. The technologies are related to computers, fibre optics, satellites and telecommunications and facilitate, through the use of electronic networks, the rapid transfer, processing and storage of all forms of information and data. Today, those technologies foster globalization by increasingly underpinning all production and service industries. Notable among the priority development and application areas for developing countries are the provision of health, education and environmental services and support for agriculture.

316. Another priority area is the development of small- and mini-satellite technology, which has the potential to offer to many countries great possibilities for affordable access to space through the rapid development of fully integrated national space programmes. Until recently, space missions required very complex satellites, developed at high cost, that could only be undertaken by large space agencies. However, the miniaturization of components and the use of nano-technologies in space missions, such as those used in small satellites, offer quick and affordable access to space to countries with small space budgets. Such national mini-satellite space programmes can lead to the creation of new industries and actually improve opportunities for transfer of knowledge both locally and internationally. In addition, small- and mini-satellite programmes develop advanced technologies, which, when transferred to industry, result in tangible benefits to States and to the international community. Furthermore, small- and mini-satellite programmes offer good opportunities for international cooperation.

(ii) Issues and concerns

317. The Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries, adopted by the General Assembly in its resolution 51/122 of 13 December 1996, provides a sound basis for the promotion of technology development and exchange.

318. While space provides a whole new realm of opportunity and a vast potential market for industry and business, it is still perceived by many as a final frontier rather than as an economic market ripe for expansion. However, a fundamental requirement for the above and many other innovative spin-offs to become reality is the reduction and minimization of development costs, thus making economy and efficiency a primary concern. For instance, in order to stimulate the commercialization of the potential market for manufacturing in space, the cost of developing the basic space infrastructure must be reduced dramatically. Governments would also have to play a role in promotion, giving incentives and aiding the development of a private sector presence in space.

319. The successful transfer of space-related technologies and spin-offs from research and development institutions to industry requires the availability of appropriate methods and infrastructures, as well as clearly defined government policy and support on the matter. The requirements include the following: establishment of organizational structures, dedicated to technology transfer and commercialization, in national space agencies or other government bodies in charge of technological development; stimulation of marketing mechanisms focusing on widespread promotion of technologies and spin-offs; development of financial and tax incentives encouraging innovators, entrepreneurs and investors; and creation of relevant education and training networks.

320. A major concern is insufficient global access to the technology related to acquiring environmental data and information. Enhanced access would, *inter alia*, contribute to the national implementation of international agreements and protocols, facilitate the formulation of national environmental strategies having a global dimension and generally improve policy planning and environmental management.

321. Technology transfer from "space-faring" countries to developing countries could be promoted by providing more opportunities for scientists and engineers from developing countries to receive training in utilizing existing technologies. Such opportunities would help the scientists and engineers from developing countries to understand and contribute to the direction of civil space technology development, which would facilitate the decision-making process in their countries, in particular with regard to prioritizing the space-related research and development activities to be pursued.

322. Favourable international and national environments need to be created to allow the transfer of technology to become a constant process. Such an environment includes trained human resources in sufficient numbers, appropriate infrastructure and institutional arrangements, a suitable policy framework, long-term financial support and opportunities for the involvement of the private sector in technology transfer initiatives. That would enable space technology applications in developing countries to become truly operational and fully integrated into development activities.

323. Providing such opportunities to developing countries may also expand market opportunities for the space-related industry of "space-faring" countries. A noteworthy example is that of some developing countries that have made agreements with commercial entities for the transfer of small-satellite technology.

324. Although several cooperative, mainly bilateral, programmes exist between developing countries for the transfer of space technology, current mechanisms for fostering South-South cooperation in technology development and transfer are insufficient. Mechanisms through which donor organizations may finance technology transfer projects at the regional level, such as regional information networks, are not sufficient because of policy constraints that heavily favour bilateral agreements.

325. Problems experienced by developing countries in the area of space technology exchange and spin-offs may be summarized as follows: (a) limited access to information; (b) low number of specialized training centres; (c) less efficient national technology transfer infrastructure; (d) lack of qualified suppliers; (e) insufficient funding and investment opportunities; (f) incompatibility of national legislation on transfer of technology between recipients and donors; and (g) insufficient effective international cooperation and collaboration. These problems could be solved in part or minimized through effective international cooperation mechanisms.

(iii) Specific action programmes

326. The effectiveness of current mechanisms needs to be enhanced in order to improve collaboration between countries on development issues as well as on global environmental problems. An effective, pragmatic and affordable approach to technology exchange, consistent with the Declaration on

International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interests of All States, Taking into Particular Account the Needs of Developing Countries, should be developed. The technology to be transferred should be appropriate for local conditions and arrangements should include provisions for periodic updating. The transfer must combine both know-how and an understanding of the fundamental principles upon which the technology is based. The transfer should also include the provision of technical, material and personnel training. Where appropriate, agreements should take into account the need to protect intellectual property rights.

327. In preparing a space plan, each State may consider small satellites one of the most valuable tools to initiate and develop indigenous space capability. As small-satellite programmes also offer an ideal possibility for training, States are encouraged to include training programmes based on small satellites in their space plans and in plans for international cooperative programmes.

328. Given the current geographical distribution of space activities, the benefits derived from space through the commercial use of space technology applications, technology transfer and spin-offs are more concentrated in developed countries and in a few of the technologically more advanced developing countries. However, space systems are neutral from a geographical point of view and can be used more by less developed countries and regions, thereby making a greater impact on their social, economic and human development.

329. Taking into account the importance of adequate access to space technologies and applications relevant to sustainable development programmes in developing countries, as well as mutual commercial benefits available to both providers of technology and its recipients and users, international cooperation in the area of space technology transfer and spin-offs should attract the particular attention of Member States. In that connection, the proper legal frameworks and international agreements being developed by United Nations bodies and agencies, covering such issues as intellectual property rights, trade marks, copyright and foreign licensing, are essential to fostering international cooperation in the area of space technology and spin-offs. Such cooperation will benefit from public and private partnerships, in appropriate circumstances, with suitable arrangements being made for risk-sharing and for developing operational systems that build on successful research and development activities.

330. Apart from developing human resources at the basic level of science and technology and fostering South-South cooperation, the regional centres for space science and technology education and relevant existing national institutions should organize specific training programmes to contribute to the building of regional and local expertise and ultimately to the success of know-how and technology transfer.

331. In order to attract the investments that are vital for the success of the development of space-related activities and technology transfer projects, it is essential that each country create conditions conducive for such investments where they do not exist. The political will and commitment of national leaders as regards the introduction of new technology and the development of appropriate infrastructure should be apparent. Incentives to encourage both foreign and local investors should be given in order to stimulate the adaptation of technologies acquired from abroad to meet local needs.

332. Maps and geospatial data derived from a combination of Earth observation information and other data are fundamental to a nation's development efforts just as the transportation network, the health-care system, telecommunications and education are. Hence, the creation of a national geospatial infrastructure should be accorded the same level of support as the other elements of national infrastructure.

333. The need for geospatial infrastructure implies that Governments should become more knowledgeable customers and users. Governments should promote indigenous industry to support national requirements, to improve the ability to extract knowledge from data and add local understanding and to identify and develop new markets. Furthermore, the creation of an indigenous industry could reduce countries' dependence on imported technology and services.

334. The Office for Outer Space Affairs should expand the technology outreach programme on space for university educators (TOPS) aimed at the promotion of the successful transfer of space-related technologies by enhancing the ability of university educators in developing countries, in particular the least developed countries, to incorporate relevant aspects of space technology into the curricula of their institutions. Through its multiplier effect on students, TOPS would lead to a broader local awareness of the benefits of space technology in addressing local concerns in the medium to long term, thus contributing to the creation of an environment that is more conducive to the acquisition, adaptation and further development associated with the transfer of space technology.

335. The effectiveness of many specialized training courses in space technology is often compromised by the reality that after receiving training, university educators in many least developed countries lack access to "seed" financial support

for undertaking practical demonstration exercises to highlight the operational utility of space technology in solving local problems. The aim of TOPS would be to provide such university educators with access to limited financial and technical support (not exceeding $10,000 per grant) for the local implementation of practical activities relating to space technology that would serve to enhance the learning experience of their students.

336. TOPS would be aimed initially at the network of university educators from developing countries in all regions who have participated in specialized space technology training courses (such as the United Nations international training course on remote sensing education for educators) or from the regional centres for space science and technology education. TOPS would also maintain a site on the World Wide Web through which educators could establish contact with each other to share experiences, with technical advisors on space technology issues and with institutions that are willing to assist or otherwise participate in the space technology demonstration activities being carried out by members of the network. Access to support under TOPS would be through applications from university educators to be selected according to merit on a competitive regional basis. The estimated annual cost of TOPS to Member States, through the United Nations, would be approximately $200,000 (corresponding to 20 awards of $10,000 each).

337. The Office for Outer Space Affairs should include among the priority activities of the United Nations Programme on Space Applications an activity aimed at assisting developing countries in obtaining funding for project proposals arising from its training courses and workshops. The projects to be selected would be those which could lead to sustainable use and development of space technology at the local level. Such an activity would entail, among other things, initial assessments of proposals and guidance on their preparation, the provision of information on potential funding sources and the requisite procedures for submission of applications and, where appropriate, direct submission by the Office for Outer Space Affairs of one or more proposals to specific funding or donor institutions. The Office for Outer Space Affairs will use its existing resources to assist interested Member States in preparing such proposals and to seek the necessary funding resources.

8. Promotion of international cooperation

(a) Use of space technology in the United Nations system

338. Various organizations within the United Nations system contribute to promoting international cooperation in the use of space technology and its applications. Valuable space-related and space-aided activities are being carried out in fields relating to remote sensing and GIS, communications and navigation, meteorology and hydrology, space science and natural disaster reduction. Those activities range from education and training to operational applications of technologies. The report of the Secretary-General entitled "Coordination of outer space activities within the United Nations system: programme of work for 1998 and 1999 and future years"[44] provides details of the space-related activities planned by the organizations within the system for the coming years. Paragraphs 339-360 below provide a summary and an analysis of the information provided in that report.

339. Space-related activities within the United Nations system are carried out with the use of such space technologies as remote sensing satellites and communication satellites. Major objectives pursued by several organizations in those space-related activities include: (a) advancement of Earth sciences; (b) protection of the environment; (c) natural resource management; (d) disaster management; (e) improvement of satellite-based communications; and (f) improvement of navigation and positioning capabilities. Other important objectives relate to food security early warning, weather forecasting, urban planning, human settlement and monitoring of illicit crops. In order to meet those objectives, organizations conduct the following activities: (a) convening of intergovernmental meetings; (b) organization of training and educational programmes; (c) provision of technical advisory services and implementation of pilot projects; and (d) dissemination of information.

340. Activities of the organizations have various specific purposes, and the organizations take different approaches within their individual mandates. However, all the space-related activities carried out within the United Nations system are aimed at achieving the overarching goal of promoting sustainable development, in particular in developing parts of the world.

(i) Advancement of Earth sciences

341. Many organizations consider it essential to ensure the availability of scientific data on various aspects of the Earth in order to enhance the planning and execution of socio-economic development activities. This is one of the areas in which efforts are being strengthened in order to coordinate activities within the system. The Office for Outer Space Affairs, the Economic and Social Commission for Asia and the Pacific (ESCAP), UNEP, FAO, UNESCO and WMO participate in the work of CEOS, as associate members, and contribute to the development of IGOS. Inter-agency cooperation and coordination are also considered crucial in the planning and operation of three global observation systems, namely GCOS, GOOS and GTOS.[45] In order to conduct joint consideration of space components for the three global observation systems, UNEP, FAO, UNESCO and WMO contribute to the work of the Global Observing Systems Space Panel.

342. WMO acts as a focal point for international efforts to improve the acquisition of data for climate and atmospheric research and for meteorology and hydrology. Its activities include the implementation and coordination of World Weather Watch, Global Atmosphere Watch, the World Climate Data Information Referral Service (INFOCLIMA), the World Hydrological Cycle Observing System and the World Climate Programme.[46] ESCAP, FAO and UNESCO also assist developing countries in building capacity in the field of meteorology and hydrology. Some activities are carried out in other disciplines of Earth sciences, such as the Geological Applications of Remote Sensing (GARS) programme of UNESCO.

(ii) Protection of the environment

343. Many bodies, including, *inter alia*, ESCAP, the Economic Commission for Latin America and the Caribbean (ECLAC), the Economic Commission for Africa (ECA), the Economic and Social Commission for Western Asia (ESCWA), the Commission on Sustainable Development, UNEP, the United Nations Institute for Training and Research (UNITAR), FAO, UNESCO and WMO, contribute to the monitoring and protection of the environment.

344. UNEP has wide-ranging and comprehensive activities aimed at the development and enhancement of environment information systems, capacity-building in environmental assessment and reporting on the status of the environment, protection of the coastal and marine environment, promotion of the use of environmental data for agricultural development, preservation of biodiversity and prevention and resolution of environmental conflicts. Those activities of UNEP are carried out through its Global Resource Information Database (GRID) centres, Environmental and Natural Resource Information Networks (ENRIN), Environmental Information Systems and the International Environment Information System (INFOTERRA), to name a few.

345. FAO is another organization active in the protection of the environment, in particular in Africa, where it carries out activities through ARTEMIS (see paragraph 120 above), Forest Assessment and Monitoring Environment (FAME) and the Regional Environmental Information Management Project (REIMP) for central Africa. The Digital Land Cover Database for Africa (AFRICOVER) was initiated by the Inter-Agency Meeting on Outer Space Activities as an inter-agency project and FAO activities relating to AFRICOVER contribute to capacity-building of local institutions and authorities in protection of the environment. In a similar manner, in the region of Latin America and the Caribbean, programmes and studies aimed at protecting the environment are being carried out in cooperation with various organizations and multilateral agencies, including the following: the development of an environmental information and modelling system (EIMS) for sustainable development; study of tropical ecosystems under the Tropical Ecosystem Environment Observation by Satellite (TREES) project; satellite monitoring of the Amazon forest in Brazil (PRODES); and the Global Observation of Forest Cover (GOFC) pilot project.

346. While various specific objectives are pursued by the United Nations system within the context of protection of the environment, objectives to solve problems of regional and global significance are stressed and pursued more than others with the use of space technologies. Examples include the monitoring of land degradation, drought and desertification, pursued by ECA, ESCWA, UNEP, FAO and UNITAR, through its Desertification Information Systems, protection of coastal and marine environments, by UNEP, UNESCO and WMO, and the preservation of biodiversity, by UNEP, FAO and UNESCO, in particular through its Man and the Biosphere (MAB) programme.

(iii) Natural resources management

347. Many projects relating to the protection of the environment are also aimed at improving the management of natural resources. Examples of such projects are AFRICOVER, FAME and Forest Resources Assessment of FAO, ENRIN and GRID activities of UNEP and MAB of UNESCO. Within the framework of MAB activities, UNESCO cooperates with UNEP in the area of forest

management. In the area of land resource management, UNEP cooperates with FAO in improving its Global Soil and Terrain Database (SOTER).

348. FAO carries out comprehensive space-related operational activities in the management of natural resources. Its activities concern the management of land, forest resources, marine/ocean, coastal zone and water resources. More bodies are carrying out activities in land resource management than any other aspect of natural resource management: ECA, ESCAP, UNEP and FAO all conduct technical advisory services in the area. ECA in particular focuses its activities on land management, through the development of land information systems and land cover mapping and its activities are supported by FAO, specifically through AFRICOVER.

(iv) Disaster management

349. Disaster management is another area in which many organizations carry out space-related activities. Those concerned with disaster management include the Office for Outer Space Affairs, the secretariat of the International Decade for Natural Disaster Reduction, ESCAP, UNESCO, the International Civil Aviation Organization (ICAO), ITU and the International Maritime Organization (IMO). While both remote sensing satellites and communications satellites are useful in enhancing disaster management, ITU focuses on the use of communications satellites for disaster communications, in cooperation with the secretariat of the International Decade for Natural Disaster Reduction and IMO. The WMO World Weather Watch combines both meteorological satellites and telecommunication facilities and includes a tropical cyclone programme and an emergency response activities programme, helping to ensure the provision of satellite data and products for natural disaster warning, mitigation and relief. UNESCO activities, such as those of GARS, focus rather on the use of remote sensing and GIS technologies in providing information on natural hazards of geological origin. In the case of ESCAP, activities in the area of disaster management relate to the use of meteorological satellites.

350. While the secretariat of the International Decade for Natural Disaster Reduction currently has no space-related operational activities, it acts as the focal point for international efforts to enhance disaster management. It is responsible for implementing recommendations of the World Conference on Natural Disaster Reduction, held in Yokohama, Japan, from 23 to 27 May 1994, such as the establishment and improvement of international disaster early warning systems. Through scientific and technical meetings organized by the secretariat of the Decade in connection with its conclusion, the use of remote sensing and communications satellites is being considered.

(v) Improvement of satellite-based communications

351. In order to improve various satellite-based communications, ITU conducts extensive activities, including training and educational activities, technical advisory services and implementation of pilot projects, dissemination of publications and organization of international meetings, such as the World Radiocommunication Conference, the World Telecommunication Development Conference and the World Telecommunication Policy Forum. ITU activities cover such issues as technical and regulatory aspects of telecommunications, radiocommunications and satellite communications.

352. Consideration should be given to the possible contribution of the Committee on the Peaceful Uses of Outer Space to the preparations for the World Summit on the Information Society, whose feasibility is being studied by ITU, with a view to ensuring the inclusion of space-related matters on the agenda of the Summit.

353. As regards the use of satellites for the development of rural and remote areas, ESCAP organizes training and educational activities, while ECA disseminates relevant publications. As for distance education, UNESCO, in cooperation with ITU, is implementing a pilot project to support primary teachers in developing countries and is establishing a satellite-based network in selected countries. UNESCO is also involved in the use of virtual laboratory technology for distance scientific collaboration between developing countries as well as between developing and developed countries. ESCAP is conducting a study project with special focus on satellite-based education. The establishment of satellite-based information networks for various purposes is pursued by the Office for Outer Space Affairs, through its cooperative information network linking scientists, educators, professionals and decision makers in Africa (COPINE), whose objective is to enhance information exchange in Africa; UNEP, through its Mercure project, UNEPnet and INFOTERRA, to enhance various aspects of environmental information management; and by UNESCO, through its African Network for Integration and Development (RAPIDE), to ensure the strong presence of Africa on the Internet.

354. Combined with the use of communication satellite technology, the use of information technology is also stressed by such entities as the Office for Outer Space Affairs, ECA, ESCAP, UNEP, UNITAR, FAO and UNESCO, in order to

improve information management and to develop sound information infrastructures.

(vi) Improvement of navigation and positioning capabilities

355. The importance of satellite-based technologies for navigation and positioning is widely recognized within the United Nations system. ICAO promotes the introduction of satellite-based technologies for communication, navigation and surveillance elements in support of global air traffic management. ICAO also considers legal aspects of the implementation of such surveillance, including the establishment of a legal framework for GNSS. Maritime policy for GNSS is dealt with by IMO. ICAO and IMO cooperate to promote multi-modal use of GNSS in order to ensure that the services provided meet the needs of both maritime users and the aviation community.

356. IMO also cooperates with ITU in developing maritime radiocommunication services, including the Global Maritime Distress and Safety System. The WMO marine broadcast system also contributes to the implementation of the Global Maritime Distress and Safety System, the development of which is being pursued by IMO in close cooperation with ITU, WMO, the International Hydrographic Organization, IMSO and COSPAS-SARSAT. ITU is also examining characteristics of satellite emergency position-indicating radio beacon (EPIRB) systems in relation to emerging rescue operations.

(vii) Other important applications of space technologies

357. Space technology and its applications are utilized in implementing pilot projects for various other development purposes. FAO, for example, provides information on food security early warning through its Global Information and Early Warning System (GIEWS), the Regional Famine Early Warning System and AFRICOVER. GIEWS also contributes to agricultural development and management. ECA cooperates with FAO in implementing those systems in the African region.

358. FAO also utilizes remote sensing satellite technology for fishery management, disease control, through its Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES), detection of locust areas, by the Reconnaissance and Management System of the Environment of Schistocerca (RAMSES) and AFRICOVER, and monitoring of illicit crops. FAO cooperates with the United Nations International Drug Control Programme (UNDCP) on pilot projects to determine the location of narcotic crop cultivation sites using satellite remote sensing data. The Office for Outer Space Affairs also provides technical advisory services to UNDCP in developing and implementing a system to monitor illicit cultivation of coca and opium poppy.

359. WMO has been the lead organization in enhancing weather forecast services by the use of meteorological satellites. Within the framework of its World Weather Watch, WMO continues its efforts to ensure that every country has access to the information it needs in order to provide weather services on a day-to-day basis as well as for longer-term planning and research. The activities relating to meteorological services also contribute to the safety of air and sea traffic. In cooperation with the Intergovernmental Oceanographic Commission, WMO continues to improve the dissemination of meteorological and oceanographic data and information to ships at sea. WMO also collaborates with ICAO in developing and implementing the World Area Forecast System, which supplies information on aeronautical meteorological forecasts in support of commercial aviation.

360. Some other uses of space technology and its applications, considered for or already incorporated into pilot projects and studies relating to economic and social development, concern urban planning by ESCWA, establishment of a database on population by UNEP through its GRID activities and establishment of urban information systems by UNITAR. UNEP contributes to United Nations efforts in refugee settlement by means of its database pertaining to contingency planning for the areas around the refugee camps. FAO is also developing a Programme Management Information System (ProMIS) to provide information relating to planning, coordination implementation, monitoring and evaluation of humanitarian, emergency and development assistance programmes, in support of the work of the United Nations Office for the Coordination of Humanitarian Affairs and the United Nations Development Programme. UNESCO implements a space archaeology programme, in which remote sensing satellite technology assists field research activities on archaeological sites. UNESCO also continues to monitor selected cultural sites and historical cities with the use of remote sensing and GIS technologies.

(b) International space law

(i) Status: international space law

361. International space law as developed by the United Nations through the Committee on the Peaceful Uses of Outer

Space and its Legal Subcommittee reflects the importance that the world community attaches to international cooperation in the exploration and use of outer space. So far, five treaties and five sets of legal principles on matters relating to the exploration and peaceful uses of outer space have been drawn up through the United Nations, gradually establishing a sound legal regime governing space-related activities.

362. The international legal principles in the five outer space treaties[47] have established that the exploration and use of outer space shall be the province of "all mankind"[48] and that outer space, including the Moon and other celestial bodies, is not subject to national appropriation. Those legal principles have also ensured freedom of exploration. They have also banned the placement of nuclear weapons and any other kinds of weapons of mass destruction in outer space and provided for international responsibility of States for national activities in outer space, liability for damage caused by space objects, the safety and rescue of spacecraft and astronauts, the prevention of harmful interference in space activities, the avoidance of harmful contamination of celestial bodies and adverse changes in the Earth environment, the notification and registration of objects launched into outer space, scientific investigation and the exploration of natural resources in outer space, as well as the settlement of disputes. Each of the treaties lays great stress on the notion that outer space, the activities carried out there and whatever benefits might accrue from them should be devoted to enhancing the well-being of all countries and humankind, and each includes elements based on the principle of promoting international cooperation in outer space activities.

363. The five declarations and sets of legal principles[49] adopted by the General Assembly provide for the application of international law and the promotion of international cooperation and understanding in space activities, the dissemination and exchange of information through transnational direct television broadcasting via satellite and the sharing of data and information from satellite observations of Earth's resources, and general standards regulating the safe use of nuclear power sources necessary for the exploration and use of outer space.

364. The Committee on the Peaceful Uses of Outer Space and its Legal Subcommittee are currently considering the question of the review and possible revision of the principles relevant to the use of nuclear power sources in outer space; matters relating to the definition and delimitation of outer space and to the character and utilization of the geostationary orbit, including consideration of ways and means to ensure the rational and equitable use of the geostationary orbit, without prejudice to the role of ITU; and a review of the status of the five international legal instruments governing outer space. In dealing with some of these topics, it is important to highlight the developments (for example, regarding the geostationary orbit), in the light of the recommendations by UNISPACE 82, that have been reflected in legal instruments developed in other bodies in the United Nations system. This is true for ITU with regard to the implementation of guaranteed equitable access in accordance with what has been established in international conferences and in the constitution and norms of ITU. It is also true for the progress that has been made in studying the topics on the basis of recent proposals and agreements in the Committee on the Peaceful Uses of Outer Space, in particular on the statement that the geostationary orbit is an integral part of outer space.

365. Other intergovernmental organizations, in particular those of the United Nations system, are also contributing to the legal regime governing international cooperative space activities. Among them are ITU, WIPO, WMO and the International Atomic Energy Agency. In addition, multilateral and bilateral treaties and agreements have secured the establishment and operation of international and regional space organizations and bodies, such as ESA, INTELSAT, the Arab Satellite Communications Organization, the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), IMSO and Intersputnik, and the development of cooperative programmes, such as the Council on International Cooperation in the Study and Utilization of Outer Space, COSPAS-SARSAT and the International Space Station. Some individual States and groups of States have also added to the corpus of space law through the adoption of their national laws and agreements within the groups governing their activities in outer space and their goals for international cooperative ventures.

(ii) Issues and objectives

366. The United Nations has succeeded in progressively developing and elaborating (in accordance with Article 13 of the Charter of the United Nations), in the form of treaties and declarations, a body of principles and norms relating to space activities that is considered a well-established branch of international law governing space activities. In recent years, the increase in space activities has given rise to new, highly technical issues such as, *inter alia*, space debris, the use of nuclear power sources in space and the protection of intellectual property rights. Those subjects pose many challenging legal questions that call for creative solutions through international cooperation if international space law is to keep pace with the rapid advances in space technology and activities. Such solutions should be sought on the basis of

respect for the principles, declarations and resolutions of the General Assembly and taking into account the needs of developing countries.

367. Innovations in space technology are also bringing activities geared towards the exploitation of natural resources in outer space and on the various celestial bodies within the realm of feasibility. In view of the apparent lack of international consensus on the principles embodied in the Moon Agreement, as shown by its relatively low level of ratification, issues relating to the ownership of and equitable access to such resources should require further substantial consideration and study within the field of international law.

368. Since UNISPACE 82 (see paragraphs 21-27 above), the world has witnessed considerable growth in the commercialization and privatization of space-related activities. That trend has led to significant increases in the number of non-state actors involved in the exploration and use of outer space, as well as the number of different activities in which they are engaged. Satellite telecommunications, satellite navigation and positioning, the provision of launching equipment and services and remote sensing are, in some cases, already developing into rapidly growing private industries. Similarly, activities such as space tourism, the mining of asteroids and other celestial bodies and waste disposal in outer space are being seriously considered as possibilities for private space enterprise in the not-too-distant future. These activities have given rise to new legal challenges.

369. Member States of the United Nations should initiate discussion of and seek solutions to emerging legal problems of relevance and should, in particular, recognize the need to consider the expanding role of private enterprise when making new laws. Specialized agencies should consider drafting standards and recommended practices as well as models for partnerships involving public and private enterprises in their respective sectors of space activity. The concept of "public service" and its various manifestations should be developed further, paying particular attention to the global public interest and to the needs of developing countries. The principles of fair trade should be strengthened. Attention should also be paid to the various aspects of the issues of liability and security of ownership in order to arrive at a coherent global framework. The international organizations concerned should make arrangements for effective and focused joint forums.[50]

370. The Committee on the Peaceful Uses of Outer Space should give attention to various aspects of space debris. The Committee on the Peaceful Uses of Outer Space should also consider the legal issues regarding low-Earth orbits (LEOs), taking into account recent changes in the ITU convention concerning the status of LEOs as limited natural resources. The issue of security of ownership regarding spacecraft should be addressed.[50]

371. The Member States should consider the development of effective mechanisms for the settlement of disputes arising in relation to space commercialization. Those mechanisms should take into account existing arbitration rules used in international practice for dispute settlement.[50]

372. A further pressing concern is the fact that many States have not yet become parties to the outer space treaties concluded within the framework of the United Nations. Despite annual resolutions by the General Assembly inviting States to consider ratification or accession to the treaties,[51] the apparent decline in the willingness of States to bind themselves to the terms of successive treaties tends to undermine the normative authority of the later international agreements. The Committee on the Peaceful Uses of Outer Space and its Legal Subcommittee have solicited the views of States regarding the obstacles that impede ratification of the five international legal instruments governing outer space[52] and have begun a review of the status of those legal instruments with a view to initiating discussion on the situation. The exercise has also drawn attention to the fact that actual adherence in practice by States to the provisions of the treaties to which they are parties is less than optimal, itself a matter requiring immediate consideration. In this regard, States are urged to ensure that their national legislation conforms with the treaties.

373. The role of the Committee on the Peaceful Uses of Outer Space and its Legal Subcommittee as mechanisms for the elaboration of necessary and appropriate principles and rules regulating outer space needs to be strengthened in order to meet the requirements of a rapidly advancing field of human activity. This might entail consideration by them of such issues as those already suggested by Member States for inclusion in the agenda of the Legal Subcommittee: commercial aspects of space activities (e.g. property rights, insurance and liability); legal aspects of space debris and review of existing norms of international law applicable to it; comparative review of the principles of international space law and international environmental law; review of the principles on direct television broadcasting and remote sensing of Earth, with a view to the possible transformation of those texts into treaties; examination of the procedures resulting in the Agreement relating to the implementation of part XI of the United Nations Convention on the Law of the Sea as a possible model to encourage wider accession to the Moon Agreement; and improvement of the Convention on Registration of Objects Launched into Outer Space.[53] The

agreement reached by the Committee on the Peaceful Uses of Outer Space at its forty-second session, in 1999, on new agenda structures for its two subcommittees should make it possible to enrich considerably the work of the Legal Subcommittee.

374. The Committee on the Peaceful Uses of Outer Space should analyse the desirability of drafting new legal instruments relating to various space applications, taking into particular account the commercial growth of some of those applications.[54]

375. The Legal Subcommittee and the Scientific and Technical Subcommittee should in general meet in such a way that there can be more interaction involving the work of those two bodies.[54]

376. The Committee on the Peaceful Uses of Outer Space should also consider legal and other aspects relevant to GNSS.[54]

(c) State and perspectives of international cooperation

(i) Status: international cooperation

377. The General Assembly, by its resolution 51/122, adopted the Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries. The adoption of the Declaration marked another achievement by the United Nations in the development of the international legal regime governing space activities and reaffirmed the commitment of Member States to promoting international cooperation in the peaceful uses of outer space for the benefit of all countries, taking into particular account the needs of developing countries.

378. The fading away of cold war tensions during the past decade has dramatically altered the way in which the "space-faring" countries conduct space activities. Valuable resources that were once subject to rival strategic considerations may now be used to foster greater cooperation. The rapidly changing world economic landscape has provided the context and impetus for closer cooperation between States moved by a new sense of urgency about long-neglected global problems. As a result, international cooperation has created a mindset whereby all those involved in space activities have come to recognize both the advantages of working together to identify common goals and the need to optimize existing resources, financial and otherwise.

379. On the other hand, obstacles remain in the way of increased international cooperation—budgetary restraints for space programmes in major "space-faring" countries and the difficulty for developing countries to obtain financing for and to participate in cooperation programmes. It has thus never been more critical in the history of the space age to stimulate and encourage international cooperation.

380. Conserving the environment, the advent of the information age and continued exploration of the solar system are just some of the important global issues in relation to which space technology can play a leading role in the coming years. Many multilateral mechanisms already exist to promote greater international cooperation, in particular with a view to assisting developing countries. Other activities may require the creation of such mechanisms, but there are a multitude of obstacles preventing greater cooperation. Without continued efforts at international cooperation, however, many developing countries may find it difficult to build up an adequate scientific and educational base for sustainable space technology and application programmes. Many national space activities, such as satellite communications and broadcasting, require international coordination in order to function successfully.

381. Recognizing the principal importance of providing prompt, reliable and affordable access to outer space on a non-discriminatory basis for the successful development of space activities, the promotion of the development of international cooperation in launch services is currently essential.

382. In order to enhance international cooperation, there should be further strengthening of the different mechanisms and channels for cooperation that already exist, such as intergovernmental mechanisms, intergovernmental/private organizations,[55] ad hoc inter-agency mechanisms,[56] transnational industrial activities[57] and international non-governmental organizations. Intergovernmental mechanisms include bilateral cooperation, currently taking place between developing countries[58] and between the latter and developed countries, and multilateral cooperation, involving intergovernmental mechanisms. The latter may take various forms, including the establishment of a permanent cooperative institutional mechanism, such as the Committee on the Peaceful Uses of Outer Space, the Regional Space Applications Programme for Sustainable Development (RESAP) under the auspices of ESCAP, the Asia-Pacific Regional Space Agency Forum in coordination with NASDA of Japan and the Institute of Space and Astronautical Sciences of Japan, the Asia-Pacific Multilateral Cooperation in Space Technology and Applications and ESA, the establishment of

an ad hoc mechanism, such as the series of space conferences of the Americas held in Latin America and the Caribbean (the last one of which, the Third Space Conference of the Americas, held in Punta del Este, Uruguay, from 4 to 8 November 1996, having adopted a plan of action for regional cooperation in space matters),[59] and project-by-project cooperative mechanisms, such as the International Space Station.

383. Many "space-faring" countries are also conducting technical assistance programmes, studies and seminars, either on a bilateral or a regional basis. While international efforts should continue to be made to explore new and innovative mechanisms for cooperation that would best meet the needs of participating countries, some of the successful mechanisms should be further promoted. It is also important for assistance programmes to be coordinated so that they complement each other. It is crucial for each country to have the best possible portfolio of options for international cooperation in order to maximize scientific and technological, economic and social, as well as industrial, returns from space activities. Considering the great capacity of the World Wide Web to disseminate information, the creation of an Internet-based common source of information should be encouraged in order to make it easier for each country to receive the above-mentioned portfolio in a timely manner.

(ii) Issues and concerns

384. As with many other instances of technology transfer and cooperative projects, a primary issue is that the recipient should have the capability to sustain or maintain the technology long after the donor has gone. Educating and training scientists and others in the user community is essential to ensuring that the technology is used to its fullest extent.

385. Environmental monitoring appears to be the most promising discipline for the pursuit of greater international cooperation. It is now universally accepted that Earth is a unified system, with events in one area of the planet potentially affecting another. Thus, it is currently beyond the resources of any single agency or country to undertake the comprehensive programmes required to understand the science of the Earth's system in all its aspects. International cooperation should be strengthened in this field.

386. The growing role of private industry in space activities and the parallel decline in government funding for space programmes are aspects of another issue reflecting overall economic trends. In that connection, it is important to encourage the involvement of the private sector as a potential partner in future activities. This could be carried out through activities such as by identifying projects that could possibly benefit from its participation that allow its involvement while encouraging fair competition in this field.

387. Greater involvement of the private sector is linked to the cost factor of many space activities, which consists of two elements: firstly, the cost of acquiring the necessary data or technology and, secondly, the cost of pursuing the space activities themselves. For most developing countries and countries with economies in transition, the acquisition of expensive data sets is a significant barrier to greater participation in space activities. As more private firms begin to offer data provision services, market forces should drive down costs and make the data more widely affordable.

388. In terms of project costs, especially for large, human space exploration missions, a single country can no longer pay such a huge bill. The International Space Station provides an example of 16 States pooling resources to share the technological and financial burdens of an ambitious project that may have many benefits for humanity. Another example is IGOS, in which space agencies and funding agencies are attempting to avoid duplication of space and surface-based measurements and address gaps in environmental observations and data in order to get the maximum return on investment.

389. Future space life science programmes should be developed to the extent possible through broad international and interdisciplinary cooperation, taking into account all space programme elements (i.e. high-quality research, industrial sponsoring, marketing plans for spin-offs and information programmes for the general public, as well as the participation of researchers from developing countries).[60]

390. Access to the International Space Station for researchers from States not represented in the international space life science working group should be encouraged.[60]

391. International cooperative schemes should be aimed at, among other things, providing developing countries with the necessary means to move beyond their status as users and to enable them to generate their own capabilities in space science and technology, promoting capacity-building in human and financial resources.

392. As discussed in paragraphs 338-360 above, space applications activities are conducted for development purposes by various organizations of the United Nations system. Such activities are coordinated by the Inter-Agency Meeting on Outer Space Activities in order to avoid unnecessary duplication in planning future endeavours and to explore possibilities of carrying out ongoing and planned

activities through joint inter-agency efforts. However, the current inter-agency mechanism is limited in what it can do to coordinate activities, in particular those already approved by the States members of the organizations concerned, if the coordination involves changes in the mandated activities.

(iii) Specific action programmes

393. Support for various programmes is often dependent upon how much and what type of information about them is available. In a number of countries, there is a need to improve the information among both the population at large and government authorities about the practical benefits of many space technologies. Better information about those benefits would probably increase the level of interest in making more extensive use of space technology applications in development programmes. To that end, the space community should stress the value of international cooperation in order to obtain concrete benefits of space technology with a view to achieving sustainable development.

394. In order to increase political support for international cooperation in space activities, there should be a multilateral political consensus to implement common space goals, identified, *inter alia*, by the General Assembly in its resolution 51/122, at the highest decision-making level. To that end, consideration should be given to strengthening the efforts to include a space item on the agenda of a multilateral meeting of heads of State.[61] A similar approach could be also taken to increase political support for international cooperation among legislators. Consideration could be given to convening ad hoc multilateral meetings of legislators who are advocates of space activities to discuss common goals to be pursued in space endeavours.

395. In order to take full advantage of the applications of space technology, developing countries need to acquire capabilities and expertise of their own. With this in mind, educational and training activities should be strengthened and supported by bilateral and multilateral programmes adapted to domestic needs, which should also consider the strengthening of the regional training centres for space science and technology education established with the assistance of the United Nations.

396. The United Nations should establish, as a matter of urgency, a special fund, based on voluntary contributions, to assist in the implementation of the recommendations of UNISPACE III, particularly those which are project-oriented in developing countries, with a view to increasing the level of awareness of space technology development and its impact on social and economic development. The special United Nations voluntary fund, the UNISPACE III implementation fund, will replace the existing space applications fund, which resulted from UNISPACE 82. Remaining monies from the existing fund will be transferred to the new fund.

397. Appropriate existing international mechanisms should be used to explore the further development of space technology applications that have a high potential for success and that contribute to meeting global needs. Where such a mechanism does not exist, one should be established and consideration should be given to new forms of cooperation that are of mutual interest and benefit. Such applications include but are not limited to the following:

(a) Cooperative efforts related to information and telecommunications, especially those of benefit to developing countries, using existing facilities and satellite capabilities;

(b) A disaster mitigation system, using scientific, Earth observation, data collection and mapping satellites coupled with a near-real-time data fusion and distribution system;

(c) An economically sustainable Earth observation system.

398. There is a need to look at innovative solutions to meet space technology and applications in support of developing countries. In this regard, some proposals have been put forward that need further study and definition.[62]

399. National agencies responsible for space activities should share information with each other on their processes for selecting and funding prospective space science projects, thus removing an impediment to expanded space science research. The conception and execution of joint projects between "space-faring" countries and developing countries should be encouraged and facilitated.

400. International partnerships and cooperation between countries and companies involved in the operation and utilization of the International Space Station and those countries not yet participating in that endeavour should be encouraged.[63]

401. Information about utilization of the International Space Station should be disseminated throughout the world in order to increase awareness of the matter in countries not yet participating in that endeavour.[63]

402. Mechanisms for improving accessibility from a technical and financial point of view (for example, loans from the World Bank) should be encouraged to simplify utilization of the International Space Station, especially for developing countries.[63]

403. The existing mechanisms are still limited in their ability to define and coordinate the needs of the user community in Earth environmental monitoring activities. Accordingly, those mechanisms should be strengthened in order to facilitate the coordination of needs in that field between satellite operators and users with a view to providing, in a more effective manner, a unified set of data requirements to help in designing and operating future Earth observation systems.

404. Member States should be encouraged to control pollution of the sky by light and other causes, for the benefit of energy conservation, the natural environment, night-time safety and comfort and the national economy, as well as science.[64]

405. More attention should be paid to the protection of intellectual property rights, in view of the growth in the commercialization and privatization of space-related activities. However, the protection and enforcement of intellectual property rights should be considered together with the international legal principles developed by the United Nations in the form of treaties and declarations, such as those relating to the principle of non-appropriation of outer space, as well as other relevant international conventions.[65]

406. The feasibility of harmonizing international intellectual property standards and legislation relating to intellectual property rights in outer space should be further explored with a view to enhancing international coordination and cooperation at the level of both the State and the private sector. In particular, the possible need for rules or principles covering issues such as the following could be examined and clarified: applicability of national legislation in outer space; ownership and use of intellectual property rights developed in space activities; and contract and licensing rules.[65]

407. All States should provide appropriate protection of intellectual property rights involving space-related technology, while encouraging and facilitating the free flow of basic science information.[65]

408. Educational activities concerning intellectual property rights in relation to outer space activities should be encouraged.[65]

409. The role of the United Nations in promoting international cooperation in the peaceful uses of outer space could be further enhanced by the following actions:

(a) Enrichment of the work of the Scientific and Technical Subcommittee, in accordance with the new approach to the agenda agreed upon by the Committee on the Peaceful Uses of Outer Space at its forty-second session,[66] in 1999, through, *inter alia*, strengthening the partnership with industry by organizing during its annual session a one-day industry symposium to provide Member States with updated information on commercially available products and services and on ongoing activities of space-related industries and to offer opportunities to managers from space-related industries to express concerns and to make suggestions preferably aimed at promoting, in particular, the interests of developing countries;

(b) Enrichment of the work of the Legal Subcommittee in accordance with the new approach to the agenda agreed upon by the Committee on the Peaceful Uses of Outer Space at its forty-second session,[66] in 1999, taking into account the relevant recommendations of the Vienna Declaration on Space and Human Development;

(c) Enhancement of the coordination of space activities within the United Nations system, without prejudice to the role and functions of the Committee on the Peaceful Uses of Outer Space or other intergovernmental bodies, through:

(i) Establishment of an ad hoc intergovernmental advisory group, consisting of the chairmen of the intergovernmental bodies responsible for space-related activities of organizations of the system, to meet for one day to review inter-agency coordination and to inform the respective intergovernmental bodies of any substantial recommendations of the Inter-Agency Meeting on Space Activities;

(ii) More critical review of inter-agency coordination by the above-mentioned intergovernmental bodies in order to provide guidelines to assist secretariats responsible for implementing space activities in identifying areas in which coordination efforts should be strengthened;

(d) Strengthening of the activities of the United Nations Programme on Space Applications including its outreach activities, by taking the following actions:

(i) Promotion of collaborative participation among Member States, at both the regional and international levels, in a variety of space science and technology activities, by facilitating and supporting the development and implementation of projects that address the operational needs of Member States;

(ii) Provision of support to the regional centres for space science and technology education affiliated to the United Nations by establishing a data management programme and by organizing: a continuing education programme for graduates of the centres; a youth programme, including workshops for primary and secondary school teachers; and short-term seminars for decision makers;

(iii) Reorientation of the long-term fellowship programme to include the following components: preparation and submission of project proposals; revitalization of the knowledge, research experience and applications skills of participants; study at the institute where the fellowships are offered; preparation of a final report;

(iv) Organization of workshops and conferences on advanced space applications and new system developments, particularly in such fields as high-resolution sensor systems and satellite navigation and positioning systems for disaster management, search and rescue operations and other applications, for programme managers and leaders of space technology development and applications activities;

(v) Organization of medium-term courses on remote sensing education for university educators and on telecommunications and tele-health for professionals, including assistance in ensuring immediate application of the acquired skills and knowledge in national development efforts in the countries of the participants;

(vi) Provision of technical advisory services to Member States, on request, on different aspects of space science and technology and related applications;

(vii) Promotion of cooperation in space applications projects between government establishments, universities and research institutions and private industry, in particular to increase the awareness of policy makers and the public of the spin-off benefits of space technology and of growing trends towards commercialization of space-related activities;

(viii) Organization of an annual public forum, to be held in various countries and regions in collaboration with interested non-governmental organizations, to inform the general public of past, ongoing and planned space activities and the future direction of such activities. The programme would be developed by the Office for Outer Space Affairs in collaboration with non-governmental organizations and interested space agencies;

(ix) Promotion of the participation of youth in activities of the United Nations Programme on Space Applications;

(x) Promotion of interest in space science and technology among students and young scientists and engineers;

(xi) Promotion of cooperation in the development of educational programmes in space science and technology at the beginner level for primary and secondary school curricula;

(xii) Establishment, in cooperation with the Association of Space Explorers, of a programme of visits by astronauts, cosmonauts and other space scientists and engineers with the aim of increasing knowledge about space-related activities, in particular among young people.

410. Through international cooperation, developed countries should employ their best efforts to transfer to developing countries the necessary knowledge and skills of their citizens in different aspects of space science and technology, in particular through their participation in the design, development and fabrication of small satellites, with a view to gaining an understanding of the technology and subsequent use of such small satellites for various socio-economic activities.

III. Proceedings of the Conference

A. Attendance and organization of work

1. Date and place of the Conference

411. In accordance with General Assembly resolution 52/56 of 10 December 1997, the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) was held as a special session of the Committee on the Peaceful Uses of Outer Space, open to all States Members of the United Nations, in Vienna from 19 to 30 July 1999. During that period, the Conference held 10 plenary meetings.

2. Pre-Conference consultations

412. Pre-Conference consultations open to all Member States were held in Vienna on 18 July 1999 to reach informal agreement on the recommendations of the Preparatory Committee for the Conference on organizational and procedural matters. The pre-Conference consultations were conducted under the chairmanship of N. Jasentuliyana, Executive Secretary of the Conference. U. R. Rao (India), Chairman of the Preparatory Committee for the Conference, reported on the work carried out by the Preparatory Committee. The report of the pre-Conference consultations (A/CONF.184/L.1) was presented to the Conference at its opening meeting and accepted by the Conference as a basis for the organization of its work.

3. Attendance

413. The following Member States were represented at the Conference: Algeria, Angola, Argentina, Australia, Austria, Azerbaijan, Belarus, Belgium, Benin, Bolivia, Brazil, Bulgaria, Burkina Faso, Cameroon, Canada, Cape Verde, Chad, Chile, China, Colombia, Comoros, Costa Rica, Cuba, Cyprus, Czech Republic, Democratic People's Republic of Korea, Denmark, Ecuador, Egypt, Equatorial Guinea, Ethiopia, Finland, France, Germany, Greece, Guatemala, Hungary, India, Indonesia, Iran (Islamic Republic of), Iraq, Ireland, Israel, Italy, Japan, Jordan, Kazakhstan, Kenya, Kuwait, Lebanon, Libyan Arab Jamahiriya, Lithuania, Luxembourg, Malawi, Malaysia, Mexico, Monaco, Mongolia, Morocco, Namibia, Netherlands, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Peru, Philippines, Poland, Portugal, Republic of Korea, Romania, Russian Federation, Saudi Arabia, Senegal, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, Sudan, Sweden, Syrian Arab Republic, Thailand, the former Yugoslav Republic of Macedonia, Tunisia, Turkey, Uganda, Ukraine, United Arab Emirates, United Kingdom of Great Britain and Northern Ireland, United States of America, Uruguay, Venezuela, Viet Nam, Yemen and Zimbabwe.

414. Representatives of the Holy See and Switzerland also attended the Conference.

415. The observer for Palestine attended the Conference.

416. The secretariats of the Economic and Social Commission for Asia and the Pacific and the Economic Commission for Africa were represented at the Conference.

417. The United Nations Environment Programme was represented at the Conference.

418. The following specialized agencies were represented: Food and Agriculture Organization of the United Nations, United Nations Educational, Scientific and Cultural Organization, International Telecommunication Union, World Meteorological Organization, World Intellectual Property Organization and International Atomic Energy Agency.

419. The following intergovernmental organizations, other organizations and other entities having received a standing invitation to participate as observers in the sessions and work of the General Assembly were represented at the Conference: African Development Bank, Asian-African Legal Consultative Committee, European Community, International Organization for Migration, League of Arab States and Organization of the Islamic Conference.

420. The following international organizations having permanent observer status with the Committee on the Peaceful Uses of Outer Space were represented at the Conference: Committee on Space Research, European Space Agency, International Academy of Astronautics, International Astronautical Federation, International Astronomical Union, International Institute of Space Law, International Mobile Satellite Organization, International Organization of Space Communications, International Society for Photogrammetry and Remote Sensing, International Space University and International Telecommunications Satellite Organization.

421. The following international organizations not having permanent observer status with the Committee on the Peaceful Uses of Outer Space were also represented at the Conference: African Association of Remote Sensing of the Environment, Asia-Pacific Satellite Communications Council, European Organization for the Exploitation of Meteorological Satellites, European Space Science Committee, Global Climate Observing System and International Institute for Applied Systems Analysis.

422. In addition, a large number of representatives of national non-governmental organizations and space industries, invited by their Governments, attended the Conference. The complete list of Conference participants is given in document A/CONF.184/INF/3 and Corr.1.

4. Opening of the Conference and election of the President

423. The Conference was declared open by the Secretary-General of the United Nations. The Secretary-General then addressed the Conference.

424. The Secretary-General noted that of all the important and challenging topics on the agenda of the United Nations, none captured the imagination like outer space. Outer space not only stirred the soul, but also had great practical implications for the lives of people everywhere. The Secretary-General indicated that UNISPACE III, the last major United Nations conference of the twentieth century, was a fitting symbol of the achievements of the past hundred years and the work of the United Nations.

425. The Secretary-General also noted the tremendous progress in science and technology during the twentieth century, as evidenced by the birth of space technology, which had already led to the revolutionizing of life on Earth. He gave examples of the benefits of space technology such as the globalizing effect of satellite communications, the role of space-based observation in gaining knowledge and understanding of the environment and climate of Earth, and the use of space technology in monitoring natural disasters and the development of navigational systems. He stated that such development provided a powerful justification for the continuation of basic research in space science with a view to enriching the collective knowledge of the world community.

426. The Secretary-General expressed the view that much more use could be made of existing knowledge in space science and technology: for example, to ensure that educational resources and medical expertise reached even the most remote communities, to make possible the location and sustainable management of natural resources, to improve weather forecasting, thereby minimizing the effects of natural disasters, to develop innovative agricultural techniques necessary for the alleviation of world hunger and to assist in guarding against threats such as landmines and illicit drug crop cultivation.

427. While recognizing the great potential that space activities had, the Secretary-General expressed his concern at the potential dangers that also existed. He noted that the advantages of globalization were far from being accessible to all human beings and that the advance of technology contributed to the widening of the gap between those with access to space technology and those without such access. He recognized the need for countries and peoples to retain their distinctive cultural practices and identities under the onslaught of globalization while they worked together to ensure that the possibilities offered by technology, both in space and on Earth, were used to foster tolerance, trust and shared values.

428. The Secretary-General stressed the need to guard against the misuse of space. He noted the joint action of the international community aimed at establishing a legal regime through the United Nations to ensure that outer space would be developed peacefully. He added that much remained to be done to ensure that the legacy of war and suffering was not passed on to the next generation. Space should not become yet another battlefield for earthly conflict; instead, the international community should ensure that the fruits of technical progress were made available to all people in all nations. To that end, ways of reducing the cost of space-related technologies must be found and resources must be provided to developing countries to allow them to acquire such technologies. The Secretary-General stressed that partnership between industry, commercial groups and governmental and non-governmental organizations would be essential to achieve those goals.

429. The Secretary-General also addressed the issue of partnership across generations, welcoming the invaluable tool represented by the Space Generation Forum in including young people in the discussions on outer space. He went on to state that, through the young, the information and knowledge of today would be translated into scientific breakthroughs of the future that would benefit coming generations.

430. In conclusion, the Secretary-General urged that the Vienna Declaration on Space and Human Development, to be adopted by the Conference, should realistically outline ways of making the benefits of space science and technology available to all. The Declaration, once adopted,

should constitute a living force that would change the lives of future generations.

431. A statement was also made by Thomas Klestil, President of Austria, who, on behalf of his country, welcomed all the Conference participants to Vienna.

432. Mr. Klestil noted that UNISPACE III was the first United Nations conference in which industry and civil society were participating in partnership with Governments. That reflected the increasing use of outer space for economic purposes and the rapidly growing importance of private companies in that field. Mr. Klestil congratulated the Secretary-General on that new approach, which represented a fundamental change in the attitude of the United Nations. He went on to note that the Space Exhibition, which was to run in parallel with the Conference, constituted a unique opportunity to meet and establish new partnerships between aerospace manufacturers, government agencies and non-governmental organizations. He stated that the Space Generation Forum would provide an unprecedented opportunity for younger space professionals to present new insight, fresh ideas and alternative scenarios for the twenty-first century. He noted that the Conference itself was unique in that it had been organized within existing resources.

433. Mr. Klestil noted that, though space technology had become a significant part of modern life, much more could be done to promote sustainable development and to monitor events that threatened the well-being and livelihood of many people throughout the world. He expressed the view that, unless developed countries were prepared to share their technological know-how with developing countries, the benefits of space technology would remain limited, to the detriment of all. Noting that developing countries needed to improve their national capabilities in that area, he called upon the United Nations to ensure that such countries were given access to the knowledge and skills required for the peaceful use of outer space, and he appealed to representatives of Governments, private industries and non-governmental organizations to actively support the United Nations in that endeavour.

434. At its 1st plenary meeting, on 19 July, the Conference elected by acclamation U. R. Rao (India) President of the Conference. In his address to the participants, the President stated that the Conference was a historic event, taking place exactly three decades after the first human landing on the Moon. He noted that the Conference was the culmination of an eight-year effort by all the member States of the Committee on the Peaceful Uses of Outer Space.

435. The President of the Conference drew attention to the significant geopolitical changes and technological advances that had taken place since UNISPACE 82, which had created an atmosphere that was more conducive to increased international cooperation. He noted the rapid growth in the commercialization of space activities, which had made a qualitative change in the spread of space benefits to many parts of the world.

436. While welcoming the many spectacular achievements in outer space and space-related activities, the President of the Conference drew attention to the numerous social and economic challenges that continued to face humankind, particularly in developing countries. He mentioned the problems of malnutrition, hunger, illiteracy, low agricultural productivity, poor infrastructure, lack of resources, environmental degradation, the overutilization of renewable and non-renewable resources and the loss of biodiversity, compounded by the rapid growth in the world population.

437. While recognizing that intensive national and international efforts had enabled many countries to benefit from applications of space technology, the President of the Conference noted that the impact of space technology in developing countries continued to be minimal, primarily because of problems such as high costs, lack of expertise and inadequate awareness among decision makers.

438. Noting that space technology had a decisive role to play in the development of a technology-rich information society, the President stated that the primary objective of the Conference was to promote maximum use of space science and technology to solve problems of global and regional significance. He went on to state that attaining that objective would require strengthening the capabilities of all countries, in particular developing countries, to use space technology to achieve economic, social and cultural development.

439. The President noted that the Conference provided a unique opportunity for policy makers throughout the world to become aware of the latest scientific and technological developments in space. It also provided a forum in which space scientists and technologists and leaders in the space industry from many countries could exchange ideas. He expressed the hope that the Vienna Declaration on Space and Human Development, to be finalized by the Conference, would serve as a manifesto for the global community to promote maximum use of space technology to achieve sustainable development.

5. Adoption of the rules of procedure

440. At its 1st plenary meeting, on 19 July, the Conference adopted its provisional rules of procedure (A/CONF.184/2), recommended by the Preparatory Committee for the Conference and endorsed by the General Assembly in its resolution 53/45 of 3 December 1998, as modified by agreement in the pre-Conference consultations (see A/CONF.184/L.1) on the basis of recommendations of the Preparatory Committee at its 1999 session.

6. Adoption of the agenda

441. At its 1st plenary meeting, on 19 July, the Conference adopted its agenda (A/CONF.184/1), as recommended by the Preparatory Committee for the Conference and agreed to in the pre-Conference consultations (see A/CONF.184/L.1). The agenda read as follows:

1. Opening of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III).
2. Election of the President of the Conference.
3. Statement by the President of the Conference.
4. Adoption of the rules of procedure and agenda.
5. Establishment of the committees and election of other officers.
6. General exchange of views.
7. Status of the scientific knowledge of Earth and its environment.
8. Status and applications of space science and technology:
   (a) The environment and natural resources and remote sensing;
   (b) Navigation, positioning and location systems;
   (c) Review of space communications and applications.
9. Benefits of basic space science and capacity-building:
   (a) Assessment of basic space sciences and their benefits;
   (b) Education and training.
10. Information needs and the global approach:
    (a) Research needs;
    (b) Application needs;
    (c) Integration of multi-source data through the use of geographic information systems.
11. Economic and societal benefits:
    (a) Secondary applications of space technology;
    (b) Ways and means of increasing the economic efficiency of space technology and its applications;
    (c) Promotion of the commercial benefits of space activities;
    (d) Ways and means of promoting international cooperation.
12. Promotion of international cooperation.
13. Activities of the Technical Forum.
14. Adoption of the report of the Conference, including the Vienna Declaration and Action Plan.
15. Closing of the Conference.

7. Organization of work, including establishment of the committees and election of other officers

442. At its 1st plenary meeting, on 19 July, the Conference approved the indicative organization of work as set out in annex I of the provisional agenda (A/CONF.184/1) and as orally amended by the President of the Conference.

443. Also at its 1st plenary meeting, the Conference established two main committees, Committee I and Committee II, in accordance with rule 4 of its rules of procedure. While agenda items 1-6 and 13-15 were retained for consideration in plenary meetings, the Conference decided to allocate agenda items 7, 9, 10 and 12 to Committee I and agenda items 8 and 11 to Committee II, respectively. In addition, the Conference established a Technical Forum as a technical body of the Conference, in accordance with rule 5 of its rules of procedure.

444. At the same meeting, the Conference elected, by acclamation, the following officers, who, together with the President, comprised the General Committee of the Conference:

Vice-President of the Plenary: Raimundo González (Chile)

Rapporteur-General of the Plenary: Mohamed Aït Belaïd (Morocco)

Chairman of Committee I: Dietrich Rex (Germany)

Vice-Chairman of Committee I: Alexander V. Yakovenko (Russian Federation)

Vice-Chairman/Rapporteur of Committee I: R. A. Boroffice (Nigeria)

Chairman of Committee II: Shunji Murai (Japan)

Vice-Chairman of Committee II: Vladimír Kopal (Czech Republic)

Vice-Chairman/Rapporteur of Committee II: Luiz Gylvan Meira Filho (Brazil)

Chairman of the Technical Forum: Peter Jankowitsch (Austria)

445. Also at the same meeting, the Conference, in accordance with rule 6 of its rules of procedure, established a Drafting Group, chaired by the Rapporteur-General of the Plenary and consisting of two designated representatives from each of the five regional groups, together with any additional representatives of the Member States invited by the Rapporteur-General to assist in the preparation of the full draft report. The following individuals were elected by acclamation as members of the drafting group: Alejandra Bonilla (Colombia), Lynn F. H. Cline (United States of America), Dawlat Hassen (Egypt), Arif Mehdiyev (Azerbaijan), Sridhara Murthy (India), Mazlan Othman (Malaysia), Héctor Raúl Pelaez (Argentina), Dumitru Dorin Prunariu (Romania), Mongezi Tshongweni (South Africa) and Gabriella Venturini (Italy).

446. At the 2nd plenary meeting, on 19 July, a statement was made by the Chairman of the Technical Committee.

447. At the 5th plenary meeting, on 21 July, a report was presented by the Chairman of the Legal Subcommittee on the work of the Committee.

448. At its 8th plenary meeting, on 26 July, the Conference was informed that Luiz Gylvan Meira Filho (Brazil) would not be able to continue his term as Vice-Chairman/Rapporteur of Committee II. On the basis of a proposal by the Group of Latin American and Caribbean States, the Conference agreed that Carlos José Prazeres Campelo (Brazil) should replace Luiz Gylvan Meira Filho for the duration of his term of office.

449. At its 8th plenary meeting, on 26 July, the Conference established an informal open-ended working group, coordinated by Richard Tremayne-Smith (United Kingdom of Great Britain and Northern Ireland), to consider issues relating to the text of the draft Vienna declaration on space and human development.

8. Appointment of the members of the Credentials Committee

450. At its 1st plenary meeting, on 19 July, in conformity with rule 3 of its rules of procedure, the Conference appointed a Credentials Committee based upon the Credentials Committee of the General Assembly at its fifty-third session, on the understanding that if any of the States comprising the Committee did not participate in the Conference, it would be replaced by another State from the same regional group.

451. At its 7th plenary meeting, on 22 July, the Conference agreed that the Credentials Committee would be comprised of Australia, China, Indonesia, the Libyan Arab Jamahiriya, the Russian Federation, the United States of America, Uruguay, Venezuela and Zimbabwe.

B. Summary of general exchange of views

452. During the course of seven plenary meetings, held from 19 to 22 July 1999, the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) heard statements by the representatives of 59 Member States and 2 non-Member States and representatives of specialized agencies and a number of intergovernmental and non-governmental organizations. A summary of the main points made by representatives during the general exchange of views is provided below.

453. Recalling resolution 52/56, in which the General Assembly agreed to convene UNISPACE III under the theme "Space Benefits for Humanity in the Twenty-first Century", all representatives observed that the Conference was an important event on the eve of the new millennium and was the appropriate forum for an exchange of views, information and experience concerning the peaceful uses of outer space. All representatives endorsed and welcomed the objectives of the Conference, which included promoting effective means of using space solutions to address problems of regional or global significance; strengthening the capabilities of Member States, especially developing countries, to use the results of space research for economic and cultural development; and enhancing international cooperation in space science and technology and its applications. They expressed the view that furthering the development and use of space science and technology, in particular in developing countries, should benefit humankind by improving the quality of life and supporting sustainable development. In addition, several speakers observed that the Conference was also an

opportunity to focus on the need to strengthen the capabilities of developing countries to utilize space technology for economic, social and cultural development.

454. All representatives noted the significant advances made in the field of exploration and peaceful uses of outer space specifically for the benefit of humankind over the past two decades. The changes in the geopolitical context, in particular the end of the cold war, had facilitated the expansion of a number of national space programmes, including those of many developing countries, and of applications of technology in a variety of areas. Those developments had also led to a climate of greater international cooperation among nations and a willingness to develop and utilize space technology for sustainable development and for the expansion of commercial opportunities. The representatives also noted that the use of space technology had vastly increased, more specifically in areas such as television and radio broadcasting, telephony, the high-speed transfer of data and business communications, Earth observation for the management of natural resources and monitoring of the environment, positioning and locational information, which was crucial to aviation and other positioning applications, and the means to reach out to the frontiers of outer space.

455. Several speakers drew attention to the widening gap between those who were benefiting from the use of space technology and those who still had no access to it. Much remained to be done to spread the gains and benefits of space technology and to ensure that those benefits were shared in an equitable manner. Speakers emphasized that the benefits needed to be harnessed through a strong cooperation model involving the "space-faring" nations. Some representatives pointed out that the United Nations had a role to play in bridging the gap between countries' capabilities in space science and technology.

456. All those who spoke emphasized the need for expanding possibilities for cooperation at the international level to exploit the peaceful uses of outer space for the benefit of all humankind and for sustainable development. Some representatives reiterated their commitment to enhancing international cooperation by offering appropriate solutions to global problems and helping developing countries expand their technological capabilities. They pointed out that they were actively promoting cooperation at the bilateral and multilateral levels with a view to sharing the benefits of space exploration, in particular in disaster management and monitoring of the environment. Other speakers emphasized that opportunities for international cooperation should be used in order to remove the obstacles in the way of access to technology, equipment and knowledge and to promote social, economic and cultural development. The view was expressed that cooperative activities should not be limited to capacity-building in space technology and applications alone, but should be extended to programmatic development of satellite missions and applications programmes.

457. Several representatives referred to the strengthening of regional cooperation and welcomed the role of the regional organizations and other intergovernmental bodies of the United Nations system in the promotion and development of space activities at the regional level. Several speakers recalled the usefulness of the regional preparatory conferences for UNISPACE III, which had addressed significant issues for regional cooperation. Some of those speakers called for focused regional programmes in space science, satellite communications and navigation systems, micro-satellites, disaster management, environmental monitoring, education and training. There was also potential for South-South cooperation in space applications programmes, which could encompass human resource development, remote sensing and cooperative satellite projects.

458. Several representatives gave an insight into their national space programmes, outlining their progress in the development of space technology and the applications they were using to address various national development goals. Some countries had advanced programmes and had built and launched their own satellites, offering space-based services not only to their own but also to other countries, some countries had developed application programmes and some countries had limited infrastructure for utilizing space technology. There was a need in developing countries for the State to take a leading role in pursuing the development of space technology and in exploiting the applications of that technology for sustainable development. The representatives of several countries stressed that their national goals would continue to be the rationale behind their work in space technology development and in ensuring its application to the benefit of society.

459. The phenomenal growth of private sector participation and investment in space activities was acknowledged by all those who spoke. In that connection, some representatives welcomed the active participation of the private sector in UNISPACE III, which reflected the growing government-private sector complementarity at the national, regional and international levels. Some speakers observed that, with increased private sector involvement in space technology and applications, favourable government

policies and joint investments could further the development of the space industry.

460. Some representatives pointed out that industry in developed countries continued to play an active role in developing both new and innovative space applications and technology geared for markets in services in satellite communications, remote sensing and space transportation. The view was expressed that private sector involvement in the space industry could improve global prosperity by creating jobs and by providing information and products that could enhance human productivity and standards of life everywhere. There was potential for reducing the costs of some services, which would benefit developing countries. Other speakers, however, cautioned that the increased involvement of the private sector could limit the possibilities for developing countries to benefit from space applications because of the high costs involved and the emphasis on the pursuit of commercial goals associated with that sector as against the need to contribute to the development of society. Efforts should be made to ensure that the benefits of the commercialization of space technology and its applications accrued to all countries.

461. Concern was expressed by several speakers at the varying extent to which developing countries benefited from advances in space science and technology and its applications. It was also observed that there was increasing recognition in most developing countries of the need to use the high-technology input of space for purposes of sustainable development. However, it was pointed out that two interrelated issues needed to be addressed: firstly, the promotion of the technology itself and the associated problems encountered; and, secondly, the effective utilization of the high-technology knowledge of space, once acquired, for sustainable development activities. The view was expressed that African countries in particular had been marginalized in that field; that was an unfortunate situation, considering that the African continent was faced with major social and economic problems, some of which could be solved by the application of space technology.

462. The view was expressed that it was necessary for a favourable political and economic environment to be created in developing countries to allow them to benefit from space technology and to improve the quality of life of their people. Some speakers pointed out that developing countries needed to be encouraged to develop their national capabilities so that they could make full use of space technology for development. The need for increased access to information about space activities was stressed by some representatives, who proposed that an electronic database be set up to provide information on a range of issues, including recent applications, ongoing research and information on international research projects, as well as possibilities for training. Such a database should take into particular account the needs of developing countries.

463. All speakers attached great importance to space-related education and training as one means of enhancing national capabilities. Several recognized that education held the key to future space technology development and its applications and therefore that space education should become an essential element in a competitive world. Those speakers indicated that some developing countries did not yet possess the critical mass of space scientists, technologists and engineers required to embark upon comprehensive national space programmes. Establishing a broad network of educational institutions and ensuring the sustainable development of human resources must be an imperative for the twenty-first century in order to build capacities that could have a far-reaching impact on the utilization of space by many countries. Several representatives elaborated on their efforts at the national level in educating and training personnel in appropriate space science and technology skills. Special mention was made of the important role that the United Nations had played in organizing training programmes. The view was expressed that a new fund managed by the United Nations should be created, or existing funds enhanced and restructured, to allow for large-scale educational opportunities and human resource development in space science and technology.

464. Several representatives welcomed the efforts of the United Nations in establishing the regional centres for space science and technology education in Africa, Asia and the Pacific and Latin America and the Caribbean. Some speakers from the region of Asia and the Pacific expressed satisfaction that the centre in that region had already provided benefits, while other speakers pointed out that the centres in their regions would contribute greatly to strengthening the indigenous capabilities of countries in the field of space science and technology. It was suggested that the centres should also become the focal points for technical assistance and consultancy in their respective regions and should provide advice in support of efforts to develop space activities in various States. Some speakers felt that the activities of the centres needed to be strengthened further. It was suggested that a similar centre could be established as part of the network of institutions set up in central, eastern and south-eastern Europe.

465. The United Nations was urged by some representatives to initiate programmes to strengthen regional cooperation among countries with economies in

transition by creating a space applications centre, similar to the regional centres for space science and technology education. The view was expressed that such a centre would help to develop appropriate infrastructure that was still absent in those countries and would contribute to the more effective implementation of space-related technologies for economic and social development.

466. Several representatives referred to the need for access to space technology. Some reiterated their commitment to ensuring that the benefits of space exploration, in particular cooperative space applications, were as widely available as possible on a bilateral basis and through the bodies of the United Nations system, in the spirit of the theme of UNISPACE III. Others emphasized that the transfer of technology should be promoted through the availability of technology and through training opportunities, including South-South cooperation in technology development and transfer. The view was expressed that matters related to access to technology should be examined and redefined using a much broader context and scope, giving due consideration to the interests of all parties. It was noted that such access to and transfer of technology would reinforce the indigenous capabilities of developing countries and allow them to participate more effectively in space research.

467. Several speakers stressed that space technology and applications should become a strong instrument to meet the challenges of the next millennium. They were of the opinion that space was the common heritage of humankind and, consequently, that every effort should be made to ensure equitable access to its benefits to the entire international community, in particular developing countries. Several speakers emphasized that application-oriented programmes should play an increasing role in solving major global problems and endorsed efforts made to develop an Integrated Global Observing Strategy (IGOS), noting that priority should be given to utilizing space technology for the preservation of the Earth's environment by contributing to the implementation of Agenda 21[67] and other instruments, including conventions, related to the Earth's environment.

468. The range of benefits of space technology was emphasized by numerous speakers. They were of the view that space technology could be used to accelerate economic development in developing countries, resulting in increased growth rates and economic returns. Many representatives noted that they were committed to achieving space benefits for humanity and to ensuring sustainable development for society.

469. While acknowledging the benefits of space technology, several representatives expressed concern about the high cost of such technology, in particular remote sensing, for developing countries. They pointed out that more efforts were needed to decrease further the cost of remote sensing data and data analysis services, which had practical applications for the development of such sectors as agriculture, mineral prospecting, water resource management, forestry and the evaluation and monitoring of fish resources. They urged the development of a standard format for the acquisition, processing and handling of remote sensing data with a view to making them available to all countries. With reduced costs there would be a wider market for the data among developing countries. The increasing involvement of the private sector held out the promise of reduced costs for all consumers. Furthermore, the availability of valuable new services that were being developed with private sector investment was expected to contribute to reducing the cost of some space activities and space applications. Some representatives noted, however, that their countries were willing to take advantage of the practical benefits of space activities for economic and social development in spite of the high cost of involvement in those activities.

470. Speakers were unanimous in commending the innovative role that the United Nations had played in space-related activities over the past 40 years. The United Nations remained the main forum for the promotion of international cooperation in outer space activities. Particular mention was made of the contribution of the Committee on the Peaceful Uses of Outer Space, the United Nations Programme on Space Applications and various United Nations regional programmes organized by specialized agencies and the regional commissions of the Economic and Social Council. Several delegations stated that the United Nations Programme on Space Applications had played a pivotal role in promoting and enhancing the use of space technology and their applications in many countries in support of developmental activities. It had contributed by identifying, and strengthening the development of, human resources in developing countries and by providing technical assistance for regional activities. Several representatives pointed out that they had made an effort to make a significant contribution to the Programme. Others stressed that the Programme should be strengthened further and provided with adequate resources to sustain its crucial role of assisting capacity-building in developing countries.

471. Several speakers called for a special fund to be set up within the Office for Outer Space Affairs to assist in the

implementation of the recommendations of the Conference. Others expressed the view that an appropriate mechanism should be established within the United Nations system to ensure regular and adequate funding on a sustainable basis, especially for the regional centres for space science and technology education and other space science and technology institutions affiliated to the United Nations and for activities carried out in cooperation with the United Nations. Developed countries were urged to provide financial and technical resources in support of such United Nations activities and to enhance cooperation with developing countries and assist in strengthening their national capacities. Several representatives pointed out that they had continued to support a number of training programmes and bilateral and multilateral initiatives to assist countries in developing their national capabilities.

472. Speakers expressed appreciation for the work of the Committee on the Peaceful Uses of Outer Space in its development of the international treaties and principles that constituted the core of international space law. Several representatives expressed support for the bilateral and multilateral efforts to promote the universality of the treaties governing activities in outer space. Noting that recent changes in the global environment and the rapid advances made in space technology posed new challenges to international space law, several speakers called on the Committee on the Peaceful Uses of Outer Space and its Legal Subcommittee to consider proposals for a review of the various treaties to take into account the dramatic changes in space activities over the past two decades, including the growing needs of the various countries and intergovernmental agencies. There would need to be a revitalization of the work of the Committee and its Legal Subcommittee if those bodies were to keep pace with the new challenges. The representatives noted that the recent decision by the Committee to restructure the work of the Legal Subcommittee was a welcome step towards such a revitalization.

473. Some representatives drew attention to the need for a *sui generis* legal regime to regulate the use of the geostationary orbit in order to guarantee equitable access to that orbit for all States, taking particular account of the needs of developing countries. The actual application of the principle of equity of access to orbit radio frequency spectrum resources was urgently required to ensure equitable opportunities for developing countries. Those representatives also indicated that the issue was of great importance to them and should therefore continue to be considered in the Legal Subcommittee until resolved to the satisfaction of all States.

474. Concern was expressed by several speakers about the increasing contamination of the outer space environment and, in particular, the pressing question of space debris, which was not specifically addressed in the existing treaties. Drawing attention to the problem and the dangers that such debris presented, they pointed out that there was an urgent need for the international community to tackle the problem. It was the collective duty of the international community to adopt measures to limit the generation of space debris. It was time for the issue to be placed on the agenda of the Legal Subcommittee. Concern was also expressed about the accidental re-entry of space systems using nuclear power in the Earth's atmosphere, endangering the health and life of people and contaminating vast areas of land. Regarding the existence of nuclear power sources in outer space, concern was expressed about the potential hazard of accidental collisions of such debris with active spacecraft and the consequences of contamination of outer space and the terrestrial environment. It was pointed out that the threat posed by nuclear and radioactive material to equatorial countries in particular demanded the urgent attention of the international community.

475. A number of proposals were made regarding other action that could be taken to strengthen the existing legal regime. The view was expressed that the mechanisms for the settlement of disputes under the Convention on International Liability for Damage Caused by Space Objects[68] should be strengthened further. Furthermore, States parties should consider making a declaration binding themselves on a reciprocal basis to the decisions of the Claims Commission established under the Liability Convention. In the interest of wider dissemination of the international instruments on space law, funds should be made available for their translation into the official languages of each country.

476. Several speakers reiterated that outer space must be used for peaceful purposes for the benefit of all humankind, which had been the endeavour of the Committee on the Peaceful Uses of Outer Space. The Committee had grown out of the recognition of space as a new frontier of human endeavour and was intended to focus exclusively on promoting cooperative achievement and sharing the benefits of space technology. Some representatives expressed concern about the use of outer space for military or military-related purposes and called for an urgent demilitarization of outer space. Several speakers suggested that funds earmarked for military-related activities could be used for enhancing the

sustainable economic development of developing countries through the peaceful uses of outer space.

477. Some speakers saw an increase in public awareness about space activities and the benefits of exploring outer space as a major need and considered that such awareness would help garner the political and financial support for major national and international programmes. To that end, it would be necessary to develop public information programmes focusing on the practical application of space technology and its applications.

478. With the expectation that the twenty-first century would bring with it a worldwide expansion of space activity requiring much wider participation of the younger generation, several speakers attached great importance to the programmes for young people in the Space Generation Forum, which was an integral part of UNISPACE III. They expressed the hope that the Forum and other similar forums geared to interesting youth in the exploration and the peaceful uses of outer space would instil in future generations an appreciation of the rewards and opportunities that space technology could offer.

479. Representatives of three bodies of the United Nations system made statements concerning the role of their respective organizations in furthering programmes of education and training in space, remote sensing programmes to promote and support sustainable agriculture and the Regional Space Applications Programme for Sustainable Development in Asia and the Pacific.

480. A number of intergovernmental organizations participated in the general exchange of views and focused on the expansion of international cooperation as a priority for their space programmes; the challenges of the competitive environment for the commercial telecommunication industry; and the need to provide reliable weather forecasting and long-term climate prediction.

481. Non-governmental organizations called for Governments to cooperate through the Committee on the Peaceful Uses of Outer Space to establish an international system to assess environmental impact, establish standards for emissions and set environmental traffic rules in the space environment in the interest of long-term sustainable development of space; to address the issue of non-discriminatory access to Earth observation systems, in particular by developing countries; and to examine the role of research and developing human resources for the space industry.

C. Report of Committee I

1. Work of Committee I

(a) Introduction

(i) Establishment of Committee I and election of officers

482. At its 1st plenary meeting, on 19 July 1999, the Conference established Committee I and elected the following officers of Committee I:

Chairman: Dietrich Rex (Germany)

Vice-Chairman: Alexander V. Yakovenko (Russian Federation)

Vice-Chairman/Rapporteur: R. A. Boroffice (Nigeria)

(ii) Programme of work

483. The Conference allocated to Committee I the consideration of agenda items 7, 9, 10 and 12.

484. The Conference requested that Committee I, in its consideration of agenda items 7, 9, 10 and 12, consider and approve chapter IV, sections A.1, D, E, F and H, of the draft report of the Conference (A/CONF.184/3 and Corr.1 and 2).

(b) Proceedings of Committee I

485. Committee I held a total of 14 meetings, from 21 to 29 July 1999.

486. At the 1st meeting of Committee I, on 21 July, the Chairman of Committee I made an opening statement.

487. The Chairman drew the attention of Committee I to the rules of procedure of the Conference and made further proposals on the procedures and schedule of work of the Committee. In adopting its indicative schedule of work, Committee I agreed to exercise flexibility in the consideration of the items on its agenda.

(i) Status of the scientific knowledge of Earth and its environment (agenda item 7)

488. Committee I began its consideration of agenda item 7 at its 1st meeting, on 21 July.

489. The Chairman drew the attention of Committee I to chapter IV, section A.1, of the draft report of the Conference (A/CONF.184/3 and Corr.1 and 2), which had been forwarded by the Preparatory Committee to the Conference for consideration.

490. General remarks on agenda item 7 were made by the representatives of Brazil, Italy and the Republic of Korea and by the representatives of the United Nations Environment Programme and the World Meteorological Organization.

491. Committee I considered, paragraph by paragraph, chapter IV, section A.1, of the draft report of the Conference and provided detailed comments for finalizing the text. On the basis of the comments made by Committee I, a revised text was prepared by the executive secretariat.

492. Committee I also considered proposals received from the Technical Forum relating to agenda item 7. After Committee I had analysed those proposals, it amended and approved some of them, which were subsequently incorporated into the draft report of the Conference.

(ii) Benefits of basic space science and capacity-building (agenda item 9)

493. Committee I began its consideration of agenda item 9 at its 1st meeting, on 21 July.

494. The Chairman drew the attention of Committee I to chapter IV, sections D and E, of the draft report of the Conference (A/CONF.184/3 and Corr.1 and 2), which had been forwarded by the Preparatory Committee to the Conference for consideration.

495. At the 8th meeting of Committee I, on 26 July, a presentation was made on the deliberations of the Space Generation Forum.

496. Committee I considered, paragraph by paragraph, chapter IV, sections D and E, of the draft report of the Conference and provided detailed comments for finalizing the text. On the basis of the comments made by Committee I, a revised text was prepared by the executive secretariat.

497. Committee I also considered proposals from the Technical Forum relating to agenda item 9. After Committee I had analysed those proposals, it amended and approved some of them, which were subsequently incorporated into the draft report of the Conference.

(iii) Information needs and the global approach (agenda item 10)

498. Committee I began its consideration of agenda item 10 at its 1st meeting, on 21 July.

499. The Chairman drew the attention of Committee I to chapter IV, section F, of the draft report of the Conference (A/CONF.184/3 and Corr.1 and 2), which had been forwarded by the Preparatory Committee to the Conference for consideration.

500. The representatives of Brazil and Italy made general remarks on agenda item 10.

501. Committee I considered, paragraph by paragraph, chapter IV, section F, of the draft report of the Conference and provided detailed comments for finalizing the text. On the basis of the comments made by Committee I, a revised text was prepared by the executive secretariat.

502. Committee I also considered proposals received from the Technical Forum relating to agenda item 10. After Committee I had analysed those proposals, it amended and approved some of them, which were subsequently incorporated into the draft report of the Conference.

(iv) Promotion of international cooperation (agenda item 12)

503. Committee I began its consideration of agenda item 12 at its 2nd meeting, on 21 July.

504. The Chairman drew the attention of Committee I to chapter IV, section H, of the draft report of the Conference (A/CONF.184/3 and Corr.1 and 2), which had been forwarded by the Preparatory Committee to the Conference for consideration.

505. General remarks on agenda item 12 were made by the representatives of Belarus, Brazil, Canada, Egypt, France and Italy and by the representative of the European Space Agency.

506. Committee I considered, paragraph by paragraph, chapter IV, section H, of the draft report of the Conference and provided detailed comments for finalizing the text. On the basis of the comments made by Committee I, a revised text was prepared by the executive secretariat.

507. Committee I also considered proposals from the Technical Forum relating to agenda item 12. After Committee I had analysed those proposals, it amended and approved some of them, which were subsequently incorporated into the draft report of the Conference.

(v) Conclusion of work

508. At its 8th meeting, on 26 July, Committee I decided to refer paragraph 338 of the draft report to the Plenary for consideration.

509. At its 9th meeting, on 27 July, Committee I forwarded to the Plenary a recommendation to amend section II, subsection H, of the summary of the draft report.

510. At its 12th meeting, on 28 July, Committee I decided to recommend to the Plenary that all recommendations of the Space Generation Forum to the Conference (A/CONF.184/C.I/L.11 and Corr.1) be annexed to the report of the Conference.

511. At its 14th meeting, on 29 July, Committee I adopted its report and concluded its work.

2. Action by the Conference

512. At its 9th plenary meeting, on 30 July, the Conference considered the report of Committee I (A/CONF.184/L.17), which was introduced by its Vice-Chairman/Rapporteur.

513. The Conference took note of the report of Committee I and adopted the text recommended by the Committee for inclusion in the final report of the Conference.

D. Report of Committee II

1. Work of Committee II

(a) Introduction

(i) Establishment of Committee II and election of officers

514. At its 1st plenary meeting, on 19 July, the Conference established Committee II and elected the following officers of Committee II:

Chairman: Shunji Murai (Japan)

Vice-Chairman: Vladimír Kopal (Czech Republic)

Vice-Chairman/Rapporteur: Luiz Gylvan Meira Filho (Brazil)

(ii) Programme of work

515. The Conference allocated the consideration of agenda items 8 and 11 to Committee II.

516. The Conference requested that Committee II, in its consideration of agenda items 8 and 11, consider and approve section II, subsections A.2, B, C and G, of the summary of the draft report of the Conference (A/CONF.184/3 and Corr.1 and 2) and chapter IV, sections A.2, B, C and G, of the draft report of the Conference.

(b) Proceedings of Committee II

517. Committee II held a total of 12 meetings, from 20 to 29 July 1999.

518. At the 1st meeting of Committee II, on 20 July, the Chairman made an opening statement.

519. The Chairman drew the attention of Committee II to the rules of procedure of the Conference and made further proposals on the procedures and schedule of work of the Committee. In adopting its indicative schedule of work, Committee II agreed to exercise flexibility in the consideration of the items on its agenda.

520. At the 9th meeting, the Chairman informed Committee II that Luiz Gylvan Meira Filho (Brazil) could not complete his term of office and that the Plenary had agreed that Carlos José Prazeres Campelo (Brazil) would replace him as Vice-Chairman/Rapporteur of Committee II for the remainder of his term of office.

(i) Status and applications of space science and technology (agenda item 8)

521. Committee II began its consideration of agenda item 8 at its 1st meeting, on 20 July.

522. The Chairman drew the attention of Committee II to section II, subsections A.2, B and C, of the summary and of the draft report of the Conference (A/CONF.184/3 Corr.1 and 2) and to chapter IV, sections A.2, B and C, of the draft report of the Conference, which had been forwarded by the Preparatory Committee to the Conference for consideration.

523. General remarks on agenda item 8 were made by the representatives of Argentina, Brazil, Canada, Ecuador, Finland, Germany, Italy, Japan and the Republic of Korea.

524. Committee II considered, paragraph by paragraph, section II, subsections A.2, B and C, of the summary of the draft report of the Conference and chapter IV, sections A.2, B and C, of the draft report of the Conference and provided detailed comments for finalizing the text. On the basis of the comments made by Committee II, a revised text was prepared by the executive secretariat.

525. Committee II also considered proposals received from the Technical Forum relating to agenda item 8. After Committee II had analysed those proposals, it amended and approved some of them, which were subsequently incorporated into the draft report of the Conference.

(ii) Economic and societal benefits (agenda item 11)

526. Committee II began its consideration of agenda item 11 at its 5th meeting, on 23 July.

527. The Chairman drew the attention of Committee II to section II, subsection G, of the summary of the draft report of the Conference (A/CONF.184/3 and Corr.1 and 2) and to chapter IV, section G, of the draft report of the Conference, which had been forwarded by the Preparatory Committee to the Conference for consideration.

528. General remarks on agenda item 11 were made by the representatives of Brazil, the Democratic People's Republic of Korea and Italy.

529. Committee II considered, paragraph by paragraph, section II, subsection G, of the summary of the draft report of the Conference and chapter IV, section G, of the draft report of the Conference and provided detailed comments for finalizing the text. On the basis of the comments made by Committee II, a revised text was prepared by the executive secretariat.

530. Committee II also considered proposals received from the Technical Forum relating to agenda item 11. After Committee II had analysed those proposals, it amended and approved some of them, which were subsequently incorporated into the draft report of the Conference.

(iii) Conclusion of work

531. At its 12th meeting, on 29 July, Committee II adopted its report and concluded its work.

2. Action by the Conference

532. At its 9th plenary meeting, on 30 July, the Conference considered the report of Committee II (A/CONF.184/L.18), which was introduced by its Vice-Chairman/Rapporteur.

533. The Conference took note of the report of Committee II and adopted the text recommended by the Committee for inclusion in the final report of the Conference.

E. Report of the Technical Forum

1. Activities and work of the Technical Forum

(a) Introduction

534. The General Assembly, in its resolution 52/56 of 10 December 1997, agreed to convene the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) at the United Nations Office at Vienna from 19 to 30 July 1999. Many countries came to realize that UNISPACE III would serve as an ideal forum to construct a practical, well-defined framework within which global society could maximize the benefits of space science and technology through international cooperation in space activities in the years ahead. UNISPACE III attracted the participation of high-level government officials and policy makers from Member States, including heads of space agencies, as well as representatives of intergovernmental and non-governmental organizations. The Conference was also attended by senior executives of space-related industry.

(b) Programme

535. The Technical Forum was an integral part of UNISPACE III. It consisted of 38 seminars, workshops, symposia, scientific and technical forums, round tables and panel discussions. Its purpose was to examine in detail various issues of space science, technology and law related to the six substantive items on the agenda of the Conference. Each of the items was covered by several activities at the Technical Forum. Immediately following the completion of each activity, all conclusions and proposals that emanated from it were summarized and submitted to the relevant committee of UNISPACE III for consideration by Member States. Those conclusions and proposals made a significant contribution to the final report of the Conference.

536. The individual activities of the Technical Forum were prepared not only by Member States and national and international space agencies, but also by renowned scientific and technical organizations, such as the Committee on Space Research (COSPAR), the International Academy of Astronautics, the International Astronautical Federation, the International Astronomical Union (IAU), the International Institute of Space Law and many others.

537. In addition to the Technical Forum, from 18 to 23 July 1999 UNISPACE III hosted an exhibition highlighting global achievements in space technology and future developments. One hundred exhibitors from all over the world took part in the event.

538. A national technical presentation session and an industry presentation session were also organized during the Conference. The technical presentation session consisted of 15 presentations made by representatives of Argentina, Bolivia, China (2 presentations), Germany, Hungary, Italy, the Republic of Korea, the Russian

Federation, Spain (2 presentations) and the Syrian Arab Republic and by representatives of the United Nations Food and Agriculture Organization (FAO), the International Telecommunication Union (ITU) and the International Telecommunications Satellite Organization (INTELSAT).

539. The industry presentation session included presentations, reports and demonstrations of products and services made by representatives of the General Organization of Remote Sensing (Syrian Arab Republic), Boeing (United States of America), the Mitsubishi Electric Corporation and the Toshiba Corporation (Japan), the Khrunichev Space Centre and KBTM (Russian Federation), Brazsat (Brazil), GeoVille GmbH and GeoSpace GmbH (Austria), Iridium Telecommunications (Germany) and DAIS (Argentina).

540. Former students of the International Space University organized the Space Generation Forum, which was aimed at giving university students and young professionals a platform to express their creative vision for the future of space in the context of the themes being discussed at UNISPACE III.

(c) Proceedings of the Technical Forum

541. The Technical Forum was headed by its Chairman, Peter Jankowitsch (Austria).

542. The activities of the Technical Forum were structured according to the substantive agenda items of the Conference.

543. The first group of activities dealt with the status of the scientific knowledge of Earth and its environment (agenda item 7). Its main components were the Scientific Forum on Climate Variability and Global Change, prepared by the National Aeronautics and Space Administration (NASA) of the United States of America; the International Forum on the Integrated Global Observing Strategy, prepared by the IGOS Partnership; the Workshop "Blue Planet, Green Planet", prepared by the Centre national d'études spatiales (CNES) of France; and the Workshop on Meteorological Satellite Systems, prepared by the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) on behalf of the Coordination Group for Meteorological Satellites. Each meeting examined the current status of knowledge in those areas and identified ways and means of enhancing cooperation.

544. The second group of Technical Forum activities explored the status and applications of space science and technology (agenda item 8). To date, the most promising field of applications derived from advanced methods of remote sensing of the Earth. It was covered, for example, by the Workshop on Resource Mapping from Space, coordinated by the International Society for Photogrammetry and Remote Sensing, by the Workshop on Disaster Management, organized by the European Space Agency (ESA) and the National Space Development Agency (NASDA) of Japan, and the Workshop on Remote Sensing for the Detection, Monitoring and Mitigation of Natural Disasters, organized by the International Society for Photogrammetry and Remote Sensing. Applications of space remote sensing technology in agriculture, infrastructure, environment and decision-making had become a prerequisite in support of the sustainable development of global society. That segment of the Technical Forum also examined ways of using space technology, in particular satellite communications for global health, in the seminar organized by NASA, telemedicine and delivery of health care, in the workshop organized by the German Aerospace Center (DLR) and the Italian Space Agency (ASI), and tele-education, in the round table organized by the Office for Outer Space Affairs of the Secretariat.

545. The benefits of basic space science and capacity-building (agenda item 9) was another subject examined by the Technical Forum. Recent progress and future plans for further exploration of the solar system, in particular of Mars, as well as the study of near-Earth asteroids and comets, which might pose a risk to Earth in the future, were discussed. In that connection, the issues of how to avoid the contamination of near-Earth space resulting from human activity and how to preserve a clear sky for astronomical research were also addressed. Meetings to consider those issues were organized by COSPAR, the International Academy of Astronautics, IAU and the Planetary Society.

546. Questions related to education were discussed in the Special Workshop on Education, organized by IAU and COSPAR, in the Workshop on Education, organized by CNES, and in the Round Table on Integration of Earth Observation into Secondary Education, organized by the European Association for International Space Year (EURISY). A special presentation on the origin of life and its distribution in the solar system was also organized by CNES.

547. Another important group of issues was related to information needs and the global approach (agenda item 10) and economic and societal benefits of space technology applications (agenda item 11). In the workshop organized by the Canada Centre for Remote Sensing, the

emerging convergence of wireless communications, Earth remote sensing observation and geographic information systems were explored. The Canadian Space Agency prepared a two-session Workshop on Developing Indigenous Earth Observation Industrial Capabilities in Developing Countries. The emphasis was on capacity-building and on developing the necessary strategic partnership between government and industry. The Workshop produced a report on the options available to those countries and suggested courses of action to assist them in developing indigenous, self-sustaining Earth observation capabilities.

548. The Workshop on Small Satellites at the Service of Developing Countries produced important guidelines for near-term involvement of the United Nations in that promising area. Perspectives in the use of clean and inexhaustible solar power in space, discussed under the guidance of International Astronautical Federation experts, might exercise substantial influence on global society in the next millennium.

549. The promotion of international cooperation (agenda item 12) was considered as a central topic throughout the Technical Forum. The Office for Outer Space Affairs, in cooperation with the American Institute of Aeronautics and Astronautics, CNES, ESA, the Indian Space Research Organization (ISRO), the International Astronautical Federation, the International SpaceUniversity, NASDA and many others prepared a series of high-level discussion panels and forums involving the heads of space agencies, senior executives of the space industry, and academics to discuss the theme of the Conference, "Space Benefits for Humanity in the Twenty-first Century". In addition, the presentation of the results of the deliberations of several preparatory meetings and a four-day Workshop on Space Law in the Twenty-first Century, prepared by the International Institute of Space Law, also fell into that important category.

550. Within the framework of the Technical Forum, the Space Generation Forum was organized by and for young professionals nd university students to present their visions and perspectives regarding space activities. The results of the discussions in the Space Generation Forum are presented in annex II of the report of the Conference. During the Conference, a Space Festival was organized for young enthusiasts between 8 and 18 years old. The aim of the festival was to put young people in touch with the possibilities of the peaceful uses of outer space and with prospects for the fuutre of the world. From 20 to 23 July, over 100 young people from seven countries took part in the Festival and competed in three contests: flying model rockets, digital landscape photography from kites and an art contest. The first prize was awarded to the Titan team from Hungary.

(d) Conclusion

551. The recommendations made by the seminars, workshops, symposia, scientific and technical forums, round tables and panel discussions of the Technical Forum appeared in documents before Committee I (A/CONF.184/C.1/L.1-20) and Committee II (A/CONF.184/C.2/L.1-12 and L.14).

552. The Chairman of the Technical Forum presented its report to the Conference.

2. Action by the Conference

553. At its 9th plenary meeting, on 30 July, the Conference considered the report of the Technical Forum (A/CONF.184/L.13), which was introduced by the Chairman of the Technical Forum.

554. The Conference welcomed and took note of all of the conclusions and proposals emanating from the activities of the Technical Forum, which were annexed to its report (see annex III to the report of the Conference).

555. The Conference noted that the conclusions and proposals emanating from the activities of the Technical Forum had been submitted to the main committees to be considered for inclusion in the final report of the Conference. Where appropriate, the conclusions and proposals had been amended, approved and incorporated into the text recommended by the respective main committee to the Conference for adoption.

F. Activities of the Space Generation Forum

556. At its 9th plenary meeting, on 30 July, the Conference considered and took note of the report of the Space Generation Forum (A/CONF.184/C.1/L.11 and Corr.1), which was introduced by its Rapporteur.

557. The Conference welcomed with pleasure the high level of interest and commitment of participants in the Space Generation Forum, as well as the comprehensive nature of its discussions and the forward-looking contributions to the Conference that had characterized the activities of the Forum.

558. The Conference noted that conclusions and proposals emanating from the activities of the Space Generation Forum had been submitted to the main bodies of the

Conference for consideration for inclusion in the final report of the Conference. The Conference endorsed the recommendation of Committee I that recommendations of the Space Generation Forum (A/CONF.184/C.1/L.11 and Corr.1) be annexed to the report of the Conference (see annex II to the report of the Conference).

G. Report of the Credentials Committee

1. Work of the Credentials Committee

559. At its 1st plenary meeting, on 19 July 1999, the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), in accordance with rule 3 of its rules of procedure, appointed a Credentials Committee, composed of the following States: China, Fiji,[69] Jamaica,[69] Mali,[69] New Zealand,[69] Russian Federation, United States of America, Venezuela and Zimbabwe.

560. The Credentials Committee held one meeting, on 26 July 1999.

561. Lance Joseph (Australia) was unanimously elected Chairman of the Credentials Committee.

562. The Credentials Committee had before it a memorandum by the Secretary-General dated 26 July 1999 on the status of credentials of representatives to the Conference. On the basis of the information made available to it, the Committee noted that, as at 26 July 1999, credentials issued by the Head of State or Government or by the Minister for Foreign Affairs, as provided for in rule 3 of the rules of procedure of the Conference, had been submitted by the representatives of each of the following 65 Member States: Argentina, Australia, Austria, Azerbaijan, Belarus, Belgium, Bolivia, Brazil, Bulgaria, Burkina Faso, Canada, Chile, China, Colombia, Costa Rica, Cuba, Czech Republic, Democratic People's Republic of Korea, Denmark, Ecuador, Ethiopia, Finland, France, Germany, Greece, Hungary, India, Indonesia, Iran (Islamic Republic of), Iraq, Ireland, Japan, Kazakhstan, Kenya, Kuwait, Lithuania, Luxembourg, Malawi, Malaysia, Mexico, Monaco, Morocco, Netherlands, Norway, Portugal, Republic of Korea, Romania, Russian Federation, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, Sweden, Thailand, the former Yugoslav Republic of Macedonia, Tunisia, Turkey, Ukraine, United States of America, Uruguay, Venezuela, Viet Nam, Yemen and Zimbabwe.

563. Each of the following 33 States had communicated to the Secretary-General, by facsimile from its Head of State or Government or its Minister for Foreign Affairs or by letter or note verbale from its Permanent Mission, information concerning the appointment of its representatives to the Conference: Algeria, Angola, Benin, Cameroon, Cape Verde, Chad, Comoros, Cyprus, Egypt, Equatorial Guinea, Guatemala, Israel, Italy, Jordan, Lebanon, Libyan Arab Jamahiriya, Mongolia, Namibia, Niger, Nigeria, Oman, Pakistan, Panama, Peru, Philippines, Poland, Saudi Arabia, Senegal, Sudan, Syrian Arab Republic, Uganda, United Arab Emirates and United Kingdom of Great Britain and Northern Ireland.

564. The Chairman of the Credentials Committee proposed that the Committee adopt the following draft resolution:

"*The Credentials Committee of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space*,

"*Having examined* the credentials of the representatives to the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, referred to in paragraphs 4 and 5 of its report,[70]

"1. *Accepts* the credentials of representatives submitted in accordance with rule 3 of the rules of procedure of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space;

"2. *Also accepts* as provisional credentials the other communications received by and reported to the Committee on the understanding that credentials in due form as required under rule 3 of the rules of procedure would be submitted promptly to the Executive Secretary of the Conference by the authorities concerned;

"3. *Recommends* to the Conference that it approve the report of the Credentials Committee."[70]

565. The draft resolution proposed by the Chairman of the Credentials Committee was adopted by the Committee without a vote.

566. Subsequently, the Chairman of the Credentials Committee proposed that the Committee recommend to the Conference the adoption of a draft resolution, which was approved by the Committee without a vote.

2. Action taken by the Conference

567. At its 9th plenary meeting, on 30 July, the Conference considered the report of the Credentials Committee (A/CONF.184/5/Rev.1).

568. The Conference approved the report of the Credentials Committee and adopted the draft resolution

recommended by the Committee in its report. (For the text, see chapter I, resolution 3, of the report of the Conference.)

H. Adoption of the report of the Conference

569. At the 9th plenary meeting, on 30 July, the Rapporteur-General introduced and orally revised the draft report of the Conference (A/CONF.184/L.16 and Add.1-3).

570. At its 10th meeting, on 30 July, the Conference adopted the draft report, as revised, and authorized the Rapporteur-General to complete the report, in conformity with the practice of the United Nations, with a view to submitting it to the General Assembly at its fifty-fourth session.

I. Closure of the Conference

571. At the 10th plenary meeting, on 30 July, the representative of the Russian Federation introduced a draft resolution expressing to the Government of Austria the gratitude of the Conference participants. At the same meeting, the Conference adopted the draft resolution. (For the text, see chapter I, resolution 2, of the report of the Conference.)

572. At the same meeting, closing statements were made by the representatives of Japan, Saudi Arabia, South Africa, Pakistan, Germany, Ecuador (on behalf of the Group of Latin American and Caribbean States), India (on behalf of the member States of the Group of 77 and China), Finland (on behalf of the member States of the European Union and the European Space Agency), Australia (on behalf of the Group of Western European and Other States), the Libyan Arab Jamahiriya (on behalf of the Group of African States), the Islamic Republic of Iran (on behalf of the Group of Asian States), and the Republic of Korea.

573. After a statement had been made by the Executive Secretary of the Conference, the President of the Conference made a concluding statement and declared the Conference closed.

Notes

[1] See *Report of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Vienna, 9-21 August 1982* (A/CONF.101/10 and Corr.1 and 2).

[2] General Assembly resolution 2222 (XXI), annex.

[3] *Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992* (United Nations publication, Sales No. E.93.I.8 and corrigenda), vol. I: *Resolutions Adopted by the Conference*, resolution 1, annex II.

[4] The existing treaties and agreements are the Treaty on Principles Governing the Activities of States in the Exploration and Peaceful Use of Outer Space, including the Moon and Other Celestial Bodies (the "Outer Space Treaty"), which was adopted on 19 December 1966 and opened for signature on 27 January 1967 and which entered into force on 10 October 1967 (95 ratifications and 27 signatures); the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (the "Rescue Agreement"),which was adopted on 19 December 1967 and opened for signature on 22 April 1968 and which entered into force on 3 December 1968 (85 ratifications and 26 signatures); the Convention on International Liability for Damage Caused by Space Objects (the "Liability Convention"), which was adopted on 29 November 1971 and opened for signature on 29 March 1972 and which entered into force on 1 September 1972 (80 ratifications and 26 signatures); the Convention on Registration of Objects Launched into Outer Space (the "Registration Convention"), which was adopted on 12 November 1974 and opened for signature on 14 January 1975 and which entered into force on 15 September 1976 (40 ratifications and 4 signatures); and the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (the "Moon Agreement"), which was adopted on 5 December 1979 and opened for signature on 18 December 1979 and which entered into force on 11 July 1984 (9 ratifications and 5 signatures).

[5] *Official Records of the General Assembly, Fifty-second Session, Supplement No. 20*, (A/52/20), annex.

[6] General Assembly resolution 2222 (XXI), annex.

[7] General assembly resolution 41/65, annex.

[8] General Assembly resolution 2222 (XXI), annex.

[9] The COPINE project proposal to establish an efficient communications network among African professionals and scientists at the national and regional levels resulted from the recommendations of the Conference on Space Technology for Sustainable Development in Africa, held in Dakar in October 1993.

[10] A/CONF.184/5/Rev.1.

[11] The five treaties and agreements are the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (the "Outer Space Treaty"), which was adopted on 19 December 1966 and opened for signature on 27 January 1967 and which entered into force on 10 October 1967 (95 ratifications and 27 signatures); the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (the "Rescue Agreement"), which was adopted on 19 December 1967 and opened for signature on 22 April 1968 and which entered into force on 3 December 1968 (85 ratifications and 26 signatures); the Convention on International Liability for Damage Caused by Space Objects (the "Liability Convention"), which was

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[12] General Assembly resolution 1348 (XIII).

[13] The original members were: Albania, Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Czechoslovakia (succeeded by the Czech Republic), France, Hungary, India, Iran (Islamic Republic of), Italy, Japan, Lebanon, Mexico, Poland, Romania, Sweden, Union of Soviet Socialist Republics (succeeded by the Russian Federation), United Arab Republic (former name of Egypt), United Kingdom of Great Britain and Northern Ireland and United States of America. The membership was enlarged to 28 in 1961 (by admitting Chad, Mongolia, Morocco and Sierra Leone), to 37 in 1973 (by admitting Chile, the German Democratic Republic, Germany, Federal Republic of, Indonesia, Kenya, Nigeria, Pakistan, the Sudan and Venezuela), to 47 in 1977 (by admitting Benin, Cameroon, Colombia, Ecuador, Iraq, the Netherlands, the Niger, the Philippines, Turkey and Yugoslavia) and to 53 in 1980 (by admitting China, Greece, Portugal, Spain, the Syrian Arab Republic, Upper Volta (former name of Burkina Faso), Uruguay and Viet Nam). As part of the 1980 expansion, Spain and Greece were admitted on the understanding that they would alternate every three years with Portugal and Turkey, respectively. In 1990, the Ukraine was appointed a member of the Committee to fill the vacancy brought about by the accession of the German Democratic Republic to the Federal Republic of Germany. The current membership of 61 was constituted in 1994 (by admitting Cuba, Kazakhstan, Nicaragua, the Republic of Korea, Senegal, South Africa, the German Democratic Republic and Germany, Federal Republic of, having been succeeded by Germany). The practice of rotating membership between Greece and Turkey as well as between Portugal and Spain was terminated as part of the 1994 expansion, and Cuba and the Republic of Korea were admitted on the understanding that they would alternate every two years with Peru and Malaysia, respectively.

[14] General Assembly resolution 1721 (XVI) B.

[15] The bureaux consist of the Chairman, First Vice-Chairman and Second Vice-Chairman/Rapporteur of the Committee; the Chairman of the Legal Subcommittee; and the Chairman of the Scientific and Technical Subcommittee. Currently, U. R. Rao (India), Raimundo Gonzalez (Chile) and Mohamed Aït Belaïd (Morroco) serve as the Chairman, the First Vice-Chairman and the Second Vice-Chairman/Rapporteur of the Committee, respectively. The chairmen of the Scientific and Technical Subcommittee and the Legal Subcommittee are Dietrich Rex (Germany) and Vladimir Kopal (Czech Republic), respectively.

[16] Following a request by the General Assembly, the small expert unit that had initially been established to render assistance to the Ad Hoc Committee on the Peaceful Uses of Outer Space became a unit within the Department of Political and Security Council Affairs in 1962 to service the Committee on the Peaceful Uses of Outer Space and its Scientific and Technical Subcommittee. It was transformed into the Outer Space Affairs Division of that Department in 1968 and then into the Office for Outer Space Affairs within the Department of Political Affairs in 1992. Since 1993, when the Office was transferred from United Nations Headquarters in New York to the United Nations Office at Vienna, it has also been servicing the Legal Subcommittee, which had previously been serviced by the Office of Legal Affairs.

[17] General Assembly resolution 1472 (XIV) B.

[18] Kurt Waldheim (Austria) was elected President and Vikram A. Sarabhai (India) was elected Vice-President and Scientific Chairman of the Conference, which was attended by 78 Member States and 13 international organizations.

[19] General Assembly resolution 33/16.

[20] Following his appointment in October 1980 by the Secretary-General of the United Nations, Yash Pal (India) took office as Secretary-General of the Conference in March 1981. The other senior members of the Conference secretariat, including the Executive Secretary, three deputy secretaries-general and three senior advisers, were appointed and took office in January 1982.

[21] Willibald Pahr (Austria) was elected President and Carlos Antonio Bettencourt Bueno (Brazil) was elected Rapporteur-General of the Conference.

[22] *Report of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Vienna, 9-21 August 1982*, (A/CONF.101/10 and Corr.1 and 2).

[23] General Assembly resolution 37/90.

[24] *Report of the Second United Nations Conference ...*, para. 361.

[25] *Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992* (United Nations publication, Sales No. E.93.I.8 and corrigenda), vol. I: *Resolutions adopted by the Conference*, resolution 1, annex II.

[26] A/AC.237/18 (Part II)/Add.1 and Corr.1, annex I.

[27] Proposed by the Workshop on Clean and Inexhaustible Space Solar Power.

[28] Proposed by the Workshop "Blue Planet, Green Planet".

[29] Proposed by the Workshop on Space Debris.

[30] Proposed by the International Astronomical Union/Committee on Space Research/United Nations Special Environmental Symposium "Preserving the Astronomical Sky".

[31] General Assembly resolution 41/65, annex.

[32] Calibrated between instruments on different platforms.

[33] General Assembly resolution 44/236.

[34] IGOS is implemented through the partnership, which includes the following: CEOS; the World Climate Research Programme and the International Geosphere-Biosphere Programme; the International Group of Funding Agencies for Global Change Research; FAO; the Intergovernmental Oceanographic Commission of UNESCO; the International Council for Science; UNESCO; UNEP; WMO; GCOS; GOOS; and GTOS. The Partnership provides a continuing mechanism to oversee the IGOS process, with meetings arranged among the partners twice a year in association with the plenary sessions of CEOS and meetings of the Sponsors Group for the Global Observing Systems. New partners willing to contribute to the implementation of IGOS may be added.

[35] Proposed by the Forum on Space Activities in the Twenty-first Century.

[36] Proposed by the International Astronomical Union/Committee on Space Research/United Nations Special Workshop on Education in Astronomy and Basic Space Science.

[37] Proposed by the Special Workshop on Education.

[38] Proposed by the Symposium on the Contribution of Space Techniques to the Exploration of the Universe.

[39] Proposed by the Workshop on Observations of Near-Earth Objects

[40] Proposed by the Round Table on the Integration of Earth Observation into Secondary Education.

[41] Proposed by the Space Generation Forum: visions and perspectives of youth.

[42] Proposed by the Workshop on Geospatial Data Access.

[43] The practice of using high-resolution remote sensing imagery, GNSS and GIS to improve agricultural productivity at the level of individual fields.

[44] A/AC.105/700.

[45] The secretariats of GCOS, GOOS and GTOS are located in WMO, the Intergovernmental Oceanographic Commission of UNESCO and FAO, respectively.

[46] The World Climate Programme consists of four key components: the World Climate Research Programme, the World Climate Data and Monitoring Programme, the World Climate Applications and Services Programme and the World Climate Impact Assessment and Response Strategies Programme. UNEP is responsible for the implementation of the latter, while the World Climate Research Programme is implemented jointly by WMO, the Intergovernmental Oceanographic Commission and ICSU.

[47] The five outer space treaties and agreements are the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (the "Outer Space Treaty") (General Assembly resolution 2222 (XXI), annex); the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (the "Rescue Agreement"), (General Assembly resolution 2345 (XXII), annex); the Convention on International Liability for Damage Caused by Space Objects (the "Liability Convention") (General Assembly resolution 2777 (XXVI), annex); the Convention on Registration of Objects Launched into Outer Space (the "Registration Convention") (General Assembly resolution 3235 (XXIX), annex); and the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (the "Moon Agreement") (General Assembly resolution 34/68, annex).

[48] Expression used in article I of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.

[49] The five declarations and legal principles are the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space (General Assembly resolution 1962 (XVIII)); the Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting (General Assembly resolution 37/92, annex); the Principles Relating to Remote Sensing of the Earth from Outer Space (General Assembly resolution 41/65, annex); the Principles Relevant to the Use of Nuclear Power Sources in Outer Space (General Assembly resolution 47/68) and the Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries) (General Assembly resolution 51/122, annex).

[50] Proposed by the Workshop on Space Law in the Twenty-first Century, organized by the International Institute of Space Law.

[51] For example, the 1979 Moon Agreement has been ratified by only 9 States and signed by an additional 5 States, as opposed to the 1967 Outer Space Treaty, which has been ratified by 95 States and signed by an additional 27 States.

[52] The views received from Member States in that regard can be found in the note by the Secretariat on the review of the status of the five international legal instruments governing outer space (A/AC.105/C.2/L.210 and Add.1).

[53] These proposals can be found in the report of the Legal Committee on the work of its thirty-seventh session (A/AC.105/698, paras. 67-69).

[54] Proposed by the Workshop on Space Law in the Twenty-first Century organized by the International Institute of Space Law.

[55] Intergovernmental/private organizations are those which may involve some or substantial governmental ownership or other influence, but which operate in accordance with business principles. One example of such an organization is INTELSAT, EUMETSAT, EUTELSAT, Inmarsat and Intersputnik are also modifications of the basic INTELSAT model.

[56] Examples include CEOS, the Inter-Agency Consultative Group for Space Science and the Space Agency Forum.

[57] There are various modes of transnational industrial cooperation, such as joint ventures, merger and acquisition, strategic or tactical alliances and foreign direct investment.

[58] A recent example is the cooperation between Brazil and China to develop remote sensing satellites.

[59] *Official Records of the General Assembly, Fifty-second Session, Supplement No. 20* (A/52/20), annex II.

60 Proposed by the Workshop on Life Science Activities on the International Space Station.

61 Precedents already exist for having space issues on the agenda of the summit meetings of the Group of Eight, resulting in the creation of a framework for political support for certain space activities. Earth observation issues were discussed at the summit held in 1982 in Versailles, giving birth to the activities of CEOS. The United States' invitation to participate in the space station programme was on the agenda of summit meetings held in 1984 in London and in 1985 in Bonn.

62 Proposed by the Workshop on Managing Space Programmes in Developing Countries: Experience and Needs.

63 Proposed by the Forum on Industrial Utilization of the International Space Station.

64 Proposed by the International Astronomical Union/Committee on Space Research/United Nations Special Environmental Symposium "Preserving the Astronomical Sky".

65 Proposed by the Workshop on Intellectual Property Rights in Space

66 See the report of the Committee on the Peaceful Uses of Outer Space on its forty-second session (to be issued as *Official Records of the General Assembly, Fifty-fourth Session, Supplement No. 20* (A/54/20)).

67 *Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992* (United Nations publication, Sales No. E.93.I.8 and corrigenda), vol. I: *Resolutions adopted by the Conference*, resolution 1, annex II.

68 General Assembly resolution 2777 (XXVI), annex.

69 At its 7th plenary meeting, on 22 July 1999, the Conference elected Australia, Indonesia, the Libyan Arab Jamahiriya and Uruguay to replace Fiji, Jamaica, Mali and New Zealand, which had been elected at the 1st plenary meeting.

70 A/CONF.184/5/Rev.1.

Annex I

List of documents

A. Basic Conference documentation

Symbol	*Title or description*
A/CONF.184/1	Provisional agenda of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III)
A/CONF.184/2	Provisional rules of procedure of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space
A/CONF.184/3 and Corr.1-3	Draft report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space
A/CONF.184/4	Report of the Chairman of the Legal Subcommittee of the Committee on the Peaceful Uses of Outer Space to the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III)
A/CONF.184/5/Rev.1	Credentials of representatives to the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space: report of the Credentials Committee
A/CONF.184/L.1	Report of the pre-Conference consultations held in Vienna on 18 July 1999
A/CONF.184/L.2	Amendments to the draft Vienna declaration on space and human development
A/CONF.184/L.3	India (on behalf of the Group of 77 and China): amendments to the draft Vienna declaration on space and human development
A/CONF.184/L.4	Chile: amendment to the draft Vienna declaration on space and human development
A/CONF.184/L.5	Morocco: amendments to the draft Vienna declaration on space and human development
A/CONF.184/L.6	Provisional agenda of the Credentials Committee
A/CONF.184/L.7	Russian Federation: amendments to the draft Vienna declaration on space and human development
A/CONF.184/L.8 and Corr.1	Proposals of the Space Generation Forum: note by the Secretariat

Symbol	*Title or description*
A/CONF.184/L.9	Canada: amendments to the draft Vienna declaration on space and human development
A/CONF.184/L.10	Bolivia: amendment to the draft report of the Conference
A/CONF.184/L.11	Australia: amendment to the draft Vienna declaration on space and human development
A/CONF.184/L.12 and Corr.1	Venezuela: amendments to the draft Vienna declaration on space and human development
A/CONF.184/L.13	Report of the Technical Forum
A/CONF.184/L.14	Technical report of the Space Generation Forum
A/CONF.184/L.15	Republic of Korea: amendments to the draft Vienna declaration on space and human development
A/CONF.184/L.16 and Add.1-3	Draft report of the Plenary
A/CONF.184/L.17	Report of Committee I
A/CONF.184/L.18	Report of Committee II
A/CONF.184/C.1/1	Technical Forum: conclusions and proposals of the Workshop on Mars Exploration
A/CONF.184/C.1/L.1	Technical Forum: conclusions and proposals of the Scientific Forum on Climate Variability and Global Change
A/CONF.184/C.1/L.2	Technical Forum: conclusions and proposals of the International Astronomical Union/Committee on Space Research/United Nations Special Environmental Symposium "Preserving the Astronomical Sky"
A/CONF.184/C.1/L.3 and Corr.1	Technical Forum: conclusions and proposals of the Workshop on Managing Space Programmes in Developing Countries: Experience and Needs
A/CONF.184/C.1/L.4	Technical Forum: conclusions and proposals of the International Forum on the Integrated Global Observing Strategy: Into the Next Millennium
A/CONF.184/C.1/L.5	Technical Forum: conclusions and proposals of the Round Table on the Integration of Earth Observation into Secondary Education
A/CONF.184/C.1/L.6	Technical Forum: conclusions and proposals of the Symposium on Recent Progress and Future Plans for Exploration of the Solar System

Symbol	*Title or description*
A/CONF.184/C.1/L.7	Technical Forum: conclusions and proposals of the Workshop on Meteorological Satellite Systems of the Coordination Group for Meteorological Satellites
A/CONF.184/C.1/L.8	Technical Forum: conclusions and proposals of the International Astronomical Union/Committee on Space Research/United Nations Special Workshop on Education in Astronomy and Basic Space Science
A/CONF.184/C.1/L.9	Technical Forum: conclusions and proposals of the Workshop "Blue Planet, Green Planet"
A/CONF.184/C.1/L.10	Technical Forum: conclusions and proposals of the Symposium on the Contribution of Space Techniques to the Exploration of the Universe
A/CONF.184/C.1/L.11 and Corr.1	Space Generation Forum: visions and perspectives of youth
A/CONF.184/C.1/L.12	Technical Forum: conclusions and proposals of the Workshop on Space Law in the Twenty-first Century, organized by the International Institute of Space Law
A/CONF.184/C.1/L.13	Technical Forum: conclusions and proposals of the Forum on Space Activities in the Twenty-first Century
A/CONF.184/C.1/L.14	Technical Forum: conclusions and proposals of the session on the results from the 5th International Cooperation in Space Workshop: "International Space Cooperation: Solving Global Problems"
A/CONF.184/C.1/L.15	Technical Forum: conclusions and proposals of the Workshop on Geospatial Data Access
A/CONF.184/C.1/L.16	Technical Forum: conclusions and proposals of the Workshop on Space Debris
A/CONF.184/C.1/L.17	Technical Forum: conclusions and proposals of the Workshop on Observations of Near-Earth Objects
A/CONF.184/C.1/L.18	Technical Forum: conclusions and proposals of the Workshop on Intellectual Property Rights in Space
A/CONF.184/C.1/L.19	Technical Forum: conclusions and proposals of the Special Workshop on Education
A/CONF.184/C.1/L.20	Technical Forum: conclusions and proposals of the Workshop on Life Science Activities on the International Space Station

Symbol	*Title or description*
A/CONF.184/C.1/L.21 and Add.1-4	Draft report of Committee I
A/CONF.184/C.2/L.1	Technical Forum: conclusions and proposals of the Workshop on Disaster Management
A/CONF.184/C.2/L.2	Technical Forum: conclusions and proposals of the Workshop on Resource Mapping from Space
A/CONF.184/C.2/L.3	Technical Forum: conclusions and proposals of the Workshop on Remote Sensing for the Detection, Monitoring and Mitigation of Natural Disasters, organized by the International Society for Photogrammetry and Remote Sensing and the European Association of Remote Sensing Laboratories
A/CONF.184/C.2/L.4	Technical Forum: conclusions and proposals of the Seminar on Environment and Remote Sensing for Sustainable Development
A/CONF.184/C.2/L.5	Technical Forum: conclusions and proposals of the Seminar on Global Health
A/CONF.184/C.2/L.6	Technical Forum: conclusions and proposals of the Round Table on Tele-education
A/CONF.184/C.2/L.7	Technical Forum: conclusions and proposals of the Workshop on Small Satellites at the Service of Developing Countries
A/CONF.184/C.2/L.8	Technical Forum: conclusions and proposals of the Forum on Industrial Utilization of the International Space Station
A/CONF.184/C.2/L.9	Technical Forum: conclusions and proposals of the Workshop on Developing Indigenous Earth Observation Industrial Capabilities in Developing Countries
A/CONF.184/C.2/L.10	Technical Forum: conclusions and proposals of the Workshop on Global Navigation Satellite Systems
A/CONF.184/C.2/L.11	Technical Forum: conclusions and proposals of the Workshop on Clean and Inexhaustible Space Solar Power
A/CONF.184/C.2/L.12	Technical Forum: conclusions and proposals of the Workshop on Telemedicine
A/CONF.184/C.2/L.13 and Add.1-5	Draft report of Committee II
A/CONF.184/C.2/L.14	Technical Forum: conclusions and proposals of the Session on International Standardization for Space Systems

B. Information documents

Symbol	*Title or description*
A/CONF.184/INF/1 and Corr.1	Information for participants
A/CONF.184/INF/2	List of documents
A/CONF.184/INF/3 and Corr.1	List of participants

C. Background papers

Symbol	*Title or description*
A/CONF.184/BP/1	The Earth and its environment in space
A/CONF.184/BP/2	Disaster prediction, warning and mitigation
A/CONF.184/BP/3	Management of Earth resources
A/CONF.184/BP/4	Satellite navigation and location systems
A/CONF.184/BP/5	Space communications and applications
A/CONF.184/BP/6	Basic space science and microgravity research and their benefits
A/CONF.184/BP/7	Commercial aspects of space exploration including spin-off benefits
A/CONF.184/BP/8	Information systems for research and applications (with emphasis on global environmental issues)
A/CONF.184/BP/9	Small satellite missions
A/CONF.184/BP/10	Education and training in space science and technology
A/CONF.184/BP/11	Economic and societal benefits
A/CONF.184/BP/12	Promotion of international cooperation
A/CONF.184/BP/13	Space Benefits for Humanity in the Twenty-first Century
A/CONF.184/BP/14	Highlights in Space 1998: Progress in Space Science, Technology and Applications, International Cooperation and Space Law
A/CONF.184/BP/15	United Nations Treaties and Principles on Outer Space: A Commemorative Edition
A/CONF.184/BP/16	Space Activities of the United Nations and International Organizations

D. National papers and abstracts

Country	*Symbol of abstract*	*Symbol of national paper*
Algeria	A/CONF.184/AB/23	A/CONF.184/NP/23
Argentina	A/CONF.184/AB/8	
Australia	A/CONF.184/AB/37	A/CONF.184/NP/37
Austria	A/CONF.184/AB/24	A/CONF.184/NP/24
Azerbaijan		A/CONF.184/NP/52
Belarus	A/CONF.184/AB/13	A/CONF.184/NP/13
Bolivia	A/CONF.184/AB/19	
Brazil	A/CONF.184/AB/14	A/CONF.184/NP/14
Bulgaria	A/CONF.184/AB/44	A/CONF.184/NP/44
Canada	A/CONF.184/AB/32	A/CONF.184/NP/32
Chile	A/CONF.184/AB/38	A/CONF.184/NP/38
China	A/CONF.184/AB/26	A/CONF.184/NP/26
Colombia	A/CONF.184/AB/33	A/CONF.184/NP/33
Cuba	A/CONF.184/AB/31	A/CONF.184/NP/31
Czech Republic	A/CONF.184/AB/6	A/CONF.184/NP/6
Denmark	A/CONF.184/AB/2	
Egypt	A/CONF.184/AB/28	A/CONF.184/NP/28
Finland	A/CONF.184/AB/11	A/CONF.184/NP/11
France	A/CONF.184/AB/25	A/CONF.184/NP/25
Germany	A/CONF.184/AB/29	A/CONF.184/NP/29
India	A/CONF.184/AB/35	A/CONF.184/NP/35
Indonesia	A/CONF.184/AB/12	A/CONF.184/NP/12
Iran (Islamic Republic of)		A/CONF.184/NP/53
Iraq	A/CONF.184/AB/36	A/CONF.184/NP/36
Israel	A/CONF.184/AB/9	
Italy	A/CONF.184/AB/21	A/CONF.184/NP/21
Japan	A/CONF.184/AB/4	A/CONF.184/NP/4

Country	*Symbol of abstract*	*Symbol of national paper*
Jordan	A/CONF.184/AB/15	A/CONF.184/NP/15
Kazakhstan	A/CONF.184/AB/48	
Libyan Arab Jamahiriya		A/CONF.184/NP/54
Malaysia	A/CONF.184/AB/34	A/CONF.184/NP/34
Mexico	A/CONF.184/AB/45	
Morocco	A/CONF.184/AB/10	A/CONF.184/NP/10
Netherlands	A/CONF.184/AB/3	A/CONF.184/NP/3
Nigeria	A/CONF.184/AB/17	A/CONF.184/NP/17
Pakistan	A/CONF.184/AB/40	A/CONF.184/NP/40
Philippines	A/CONF.184/AB/56	A/CONF.184/NP/56
Poland	A/CONF.184/AB/22	A/CONF.184/NP/22
Portugal	A/CONF.184/AB/51	
Republic of Korea	A/CONF.184/AB/7	A/CONF.184/NP/7
Romania	A/CONF.184/AB/39	A/CONF.184/NP/39
Russian Federation	A/CONF.184/AB/47	A/CONF.184/NP/47
Saudi Arabia	A/CONF.184/AB/30	A/CONF.184/NP/30
Slovakia	A/CONF.184/AB/42	A/CONF.184/NP/42
South Africa	A/CONF.184/AB/50	
Spain	A/CONF.184/AB/5	A/CONF.184/NP/5
Sri Lanka		A/CONF.184/NP/55
Sweden	A/CONF.184/AB/1	A/CONF.184/NP/1
Switzerland		A/CONF.184/NP/46
Syrian Arab Republic	A/CONF.184/AB/57	
Thailand	A/CONF.184/AB/49	A/CONF.184/NP/49
Tunisia	A/CONF.184/AB/18	
Ukraine	A/CONF.184/AB/20	A/CONF.184/NP/20

Country	*Symbol of abstract*	*Symbol of national paper*
United Kingdom of Great Britain and Northern Ireland	A/CONF.184/AB/27	A/CONF.184/NP/27
United States of America	A/CONF.184/AB/16	A/CONF.184/NP/16
Uzbekistan	A/CONF.184/AB/41	
Viet Nam	A/CONF.184/AB/43	A/CONF.184/NP/43

E. Papers and abstracts submitted by intergovernmental organizations

1. Abstracts of papers

Symbol	*Title or description*
A/CONF.184/AB/IGO/1	Abstract of the paper of the International Organization of Space Communications
A/CONF.184/AB/IGO/2	Abstract of the paper of the European Space Agency
A/CONF.184/AB/IGO/3	Abstract of the paper of the United Nations Institute for Training and Research
A/CONF.184/AB/IGO/4	Abstract of the paper of the Economic and Social Commission for Asia and the Pacific
A/CONF.184/AB/IGO/5	Abstract of the paper of the International Telecommunications Satellite Organization
A/CONF.184/AB/IGO/6	Abstract of the paper of the World Meteorological Organization
A/CONF.184/AB/IGO/7	Abstract of the paper of the Food and Agricultural Organization of the United Nations
A/CONF.184/AB/IGO/11	Abstract of the paper of the United Nations Educational, Scientific and Cultural Organization

2. Papers

Symbol	*Title or description*
A/CONF.184/IGO/2	Paper of the European Space Agency
A/CONF.184/IGO/4	Paper of the Economic and Social Commission for Asia and the Pacific
A/CONF.184/IGO/5	Paper of the International Telecommunications Satellite Organization
A/CONF.184/IGO/6	Paper of the World Meteorological Organization
A/CONF.184/IGO/7	Paper of the Food and Agriculture Organization of the United Nations
A/CONF.184/IGO/8	Paper of the South Pacific Applied Geoscience Commission/South Pacific Forum
A/CONF.184/IGO/9	Paper of the International Telecommunication Union
A/CONF.184/IGO/10	Paper of the Economic Commission for Africa

F. Abstracts of papers submitted by non-governmental organizations

Symbol	*Title or description*
A/CONF.184/AB/NGO/1	Abstract of the paper of the International Astronomical Union
A/CONF.184/AB/NGO/2	Abstract of the paper of the Committee on Space Research
A/CONF.184/AB/NGO/3	Abstract of the paper of the International Society for Photogrammetry and Remote Sensing

G. Documents of the preparatory bodies of the Conference

1. Document for the pre-Conference consultations

Symbol	*Title or description*
A/CONF.184/PRE-CONF/L.1	Note by the Secretariat on matters for consideration in the pre-Conference consultations to be held in Vienna on 18 July 1999

2. Documents of the Preparatory Committee

Symbol	*Title or description*
A/CONF.184/PC/6	Note verbale dated 12 July 1999 from the Permanent Mission of the Russian Federation to the International Organizations in Vienna addressed to the Office for Outer Space Affairs of the Secretariat
A/CONF.184/PC/L.1	Note by the Secretariat on the draft report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, prepared for consideration by the Preparatory Committee at its 1998 session
A/CONF.184/PC/L.2	European position paper on the draft report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space: working paper submitted by the United Kingdom of Great Britain and Northern Ireland on behalf of the following member States of the European Space Agency (ESA) and States having cooperation agreements with ESA: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Norway, Portugal, Romania, Spain, Sweden and Switzerland
A/CONF.184/PC/L.3	Note by the Secretariat on the draft provisional rules of procedure for the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space
A/53/20	Report on the forty-first session of the Committee on the Peaceful Uses of Outer Space, including preparations for the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space by the Preparatory Committee
A/52/20	Report on the fortieth session of the Committee on the Peaceful Uses of Outer Space, including the report on the 1997 session of the Preparatory Committee

3. Documents of the Advisory Committee

Symbol	*Title or description*
A/CONF.184/PC/1	Note by the Secretariat on the draft report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, prepared for consideration by the Advisory Committee at its 1999 session
A/CONF.184/PC/L.4	Report by the Secretariat on organizational matters relating to the holding of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space

Symbol	*Title or description*
A/AC.105/C.1/L.218	Note by the Secretariat on the draft report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, prepared for consideration by the Advisory Committee at its 1998 session

4. Documents of the regional preparatory conferences

Symbol	*Title or description*
A/CONF.184/PC/2	Report on the Regional Preparatory Conference for the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space for Asia and the Pacific (Kuala Lumpur, 18-22 May 1998)
A/CONF.184/PC/3	Report on the Regional Preparatory Conference for the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space for Latin America and the Caribbean (Concepción, Chile, 12-16 October 1998)
A/CONF.184/PC/4	Report on the Regional Preparatory Conference for the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space for Africa and the Middle East (Rabat, 26-30 October 1998)
A/CONF.184/PC/5	Report on the Regional Preparatory Conference for the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space for Eastern Europe (Bucharest, 25-29 January 1999)
A/CONF.184/PC/L.5 and Add.1	Recommendations of the regional preparatory conferences for the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space
A/C.4/53/8	Note verbale dated 23 October 1998 from the Permanent Mission of Chile to the United Nations addressed to the Secretary-General, transmitting the text of the Concepción Declaration

Annex II

Report of the Space Generation Forum*

I. Procedures

1. In December 1997, the Secretariat invited the International Space University to organize a youth forum as part of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space.

2. The 160 participants of the Space Generation Forum were from 60 nations. Their expertise covered all fields of space, including science, technology, law, ethics, art, literature, anthropology and architecture, and many other fields relevant to space.

3. The participants of the Space Generation Forum were encouraged from the beginning to think in terms of a broader perspective, encompassing all humanity, and to disregard national agenda. All participants spoke only as concerned individuals, guided by their conscience and a belief in the power of space to change humanity in positive ways.

4. The discussions of the Space Generation Forum resulted in 49 recommendations (A/CONF.184/L.8 and Corr.1, annex). On 23 July, the participants were asked to choose the 10 best recommendations. Consensus was achieved concerning the selection of the 10 recommendations.

II. Guiding vision

5. It was noted that the cosmos naturally inspired wonder and curiosity. Throughout history, space had provided humanity with both fertile soil for the imagination and practical benefits for daily use. In ancient times, people had learned to navigate ships, plant crops and determine the seasons by observing objects in the night sky. In the twentieth century, people had developed the ability to go into space and had even visited some of those objects which had once guided their way.

6. It was noted that the combination of human ingenuity and the rich province of space had yielded benefits that had not been possible to imagine only 100 years ago. Although what lay ahead was unknown, the more important question was "In what manner will the space millennium unfold?".

7. The participants of the Space Generation Forum expressed the hope and the conviction that the common future of persons living on Earth ought to proceed ethically, with an understanding of the long-term consequences of their action and with all peoples walking forward together as one.

* The recommendations of the Space Generation Forum are presented in more detail, together with implementation plans, in document A/CONF.184/L.14

III. Recommendations

8. The participants of the Space Generation Forum agreed on the following recommendations:

Universal space education

1. An appeal should be made to the Office for Outer Space Affairs and the United Nations Educational, Scientific and Cultural Organization to develop a space education curriculum, to be implemented by Member States in their education curricula. The dissemination of resources and knowledge should be a cooperative effort to improve literacy involving Governments, corporations and non-governmental organizations at the national and international levels.

2. A Space Prize, having the equivalent status of the Nobel Prize, should be awarded in recognition of outstanding achievement in the area of peaceful applications of outer space for the benefit of society, in order:

(a) To advocate the peaceful uses of outer space;

(b) To increase awareness of achievements made towards bringing outer space closer to society;

(c) To promote international cooperation through professional interaction.

Meeting basic needs from an ethical standpoint

3. The United Nations and mobile satellite communication operators should work together to establish a memorandum of understanding on priority access to mobile satellite communication networks during disasters and emergencies.

4. Given the many programmes throughout the world aimed at providing developing countries with useful space technologies, there should be a programme for promoting the implementation of those technologies, taking into account cultural and ecological differences, in exchange for the discontinuation of activities harmful to the Earth.

Cooperation among nations

5. An international space authority should be constituted to make possible:

(a) Oversight and enforcement of a balanced optimization of the multiple interests in space;

(b) Access for all peoples to the material benefits and knowledge and understanding resulting from the exploration and use of space resources;

(c) The pooling of resources of nations and industries for the creation of space infrastructure, missions and enterprises for the optimal development of large-scale space endeavours.

6. An international entity should be created, charged with maximizing the economic value of all space activities by facilitating long-term investments to accelerate space exploration and development, bringing the full benefits of space technology to all nations and promoting public awareness worldwide.

An enduring human presence on Earth and in space

7. An appeal should be made to the United Nations to recognize the hazards and dangers in outer space that threaten the Earth and to take adequate, proactive measures to mitigate or prevent the risks involved.

8. An international centre for space medicine should be established to provide a sound basis for the development, promotion and application of state-of-the-art space medicine for the benefit of humanity on Earth and in space.

Maintaining accountability with regard to the objectives

9. Given that young people have a responsibility to take an active role in the promotion and development of space, it is recommended that a youth advisory council be established as part of the Committee on the Peaceful Uses of Outer Space.

10. The Space Generation Forum should be held every five years, with an annual follow-up meeting. The link with the International Space University should be maintained, and the annual follow-up meeting should be held in parallel with the annual conference of the International Astronautical Federation.

Annex III

Conclusions and proposals emanating from the activities of the Technical Forum

Contents

I. Conclusions and proposals of the Scientific Forum on Climate Variability and Global Change*

1. The climate of the Earth's system is a consequence of a complex interplay of external solar forcing and internal interactions among the atmosphere, the oceans, the land surface, the biosphere and the cryosphere. Surface climate generally defines thresholds for the sustainability of water resources, agriculture, human shelter, transportation and health, among other things. Variability within the climate system has a significant impact on natural and managed resources throughout space and on all time-scales, posing a particularly acute challenge to better observe the Earth's system, improve understanding of interactive processes and produce more sophisticated conceptual models of the Earth's system.

2. Inter-annual variability in the coupled ocean-atmosphere system is best exemplified by the well-known El Niño/Southern Oscillation phenomenon and its corresponding cold phase, La Niña; their impact is generally worldwide. It is now known that human activities are increasingly being recognized as a potential factor forcing change in the global system by altering the chemical composition of the atmosphere and the oceans, as well as the character of the land surface and vegetation cover. Of particular interest is the potential regional impact of such changes on coastal areas, freshwater resources, food production systems and natural ecosystems.

3. Over the past 10 or more years, substantial improvements have been made in observing technology and in constructing sophisticated computer models of the Earth's system. Currently, predictions are routinely made of detailed weather anomalies as well as inter-annual climate variability and global climate change. Improving the accuracy of those predictions requires more comprehensive global observations of key variables, better calibration procedures and, importantly, the uninterrupted maintenance of observing systems over long periods of time. In that connection, special efforts are required to ensure the continuity of monitoring systems and the incorporation of proven research or experimental observing technology into stable operational platforms. It is also considered crucial that the next generation of operational observing systems be designed specifically to meet the more stringent requirements imposed by the need for the detection of climate and global change. With some exceptions, those requirements are not adequately met by most of the existing operational observing systems.

4. During the first decade of the next millennium well over 30 new Earth observing satellites are expected to be launched. They will provide an unprecedented capability to monitor, on a global basis, nearly all aspects of the Earth's climate system. In order to take advantage of those observations, a parallel effort is required in data assimilation, data analysis and modelling technology. In particular, improvements are required in high-resolution regional and local applications. Several scientific issues remain to be addressed with regard to the observation and parameterization of processes in conceptual and mathematical computer models of the global Earth system and its interactive component subsystems. Of particular importance are the quantification and representation of hydrological and biogeochemical cycles in models. The modelling of biogeochemical processes, which involve the cycling of nutrients and carbon by and through land and ocean ecosystems, is less developed than the models dealing with the physical atmosphere and the ocean.

* A/CONF.184/C.1/L.1.

5. The Scientific Forum on Climate Variability and Global Change recognized the considerable progress made in observing technology and also in the improved delivery of products for resource management. Also recognized were the strides made in the improvement of weather and climate predictions, both critical aspects in nearly all activities of the world. Notwithstanding past achievements, the Scientific Forum considered it necessary actively to pursue improvements in global observing systems and in research into climate and global change. To that end the Scientific Forum recommended that action be taken:

(a) To improve scientific knowledge of the interactions between the interlinked components of the global Earth system, namely, the atmosphere, the oceans, the land surface and vegetation and the cryosphere, and, in particular, the global water, energy and carbon cycles;

(b) To improve monitoring and understanding of external and internal forcing and feedback processes governing climate and global change, including the effects of anthropogenic influences;

(c) To improve space-based observing technology in conjunction with surface-based and *in situ* networks to observe the composite global Earth system and to develop integrated data assimilation models, as well as diagnostic and prediction models of the behaviour of the Earth's system and climate throughout space and on all timescales, paying particular attention to the transition from research and observing platforms to operational systems and to the calibration and long-term stability of operational observing systems for climate variability and global change applications;

(d) To improve, through monitoring, the preparation and distribution of assessment products and information to mitigate, where possible, the potential impact of climate and global change on food supply, water resources and managed and natural ecosystems; and to improve the monitoring and prediction of extreme events and other natural disasters;

(e) To encourage all States to participate in the development of a cohesive, internationally coordinated, global Earth observing strategy in order to provide, on a long-term basis, the data required for operational management and decision-making services, as well as for research into global change.

Amendments to the draft report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) for consideration of Committee II and/or Committee I

6. In order to incorporate the conclusions and recommendations of the Scientific Forum on Climate Variability and Global Change into the report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), the following changes are suggested to the draft report of the Conference (A/CONF.184/3 and Corr.1 and 2):

Paragraph 84

(a) Replace the subheading "Applications in weather forecasting" with the subheading "Applications in weather and climate forecasting";

(b) Replace the words "The weather" with the words "The weather and climate";

Paragraph 85

(c) Replace the words "Since many weather phenomena" with the words "Since many weather and climate phenomena";

Paragraph 126

(d) Replace the words "To improve the understanding of weather phenomena" with the words "To improve the understanding of weather and climate phenomena";

Paragraph 88

(e) Insert paragraphs 1, 2 and 3 from the conclusions of the Scientific Forum contained in the present document as new paragraphs 88 *bis*, 88 *ter* and 88 *quater*;

Paragraph 90

(f) Insert paragraph 4 from the above conclusions as paragraph 90 *bis*.

Chapter V: The space millennium—Vienna declaration on space and human development

(g) Add a new section to read:

III. *bis* Advancing scientific knowledge of the Earth-climate system and global environmental change

Action should be taken:

[*Insert paragraphs 5 (a)-(e) from the conclusions of the Scientific Forum.*]

II. Conclusions and proposals of the International Astronomical Union/Committee on Space Research/United Nations Special Environmental Symposium "Preserving the Astronomical Sky"*

Recalling the paragraphs of the draft report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) (A/CONF.184/3 and Corr.1 and 2) referenced in parentheses below, and noting that:

(a) Understanding the nature of the universe is one of humanity's oldest and strongest fascinations and has been of immense scientific, cultural and practical value for many centuries. Observations at all wavelengths of the electromagnetic spectrum, from the ground and from space, have been vital in the phenomenal progress in all areas of astronomy in the twentieth century, from the exploration of the solar system to discoveries of the echo of the big bang and the beginnings of structure in the universe (paras. 1, 2, 6 and 28);

(b) The space treaties adopted by the United Nations have defined outer space and the space environment as the province of all mankind, to be protected from harmful contamination and adverse changes of all kinds, the exploration and peaceful use of which should be carried on for the benefit and in the interests of all mankind (para. 313). This principle is also strongly supported by the International Astronomical Union and the Committee on Space Research;

(c) Nevertheless, continued scientific studies of the origin and evolution of the universe and mankind's place within it are being jeopardized worldwide by man-made environmental problems of rapidly growing severity. In space, interference in radio frequencies by telecommunications satellites and their ever-increasing demand for frequency space (para. 158) cloud the future of radio astronomy and the operation of scientific satellites for astronomy and remote sensing; space debris is a growing threat to

* A/CONF.184/C.1/L.2.

scientific satellites and interferes with ground-based observations (para. 70); and projects to launch bright objects into space to illuminate the Earth or for artistic, celebratory or advertising purposes present a growing danger to observational astronomy against which no international protection at present exists (para. 73). On the ground, man-made light pollution has already made large areas of the world unsuitable for astronomical observations and is beginning to influence wildlife;

(d) Space is not just another place to do business (para. 273), but a finite natural resource common to all of humanity and already showing inexorable symptoms of over-exploitation (para. 70). The problems enumerated above are global in extent and some are long-term or irreversible in time. Owing to the extreme sensitivity of astronomical observations, science has been the first to detect and suffer from these effects, but it will not be alone for long;

It is recommended that:

(a) Member States should continue to cooperate, at the national and regional levels, and with industry and through the International Telecommunication Union, to implement suitable regulations to preserve quiet frequency bands for radio astronomy and remote sensing from space (para. 162), and to develop and implement, as a matter of urgency, practicable technical solutions to reduce unwanted radio emissions and other undesirable side-effects from telecommunications satellites;

(b) Member States should cooperate to explore new mechanisms to protect selected regions of Earth and space from radio emissions (radio quiet zones), and to develop innovative techniques that will optimize the conditions for scientific and other space activities to share the radio spectrum and coexist in space;

(c) Member States should cooperate, as a matter of urgency, to ensure that future space activities that would cause potentially harmful interference with the scientific research or natural, cultural and ethical values of other nations (para. 73) are subjected to an environmental impact assessment and international consultations before approval;

(d) Member States should cooperate to ensure that the implementation of measures, at the international level, to preserve all aspects of the space environment in the long term, are included in the work plan of the Committee on the Peaceful Uses of Outer Space and its Subcommittees (paras. 318-321). It is proposed that section III, subparagraph (b), of the draft Vienna declaration on space and human development be formulated more adequately as follows:

> "To improve the protection of the near and outer space environment through further research in, and implementation of, measures to control and reduce the amounts of space debris and unwanted emissions at all wavelengths of the electromagnetic spectrum";

(e) Member States should act to control pollution of the sky by light and other causes, for the benefit of energy conservation, the natural environment, night-time safety and comfort and the national economy, as well as science.

III. Conclusions and proposals of the Workshop on Managing Space Programmes in Developing Countries: Experience and Needs*

1. Space technology and its applications have been widely recognized as one of the major instruments for enhancing capabilities to manage the environment, shrinking distances for effective communications and for promoting economic development, in particular for developed countries. While there is increasing recognition in most developing countries of the need to use such high technology input in support of sustainable development and of developmental activities, interestingly there are two interrelated issues to be addressed: firstly, promoting the technology itself and the associated problems encountered and, secondly, effective utilization of the high technology knowledge, once acquired, for sustainable development activities.

2. Many developing countries have initiated their own space technology and applications programmes. The essential impetus for embarking on such programmes is the need to support the nation's developmental needs and to deal with the problems of education, pollution, health, telecommunications, environmental management, utilization of natural resources, weather and climate applications, food security, urban and rural infrastructure, land-use management and many other local-level resource problems. Technology development is a major issue that is being addressed by developing countries, specifically by means of small satellites and their launches.

3. In that connection, the Workshop participants examined the overall objectives and achievements of space programmes of different developing and developed countries, with special emphasis on the management models used and applications of space science and technology that could be gainfully integrated into the developmental programmes in developing countries.

4. Presentations were made by participants from Brazil, India, Indonesia, Malaysia, Pakistan and South Africa on the experience in organizing the national space programmes in their countries. Subsequently, in the panel discussion, many participants from developing countries addressed issues highlighting the developmental imperatives and the methods by which they could be addressed using space technology. The Workshop participants also noted the advances made in many developing countries in organizing national space programmes and effectively maximizing the benefits from space technology for people.

5. The major recommendations emanating from the Workshop are:

(a) Developing countries need to be encouraged to utilize space in support of their national developmental activities and to address the basic requirements of their people: education, pollution monitoring, health, telecommunications, environmental management, weather and climate applications, utilization of natural resources, food security, urban and rural infrastructure, land-use management and many other local-level resource problems;

(b) An institutional framework within individual developing countries would help in developing national space programmes. The framework could address policy and programme issues, as well as the implementation of the programme. The framework could also address the key research and development issues and operational development plans and lay stress on the involvement of industry;

* A/CONF.184/C.1/L.3.

(c) Given the lack of educated and trained manpower, international efforts are required to ensure that sufficient opportunities are available to developing countries to build their human resource base in different areas of space technology and its applications;

(d) Enhancing indigenous capacities in developing countries needs to be the objective of international cooperation, addressing the effective transfer of knowledge and know-how to developing countries;

(e) There is a need for a forum for the sharing of experience among developing countries in the use of space technology, perhaps in the form of a clearing house for technology and applications. The United Nations and other intergovernmental agencies could take a lead role in such an initiative;

(f) Efforts should be made by international bodies and developed countries to share technology elements in support of space programme development in developing countries. Some areas where developing countries are making efforts in the development of small satellites and the initiation of such activities need to be supported further;

(g) There is a need to look at innovative solutions to meet space technology and applications in support of developing countries. One such proposal put forward is the possibility of a series of small equatorial-orbit satellites to meet imagery requirements. This needs further study and definition.

IV. Conclusions and proposals of the International Forum on the Integrated Global Observing Strategy: Into the Next Millennium*

1. The Integrated Global Observing Strategy (IGOS) Partnership, established in 1998, links the major satellite- and surface-based systems for global environmental observations of the atmosphere, oceans, land and biota. IGOS is a strategic planning process, involving many partners, that combines research, long-term monitoring and operational programmes, as well as data producers and users, in a framework that delivers maximum benefit and effectiveness. It recognizes that data collection must be user-driven, leading to information products that increase scientific understanding and guide early warning, policy-setting and decision-making for sustainable development and environmental protection.

2. The complex global observing activities needed to understand and monitor Earth processes and to assess the impact of human activity require integration and cooperation at many levels. Such cooperation is imperative because of the impossibility for any single nation to equip itself to carry out all its necessary observations either because of the costs involved in space observations or the complexity of the logistic of many *in situ* observations. The need for collaboration between data providers also arises from the fact that contemporary data products often require the combination of multiple observations from multiple sources.

3. IGOS provides both a strategic framework and a planning process to bring together remotely sensed and *in situ* observations, from both research and operational programmes. Major thrusts of IGOS as it proceeds will include strengthening space-based and *in situ* linkages to improve the balance between satellite remote sensing and ground- or ocean-based observing programmes; encouraging the transition from research to operational environmental observations within appropriate institutional structures; improving data policies and facilitating data access and exchange; stimulating better

* A/CONF.184/C.1/L.4.

archiving of and access to data to build the long-term time-series necessary to monitor environmental change; and increasing attention to harmonization, quality assurance and calibration and validation so that data can be used more effectively. IGOS encourages the use of modular approaches to strategies for specific components or processes that need to be integrated and thematic approaches to particular categories or cross-cutting themes of observations such as oceans, disaster management and carbon storage and cycling.

4. Most environmental observations come from national activities, carried out by national Governments through agencies, ministries and research programmes, and their commitment is essential to the effective implementation of IGOS. The IGOS process promotes awareness of the benefits arising from integrated global observations in contributing to meeting the political objectives that have been set to improve the way the Earth is understood and managed. Moreover, IGOS can make a significant contribution to assisting national Governments and international organizations in implementing the international environmental conventions through both improved data and information access and quality of observations.

5. The Integrated Global Observing Strategy is implemented through an IGOS Partnership that includes the Committee on Earth Observation Satellites (CEOS), the World Climate Research Programme and the International Geosphere-Biosphere Programme, the International Group of Funding Agencies for Global Change Research, the Food and Agriculture Organization of the United Nations, the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (UNESCO), the International Council for Science, the United Nations Environment Programme, and the World Meteorological Organization, as well as the Global Climate Observing System, the Global Ocean Observing System and the Global Terrestrial Observing System. The Partnership provides a continuing mechanism to oversee the IGOS process, with meetings arranged among the partners twice a year in association with the plenary sessions of CEOS and meetings of the Sponsors Group for the Global Observing Systems. New partners willing to contribute to the implementation of IGOS can be added.

6. Participants in the Technical Forum on IGOS were briefed on the status of the development of IGOS and the creation of the IGOS Partnership. Participants underscored the relevance of IGOS to many of the themes of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) and encouraged the continued implementation of IGOS. In particular, support was voiced for the role of IGOS in:

(a) Enhancing international cooperation in general and between data providers, users and policy makers in particular;

(b) Promoting more effective means of using space-based data in addressing practical problems and environmental issues of local, regional and global significance;

(c) Capacity-building in the area of Earth observation and global environmental monitoring, especially in developing countries.

7. The main recommendations of the Forum are as follows:

(a) The efforts of the IGOS Partnership to achieve a coherent articulation of the requirements for data from Earth observing systems and to stimulate the coordinated development and integration of remote sensing and *in situ* data collection systems should be supported. This is an essential process to combine current and planned space capabilities with those on the ground and in the oceans, and should involve international bodies and national agencies and organizations, including industry;

(b) The rapid improvement in the quality, frequency and resolution of satellite data acquisition must be matched by a comparable strengthening of the complementary surface observation and ground "truthing" activities;

(c) The reinforcement of a full range of data collection programmes and of the institutional structures for processing, archiving, integrating and assessing environmental data from all sources is essential to build the reliable long-term time-series of data necessary for global change research on critical environmental problems;

(d) Special attention should be given to strengthening the research, operational, data collection and analysis and application capacities of developing countries to fill critical gaps in global data sets and their utilization to improve local knowledge of changes in and pressures on environmental resources;

(e) As observing systems for environmental data collection prove their usefulness, Governments should support the transition from research and development programmes to operational environmental observing programmes with appropriate institutional arrangements and budgetary support;

(f) The systematic assessment of user needs and of the ability of satellite instruments to meet those needs should be continued and extended. Commitments will be needed from space agencies to meet the resulting requirements and also from users to maximize the use of satellite-derived inputs in their modelling and decision-making processes.

V. Conclusions and proposals of the Round Table on the Integration of Earth Observation into Secondary Education*

1. The consensus among participants of the various meetings of the European Association for the International Space Year (EURISY) on the subject of Earth observation as a tool for learning (notably the meeting held in Frascati, Italy, in 1998) is that enhancing education and training opportunities about space is a major educational challenge. In accordance with the draft report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) (A/CONF.184/3 and Corr.1 and 2), referenced in parentheses below, EURISY recommends:

(a) That efforts should be undertaken to improve education on space subjects by using space tools, namely, satellite-based observation (e.g. satellite images) and communication systems. In fact, it is becoming increasingly cheaper and easier to obtain access to space-related databases, freely accessible World Wide Web sources on Earth observation and courses for teachers on remote sensing (para. 227) through a satellite network than by other means of transmission. This is true both for developed countries, which often face high telecommunication charges, and for vast, sparsely populated areas or developing countries;

(b) Since successful knowledge of the benefits brought by space activities depends on well-trained teachers, that initial and in-service teacher training in the field be made part of long-term strategies for human resource development (para. 229). Space programmes are multi-disciplinary by nature (environmental subjects, biology, geography, physics, astronomy, telecommunications information technologies, etc.), global in their scope and local in their applications. They provide an ideal basis for those multidisciplinary projects

* A/CONF.184/C.1/L.4.

which stimulate teachers, help to build bridges across disciplines and borders, provide on-the-spot in-service training and broaden students' horizons;

(c) That the United Nations and the United Nations Educational, Scientific and Cultural Organization (para. 231) urge the relevant decision-making bodies in ministries of education to institutionalize space studies in national curricula and teacher training programmes as the best way to meet the needs and demands of present and future generations.

2. It is also desirable for some inter-European ventures on Earth observation for primary and secondary school purposes to be made known, through the United Nations, to other countries beyond Europe, thereby developing satellite image material and enriching the World Wide Web databases on Earth observation that are currently being created, as recommended at the EURISY meeting in Frascati in 1998. This will also foster among students an interest in individual research, the ability to visualize abstract concepts and the development of skills in using information technology-based tools (para. 228).

3. On the basis of the EURISY and other cross-border initiatives, the creation of an international partnership for cooperation in space education along the lines of the Integrated Global Observing Strategy is now needed to address this matter worldwide.

VI. Conclusions and proposals of the Symposium on Recent Progress and Future Plans for Exploration of the Solar System*

1. Reports were made by the four large space agencies. The Institute of Space and Astronautical Science of Japan had a rather wide programme covering exploration of the Moon, all terrestrial planets and asteroids. The Russian Federation, in spite of its present severe financial situation, maintained a Mars programme at the Russian Aviation and Space Agency that it planned to expand in future to other terrestrial planets. The European Space Agency (ESA) programme included projects to study Mars, Mercury and small bodies (comets, asteroids and Titan). The National Aeronautics and Space Administration (NASA) of the United States of America had a large programme for Moon and Mars exploration, small bodies, outer planets and moons.

2. The presentations made by the representatives of the four agencies had brought into perspective the worldwide effort to reach a new level of knowledge in the exploration of the solar system, more specifically of Mars, the Moon and the small bodies, including near-Earth objects. Quite clearly, such a vast enterprise would profit, on both scientific and economic grounds, from international collaborative and coordinated activities such as those carried out by the Inter-Agency Consultative Group in relation to the exploration of Halley's Comet and the International Solar-Terrestrial Physics programme.

3. Composed of the four agencies mentioned above, ESA, the Institute of Space and Astronautical Science, NASA and the Russian Aviation and Space Agency, the Inter-Agency Consultative Group had in its first phase coordinated the missions of the five spacecraft directed towards Halley's Comet and the ground-based Halley Watch. Some 40 spacecraft were involved in the second phase, providing data on the solar-terrestrial environment that were being analysed through scientific campaigns set up and coordinated by the Consultative Group. In both phases, through the coordination of the Consultative

* A/CONF.184/C.1/L.6.

Group, a significantly higher level of scientific return had been obtained than the mere sum of individual results from the different spacecraft.

4. Exploration of the solar system would constitute the third phase of the work of the Inter-Agency Consultative Group. The latter had already initiated the creation of the Mars Exploration Working Group and of the International Lunar Exploration Working Group specifically to address and coordinate Mars and lunar activities. The Consultative Group was also setting up a Working Group on Solar System Exploration to address and coordinate the several missions of the four agencies to explore the small bodies (e.g. asteroids and comets), including near-Earth objects.

VII. Conclusions and proposals of the Workshop on Meteorological Satellite Systems of the Coordination Group for Meteorological Satellites*

1. Participants in the Workshop on Meteorological Satellite Systems of the Coordination Group for Meteorological Satellites, held in the framework of the Technical Forum of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), noted with satisfaction that, since its creation in 1972, the Coordination Group had provided a forum in which satellite operators had studied, jointly with the World Meteorological Organization (WMO), the technical and operational aspects of the global network, in order to ensure maximum efficiency and usefulness through proper coordination in the design of the satellites and in the procedures for data acquisition and dissemination. The Coordination Group could be credited with considerable accomplishments. For example, the participants noted that:

(a) The Coordination Group had played a key role in the coordination of satellite operators' activities. It had been very successful in coordinating the overall system in terms of orbital positions, contingency, dissemination schedules, data collection systems and frequency. Concerning the latter, the Coordination Group had noted that it was absolutely necessary to provide the required protection to passive sensor bands and to limit the sharing of such bands with active services. The Coordination Group should strive to continue to meet the requirements of the user communities and to provide even better coordination to maximize the efficiency of the system as a whole;

(b) The Coordination Group had been very successful in establishing standards for the betterment of all users. It had recently agreed upon the standardization of low-rate dissemination services, low-resolution picture transmission and low-rate information transmission. It should strive to standardize all the dissemination services;

(c) The Coordination Group had improved the products delivered to the user through the exchange of information concerning product development, both in plenary meetings and in co-sponsored workshops such as those in the Winds Workshop Series and International TIROS Operational Vertical Sounder (TOVS) Working Group Meetings and other conferences and workshops. The Coordination Group brought top scientists together to discuss specific problems. The scientific interactions greatly enhanced the value of the products;

(d) The Coordination Group should highlight the landmark contingency planning that had occurred between the various satellite operators. The initiatives of the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) and the

* A/CONF.184/C.1/L.7.

National Environmental Satellite, Data and Information Service of the National Oceanic and Atmospheric Administration (NOAA) of the United States had contributed greatly to the stability of space-based observing systems by providing a reasonable level of assurance to the user communities that the satellite data, products and services would have continuity;

(e) Coordination Group satellite operators had responded directly to the requirements of the user communities through the user community representative, WMO. The direct interaction between user and provider was mutually beneficial and should continue in the future.

2. The Coordination Group was contributing and would contribute even more in the future to the global objectives of UNISPACE III, providing synoptic, continuous and long-term global observations needed to understand the Earth's system more comprehensively, in conjunction with the use of modelling technology. The data delivered by Coordination Group members would contribute to the improvement of the human condition, providing reliable weather forecasting and long-term climate prediction, making possible the better management of the limited resources of Earth. The Coordination Group was fully aware that that contribution would only be effective with the development of further knowledge and capacity-building within the user community. Therefore, the Coordination Group was developing important education and training activities. Finally, the Coordination Group was totally committed to promoting international cooperation, as stated in its charter, and therefore to enhancing weather forecasting by sharing information from all relevant satellites operated by its members in order to develop new meteorological applications.

VIII. Conclusions and proposals of the International Astronomical Union/Committee on Space Research/United Nations Special Workshop on Education in Astronomy and Basic Space Science*

1. Having considered the draft report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) (A/CONF.184/3 and Corr.1 and 2), the International Astronomical Union/Committee on Space Research/United Nations Special Workshop on Education in Astronomy and Basic Space Science noted the following (paragraphs in parentheses refer to paragraphs in the draft report):

(a) Human resources with appropriate knowledge and skills are the critical factor in developing and using space science and technology (para. 184). Nevertheless, many countries still lack the educational capacity to build and deploy such skilled human resources. Thus, promoting scientific literacy is one of the great challenges for the future (paras. 190-192);

(b) Astronomy and the origin of humankind in the universe have fascinated humans through the ages and astronomy is still viewed favourably by a public that is otherwise becoming increasingly sceptical about science. Thus, astronomy and basic space science have a unique ability to make an education in the physical and applied sciences attractive to young people. Astronomy has also long been an important vehicle for effectively passing on a wide range of scientific knowledge and teaching the basic principles of scientific reasoning and for communicating the excitement of science to the public (paras. 191, 192 and 213);

* A/CONF.184/C.1/L.8.

(c) Education in astronomy and basic space science in many developing countries remains impeded by the lack of trained instructors, teaching materials and a clear vision of the role of astronomy and basic space science within the broader context of education in physical and applied sciences (para. 325);

(d) Finally, many trained scientists remain unable to contribute effectively to the development of their countries because of scientific isolation and their lack of suitable employment and research tools (paras. 186, 206 and 325).

2. The Special Workshop made the following recommendations:

(a) All States should formulate national policies for education in basic space science. The International Astronomical Union (IAU), the Committee on Space Research (COSPAR) and other international organizations should help to collect and systematize information on experience with the build-up of education in astronomy and basic space science, at various levels of formal and informal education, in countries with differing conditions. That information could help interested States to assess their current situation and develop realistic national goals and expectations, as well as effective long-term educational strategies, adapted to local conditions. In implementing such strategies, it is recommended that a significant fraction (1-2 per cent) of the budgets of national space projects be devoted to education and public outreach activities (paras. 194, 229, 325 and 328);

(b) International organizations such as IAU and COSPAR should help to develop an inventory of teaching methods and materials that have proved effective in various countries at all levels of formal and informal education, up to and including the graduate level. The inventory should include methods and materials for the training and professional development of teachers, introducing multicultural and multidisciplinary elements as necessary. The materials should be disseminated to interested States and communities worldwide and adapted to local conditions as appropriate in collaboration with other partners (paras. 194, 196, 210, 211 and 229);

(c) Collaboration should be established between the regional centres for space science and technology education, affiliated to the United Nations, and IAU, COSPAR and other scientific organizations to strengthen components of their curricula that involve astronomy and basic space science and thus increase the attraction and effectiveness of their programmes in basic, environmental and applied space sciences (paras. 199, 205, 206, 215, 217 and 231);

(d) All States should recognize that, for space scientists and engineers to serve effectively in the technical, economic and social development of their country, they need suitable employment and adequate research tools, as well as appropriate training. Developing partnerships with industry and increasing the public's appreciation of science should be considered important steps towards achieving those goals (paras. 197, 198, 226, 229, 328 and 337).

IX. Conclusions and proposals of the Workshop "Blue Planet, Green Planet"*

1. The study of the environment is the study of the Earth system. It requires coordinated multidisciplinary action at every level. Global climate change is largely the result of the

* A/CONF.184/C.1/L.9.

growth of greenhouse gases, stemming from anthropogenic activity taking place on a regional or local scale. Global phenomena have a local and regional impact, however. Examples are the impact of El Niño on the living conditions of Peruvian fisherfolk and the impact of drought on nomads in the Sahel. The Workshop "Blue Planet, Green Planet" concentrated on those important scientific problems with a major short-, middle- or long-term social impact, especially on the poorest sections of the population. The regional impact of climate change can best be studied after more is known about their mechanisms and characteristics.

2. The Workshop examined the two major systems on the Earth's surface: oceans and dry land. It examined some local concerns, but concentrated more on regional and global phenomena, the means of observing them and model-building that make it possible to understand and predict their behaviour and their interactions.

3. The most crucial scientific issue in this field is learning more about the carbon cycle, in particular the role of carbon dioxide (and that of methane), and about the water cycle, together with their interactions. For example, it would be useful to know more about the impact of a change in the water cycle on the carbon cycle, from one year to another and in the long term.

4. There is a need to know more about the carbon flux: how much the land emits; how much it absorbs; what the role is of the anthropogenic factor; how the balance between oceans and dry land evolves; and what interaction there is between major oceanic phenomena such as El Niño and the carbon flux. Research has been done on some 2 billion tons, out of a total of about 100 billion tons, the anthropogenic contribution being around 6 billion tons.

5. Growth in modelling and data assimilation, together with progress in space techniques and orbital systems, has made important contributions to the knowledge and understanding of those mechanisms. Systems such as the advanced very high resolution radiometer (AVHRR) of the National Oceanic and Atmospheric Administration (NOAA) of the United States of America, the Satellite pour l'observation de la Terre (SPOT 4) Vegetation system, the Polarization and Directionality of the Earth's Reflectances (POLDER) system, Topex-Poseidon and ENVISAT, among others, have helped to increase not only the knowledge and understanding of the evolution of those phenomena, but also the possibility of predicting them.

6. It is important to set standards for space system products. In addition, there is a need to organize a coherent database and to ensure the continuity of space systems.

7. The Workshop made the following recommendations:

(a) Homogeneous, calibrated and validated databases of surface parameters (both land and ocean) of the last two decades should be established, with a view to providing a documented historical perspective of the Earth's evolution;

(b) The above-mentioned databases should be used to support improved global change models;

(c) The continuous acquisition of high-quality remote sensing surface data should be ensured;

(d) Data availability should favour the largest user community;

(e) The needs of the users, including developing countries, should be taken into account when designing new systems;

(f) New methods and associated databases that include socio-economic data should be developed that will make it possible to use new systems together with historical data records.

X. Conclusions and proposals of the Symposium on the Contribution of Space Techniques to the Exploration of the Universe*

1. The participants of the Symposium on the Contribution of Space Techniques to the Exploration of the Universe, organized by the Committee on Space Research (COSPAR), noted with satisfaction the following:

(a) Exploration of the universe using space techniques had made impressive progress since the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space, held in 1982, and major fundamental discoveries had been made in the study of the entire electromagnetic spectrum in relation to a number of scientific topics;

(b) New challenges were being addressed by the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) to ensure continued technological development so that even more complex future missions could be undertaken. Given its complexity, space research to explore the universe was an international endeavour, requiring global collaboration;

(c) The extensive, publicly accessible, scientific databases that were currently available or becoming available from space observatories also allowed global participation in scientific analysis and interpretation, including by developing countries.

2. Accordingly, the participants of the COSPAR Workshop recommended the following (paragraph numbers in parentheses refer to paragraphs in the draft report of UNISPACE III (A/CONF.184/3 and Corr.1 and 2)):

(a) Existing activities, such as the successful series of United Nations/European Space Agency workshops on basic space science, organized in the period 1991-1999, should continue to be supported (paras. 199 and 215);

(b) New initiatives, such as those of COSPAR and the International Astronomical Union aimed at organizing, together with the regional centres for space science and technology, workshops on more specific topics, should be encouraged (paras. 222 and 223).

XI. Conclusions and proposals of the Workshop on Space Law in the Twenty-first Century, organized by the International Institute of Space Law**

A. Introduction

1. The Workshop on Space Law in the Twenty-first Century, organized by the International Institute of Space Law, noted that the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, (General Assembly resolution 2222 (XXI), annex, of 19 December

* A/CONF.184/C.1/L.10.

** A/CONF.184/C.1/L.12.

1966) and other international instruments built upon it had been successful in answering the challenge to create a legal framework for exploration and peaceful uses of outer space and had thereby preserved the space environment for the benefit of humankind. However, the present significant changes in space activities had given rise to a need for further developing that framework, while protecting what the international community had gained.

2. The Workshop also noted that the Legal Subcommittee of the Committee on the Peaceful Uses of Outer Space, as a vehicle for law-making within the United Nations, was currently in a unique position to take up issues related to space law in an exploratory way. Those issues could be dealt with by the Legal Subcommittee in a flexible manner, subject to decision by the Committee and the General Assembly on the sequence in which they should be included in the agenda of the Subcommittee.

3. The Workshop proposed the recommendations listed below.

B. Conclusions and proposals

4. The rapid expansion of private activities in and related to outer space requires examination of many aspects of existing space law, in particular:

(a) With respect to space application services, which give rise to responsibility, liability and jurisdiction issues not currently covered by space law;

(b) The impact of commercialization and privatization of space activities on the public service aspects of such services;

(c) Intellectual property rights and technology transfer issues that may require special treatment for global uniformity in practice;

(d) The protection of investors' rights as regards space objects and space artefacts, which may require totally new approaches in order for it to be effective and enforceable;

(e) The nationality of spacecraft;

(f) The protection of the environment, where private entities are currently not held directly accountable.

It is recommended that a new paragraph 319 *bis* be added to the draft report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (A/CONF.184/3 and Corr.1 and 2) as follows:

> "319 *bis*. Member States of the United Nations should initiate discussion of and seek solutions to emerging legal problems of relevance and should, in particular recognize the need to consider the expanding role of private enterprise when making new laws. With regard to the protection of the environment, the establishment of launch standards and environmental impact assessments should be examined. Specialized agencies should consider drafting standards and recommended practices as well as models for partnerships involving public and private enterprises in their respective sectors of space activity. The concept of 'public service' and its various manifestations should be developed further, paying particular attention to the global public interest and to the needs of developing countries. The principles of fair trade should be strengthened. Attention should also be paid to the various aspects of the issues of liability and security of ownership in order to arrive at a coherent global framework. The international organizations concerned should make arrangements for effective and focused joint forums."

5. The use of outer space is expanding and many of the resources (orbits, frequencies, access to ground infrastructure etc.) have turned out to be limited. Consequently, such

resources should be dealt with by means of coherent frameworks for global resource management. The global public interest in this field can be safeguarded primarily by public institutions. There is currently a need for coordination in this area. It is recommended that a new paragraph 319 *ter* be added to the draft report as follows:

> "319 *ter*. Member States of the United Nations should consider possible coordinating frameworks for space-related global resource management. This work should focus on the needs, the potential conflicts, the natural limits, the values, the costs and the growing privatization of space activities. International organizations involved in space activities should seek coordination at an early stage. There is a need to have at least a code of conduct concerning space debris. To this end, previous work in this area should be taken into account with a view to identifying possible models. The Legal Subcommittee of the Committee on the Peaceful Uses of Outer Space, together with its Scientific and Technical Subcommittee, should discuss the topic without delay. The development of a legal regime for low-Earth orbits (LEOs) should be considered, taking into account recent changes in the ITU convention concerning the status of LEOs as limited natural resources. The issue of security of ownership regarding spacecraft should be addressed promptly, for example, by means of an international inventory linked to the Register of space objects maintained by the Secretary-General of the United Nations. The General Assembly should encourage Member States to adhere to the Convention on Registration of Objects Launched into Outer Space (Assembly resolution 3235 (XXIX), annex, of 12 November 1974). In the context of the role of international organizations, the issue of consumer rights should be dealt with. The General Assembly, through the Committee on the Peaceful Uses of Outer Space and/or through special meetings for this purpose, should consider soon how best to coordinate the burgeoning demands on global resources generated by expanding space activities, both governmental and non-governmental."

6. The ongoing development of space activities requires the resolution of a growing number of issues. Space activities are increasingly being affected by the expanding body of international economic law, which is blurring the boundaries between public and private law and generating more reliance on recommended standards and practices. In this environment, it is important to have appropriate dispute settlement mechanisms for giving effect to the principles of outer space law in a flexible and timely manner. It is recommended that a new paragraph 319 *quater* be added to the draft report as follows:

> "319 *quater*. The General Assembly should consider the development of effective mechanisms for the settlement of disputes arising in relation to space commercialization. Those mechanisms should take into account existing arbitration rules used in international practice for dispute settlement."

7. The expanding growth in areas such as commercial remote sensing services, commercial complexity, the effect on international cooperation and scientific and industrial applications of services necessitates consideration of appropriate regulations. National restrictions on access to data are emerging. It is recommended that a new paragraph 32 *bis* be added to the draft report as follows:

> "321 *bis*. The Legal Subcommittee of the Committee on the Peaceful Uses of Outer Space should initiate the drafting of a treaty covering remote sensing from outer space on the basis of the Principles Relating to Remote Sensing of the Earth from Outer Space (General Assembly resolution 41/65, annex, of 3 December 1986), taking into particular account the expanding growth in commercial remote sensing services and preserving the principle of non-discriminatory access to data."

8. Many emerging issues are influenced by rapid advances in space science and technology. Space law should be based upon a solid foundation of scientific and technological facts to ensure effective legal formulation. Interaction among scientific and legal experts will strengthen the relevance of space law. It is recommended that a new paragraph 321 *ter* be added to the draft report as follows:

> "321 *ter*. The Legal Subcommittee and the Scientific and Technical Subcommittee should in general meet at the same time so that there can be more interaction involving the work of those two bodies."

9. One of the most challenging new developments in space activities concerns expanding global navigation satellite services. It is recommended that a new paragraph 175 *bis* be added to the draft report as follows:

> "175 *bis*. The recommendations set forth in paragraphs [319 *bis*, 319 *ter*, 319 *quater*, 321 *bis* and 321 *ter*] below should apply, where relevant, to GNSS."

C. Final remark

10. The proceedings of the Workshop on Space Law in the Twenty-first Century should be referred to for clarification of the above-mentioned issues and recommendations.

XII. Conclusions and proposals of the Forum on Space Activities in the Twenty-first Century*

A. Introduction

1. A Forum on Space Activities in the Twenty-first Century, co-sponsored by the International Astronautical Federation, the International Space University and Prospective 2100, was held during UNISPACE III to address the question of the space activity in the next century that would best meet the needs of humanity. Participants from a broad range of nations and backgrounds developed the following high-level findings and recommendations on two major topics considered during both plenary sessions and workshops, namely, "Living on planet Earth" and "Leaving planet Earth".

B. General findings

2. During the next century, attention will shift from considering only living on planet Earth to considering both living on planet Earth and leaving planet Earth. Such a shift demands a reconsideration of space activity and its increasing role in human development.

3. Using Earth and solar energy, life developed and, finally, a small number of humans were accommodated in Earth's biosphere. Humankind is now positioned both to have a marked influence on Earth's biosphere and to migrate away. In the next century, space activity will be central to monitoring and controlling such human influence on Earth's biosphere and to human migration to other biospheres.

C. General recommendations

4. General recommendations applicable to both topics:

* A/CONF.184/C.1/L.13.

(a) Strategies for enhancing international cooperation in space should be explored and implemented, starting from the earliest phases of strategic planning;

(b) Space exploration should be widely used to provide motivating educational processes and materials;

(c) All people should be engaged in space activities through education about the position of humankind in the cosmos and its implications on humanity;

(d) All people should be involved in the adventure and discovery of space exploration and the search for life elsewhere and in the formulation of the goals for and implementation of space activities.

D. Living on planet Earth in the twenty-first century

1. Finding

5. Human activities on Earth will be increasingly dependent on space assets.

6. Space activity will support the sustainability of life on Earth:

(a) As the world's population increases, space activity makes possible or easier the continuing provision of the necessities of life such as food, water, protection of shelter, the health of the life support environment, education, the benign use of Earth's resources, energy, communications, transportation guidance and safety, and security against natural and hostile human interventions;

(b) Space activity helps define the place of humanity in the cosmos and generates adventure. It also adds to the quality of life by generating economic value, by being a positive human motivational force and by providing the tools leading to a just and equitable society.

2. Recommendations

7. It is recommended that space activity be pursued in such a manner as to maximize the benefits to society at large living on Earth by:

(a) Continuing the development of space assets to observe, measure, communicate, warn and increase knowledge about Earth and its environment;

(b) Measuring the capacity and limitations of Earth's resources as regards supporting life;

(c) Developing and applying space activity to make possible or easier the provision of the necessities of life such as food, water, shelter, the health of the life support environment, education, the benign use of Earth's resources, energy, communications, transportation guidance and safety, and security against natural and hostile human interventions;

(d) Developing new skills and space assets to free humankind from complete dependence on the biosphere;

(e) Developing effective, reliable, safe, clean and low-cost space transportation systems for space activity on a much larger scale than at present.

E. Leaving planet Earth in the twenty-first century

1. Finding

8. Humans have developed a limited capacity to explore the depths of the solar system and of the universe through robotic devices and also the capacity to support life outside the biosphere in a very limited way. Humankind is ready to develop those two capacities fully, allowing it to explore, understand, prospect and settle away from Earth.

2. Recommendations

9. Humans should prepare to follow their inexorable drive to explore and gain knowledge and understanding beyond Earth by:

(a) Developing integrated scenarios and strategies for space exploration, utilization, development and settlement;

(b) Investigating the synergy between and integration of robotic and human space exploration;

(c) Continuing the development of space assets to observe, measure, and warn about the elements of the universe, as well as to communicate and increase knowledge about those elements;

(d) Developing effective, reliable, safe, clean and low-cost space power and transportation systems for space exploration on a much larger scale than at present;

(e) Developing space-based energy sources, including *in situ* fuels, for use in space or transfer to Earth;

(f) Further developing, adapting and applying tools already developed for use on Earth for use on extraterrestrial bodies, in particular the Moon;

(g) Determining the resources required for long-term migration beyond Earth;

(h) Defining roles for the protection and preservation of the planetary and space environment and establishing a framework for implementation;

(i) Investigating the medical, psychological, social, ethical and legal frameworks for the development of communities in space;

(j) Establishing biospheres beyond Earth and establishing pilot space settlements, thereby learning to live away from the Earth's biosphere;

(k) Encouraging the development of space tourism.

XIII. Conclusions and proposals of the session on the results from the 5th International Cooperation in Space Workshop: "International Space Cooperation: Solving Global Problems"*

1. The 5th International Cooperation in Space Workshop consisted of five independent working groups addressing diverse topics. The major findings and recommendations of each working group are described below.

* A/CONF.184/C.1/L.14.

2. *The Working Group on the Government-industry Partnership in Space Projects: Towards Commercialization* found that effective public-private partnerships were vital for the continued growth and commercialization of the global space sector. Participants recommended that selection of a particular form of partnership and path to commercialization be based on the ratio of public to private sector investment and the degree of commercialization and risk. Partnerships should satisfy criteria for success such as the benefits to be offered to all partners, a predictable and adaptable policy and regulatory environment, and complementary and realistic objectives. Potential barriers, whether cultural and organizational, political and legal, technical and programmatic or economic, needed to be identified and then removed or minimized. Access by developing countries to the products and services of space systems would require the establishment of a trained workforce and the necessary ground infrastructure. For that to occur, such countries would have to provide an enabling environment.

3. *The Working Group on Global Navigation Satellite Systems* concluded that satellite navigation systems should be fully interoperable and transparent to the user and as a consequence recommended that the United States of America and the European Union develop a common definition of global navigation satellite systems (GNSS) for civil and public safety services. A consolidated definition of the modernized United States Global Positioning System and the technical characteristics of the proposed Galileo system of the European Union was required and should be generated as soon as possible by the relevant technical staffs. The European Union should also continue its dialogue with the Russian Federation concerning possible Russian involvement in the Galileo system and the maintenance of the Russian Global Navigation Satellite System (GLONASS). Globally recognized and rigidly protected GNSS frequency allocations were required and should be the subject of a common approach developed before the World Radiocommunication Conference in the year 2000. The dual civil and military use of GNSS services created security requirements that needed to be taken into account in both civil and military international dialogues. Developing countries needed to be made aware of the cost benefits and security issues related to satellite navigation, through GNSS-related workshops, seminars and internships organized under the auspices of the United Nations Programme on Space Applications of the Office for Outer Space Affairs.

4. *The Working Group on International Earth Observation Data Distribution Systems* determined that factors preventing developing countries from using international Earth observation data distribution systems included a lack of awareness of the benefits of Earth observation, lack of infrastructure and a need for education and training. Focused effort would be required on the part of the United Nations to make relevant information available; space agencies and commercial system operators should become more attuned to the needs of developing countries; and the developing countries themselves should be more active in obtaining archived data and training from the appropriate sources. Discussions to date on Earth observation data distribution had taken place for the most part at the intergovernmental level and needed to be expanded to include authorities at the regional and local levels also. The Working Group noted that the collection of Earth observation data over certain geographical regions conflicted with national security interests and, given that such restrictions impeded the development of diverse Earth observation products and services, recommended strong support for the Principles Relating to Remote Sensing of the Earth from Outer Space (General Assembly resolution 41/65, annex).

5. *The Working Group on Using Space Assets of Disaster Management* recognized that space assets could contribute greatly to the field of disaster management. A major communication gap existed between the space community and the disaster management community, however. To overcome this, the Working Group recommended establishing

and maintaining a one-call coordination and information resource, which would supply information and services, using space-based remote sensing, telecommunications and navigation assets, to disaster managers. Services could include monitoring potential disaster risk. The successful implementation and operation of such a resource would require the active support of the disaster management community in its initiation, definition and evaluation. Several members of the Working Group were currently engaged in establishing such a resource. Organizations of the United Nations system could play a major role in defining user requirements and support and should determine how and to what extent to contribute to that effort.

6. *The Working Group on the Growing Number of Satellites in Orbit: Facing the Issues* determined that commercial and government operators needed accurate, timely and dependable information regarding the location of satellites and the planned allocation of resources. They recommended the establishment of an international clearing house, or international orbital information centre, to collect, maintain and interpret data regarding existing and planned satellites constellations and to facilitate their distribution. The issue of collision avoidance also needed to be addressed from a number of standpoints, including in relation to collision warning, liability and avoidance strategies, which could be an additional task for the international orbital information centre to undertake. The Working Group was of the opinion that government and commercial operators would be willing to pay for such a service. An in-depth study to examine the feasibility of an advisory or regulatory framework to address issues of space traffic control should be carried out in cooperation with the United Nations. The Working Group was of the opinion that, while the situation of orbital crowding was not yet critical, it was important to move forward immediately on the above issues before the proliferation of space objects reached unmanageable proportions.

XIV. Conclusions and proposals of the Workshop on Geospatial Data Access*

1. The Workshop on Geospatial Data Access addressed issues concerning direct access to Earth observation and related geospatial databases through the World Wide Web. It was noted that the provision of global geospatial information services required the adoption of standards and common interfaces for accessing catalogues and databases. As international standards matured, then national and regional infrastructures would increasingly be able to interconnect into a truly global system.

2. The Workshop also considered the merging of three space technologies, global positioning systems, satellite digital data communications and Earth observation data, to satisfy the needs of resource and disaster management operations. Information was being created and exchanged through geographic information systems and transferred between mobile units in the field and central databases.

3. Geospatial data and other information were crucial to the effective resolution of problems at the local, national, subregional, regional and global levels. Many of those problems—poverty, natural disasters, desertification and deforestation, to name but a few—had no regard for international borders. Those problems required cooperation and sharing of infrastructure between agencies.

4. The participants of the Workshop recommended that action be taken:

* A/CONF.184/C.1/L.15.

(a) To recognize the importance of geospatial data and other information in resolving the important environmental, economic and social issues faced by humanity;

(b) To recognize the importance of and interaction between geospatial data and space technologies such as communications, Earth observation and geopositioning;

(c) To facilitate the development of fundamental and useful geospatial data in a form that could be used in many applications;

(d) To share geospatial data to the maximum extent possible; metadata, in particular, should be made as freely available as possible;

(e) To engage industry in an appropriate way to collaborate in the development and implementation of spatial data infrastructure;

(f) To communicate, collaborate and participate in the many networks existing at the national, subregional, regional and global levels;

(g) To recognize the importance of training, transfer of technology and capacity-building in support of the management of the application of those technologies.

5. In conclusion, the Workshop encouraged the United Nations and space agencies to provide active support to the many initiatives aimed at developing geospatial data infrastructures (for example, the Global Spatial Data Infrastructure).

XV. Conclusions and proposals of the Workshop on Space Debris*

1. The objective of the Workshop on Space Debris was to inform participants of the current status of the knowledge and the extent of the space debris problem, applied space debris mitigation measures and activities related to space debris by professional societies, the Inter-Agency Space Debris Coordination Committee and the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space.

2. Presentations were given on the following aspects of the space debris problem:

(a) The complete technical spectrum of the space debris issue, including measurements, modelling, mitigation (active and passive protective measures and debris preventative and reduction measures), the effects of the particulate environment on space systems, hazards in space and on the ground, and risk analysis;

(b) Space debris mitigation measures currently in use by space agencies and space operators;

(c) Activities related to space debris involving space agencies and the Inter-Agency Space Debris Coordination Committee, including the definition of space debris mitigation guidelines and standards;

(d) Activities related to space debris involving professional organizations (the International Academy of Astronautics, the Committee on Space Research and the International Astronautical Federation) and their recommendations;

(e) Deliberations of the Scientific and Technical Subcommittee on space debris.

3. The Workshop participants strongly supported the work being done by the United Nations, the Inter-Agency Space Debris Coordination Committee, the International

* A/CONF.184/C.1/L.16.

Academy of Astronautics and others to develop guidelines designed to minimize the creation of new debris objects.

4. In particular, it was recommended that:

(a) The United Nations should continue its work on space debris;

(b) Debris minimization measures should be applied uniformly and consistently by the entire international space-faring community;

(c) Studies should be continued on future possible solutions to reduce the population of on-orbit debris.

5. The Workshop concluded with a round-table discussion on the theme "Future directions of space debris research". In the discussion, the issue of the Legal Subcommittee of the Committee on the Peaceful Uses of Outer Space considering space debris was addressed.

6. It was noted that the current technical knowledge on space debris had been summarized in the technical report on space debris (A/AC.105/720) of the Scientific and Technical Subcommittee, which was fully supported by the International Academy of Astronautics.

XVI. Conclusions and proposals of the Workshop on Observations of Near-Earth Objects*

1. The Workshop on Observations of Near-Earth Objects reviewed the problem of possible collisions of asteroids and comets with the Earth. It was stressed that the Earth, like all other solid bodies in the solar system, had been continuously bombarded by cosmic debris ranging in size from microscopic to up to several kilometres in diameter.

2. The chances of a major collision in the near future were extremely small, but the consequences would be so large as to require that the scientific and political communities made every effort possible to reduce major risks and to identify possible countermeasures for smaller ones.

3. The field of near-Earth object research should be viewed not only as an exciting scientific discipline, but also as a service to humankind and a very good opportunity to encourage and promote international collaboration.

4. The International Astronomical Union had already promoted collaboration and coordination of activity, through the establishment of the Spaceguard Foundation. All countries in the world were invited to join those efforts, which did not require extremely sophisticated or expensive instrumentation.

5. The Workshop therefore recommended:

(a) That the United Nations promote education and information on near-Earth objects, especially in developing countries;

(b) That the United Nations take the initiative of inviting all Member States to support near-Earth object research in their own countries, through the establishment of national or regional "spaceguard" centres to be coordinated by the international Spaceguard Foundation;

* A/CONF.184/C.1/L.17.

(c) That every effort be made to provide financial support for near-Earth object research, both theoretical and observational (from ground and space), and especially for the encouragement of exchanges and training of young astronomers in developing countries;

(d) That the United Nations support and promote greater involvement of scientists and observatories from nations in the southern hemisphere as an opportunity for cultural and scientific development.

6. The Workshop endorsed the following paragraphs of the draft report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (A/CONF.184/3 and Corr.1 and 2): paragraphs 212 and 224 and paragraph (c) of section III of the draft Vienna declaration on space and human development (see A/CONF.184/3/Corr.2).

7. The Workshop welcomed the discussion and initiatives of the Space Generation Forum and encouraged participation in future near-Earth object research.

XVII. Conclusions and proposals of the Workshop on Intellectual Property Rights in Space*

1. The results of the discussions held by the participants of the Workshop on Intellectual Property Rights in Space may be summarized as follows:

(a) It was recognized that significant changes and developments in space activities gave rise to new issues, such as those relating to intellectual property rights;

(b) It was realized that the protection of intellectual property rights played an essential role in the development and transfer of space technology under current political and economic conditions, which had resulted in a shift in the focus of space activities towards a greater emphasis on commercial opportunities and the potential benefits of privatization, as described in paragraphs 283, 317 and 321 of the draft report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) (A/CONF.184/3 and Corr.1 and 2);

(c) It was noted that effective and appropriate protection of intellectual property rights should encourage and facilitate the transfer of technology to developing countries;

(d) It was recognized that the increasing number of international cooperative programmes in outer space required the continued harmonization of international intellectual property standards and legislation;

(e) It was noted that the subject of commercial aspects of space activities, including property rights, was discussed for possible inclusion as an item on the agenda of the Legal Subcommittee of the Committee on the Peaceful Uses of Outer Space, as described in paragraph 321 of the draft report of UNISPACE III.

2. The participants of the Workshop recommended the following action to address the common challenges:

(a) More attention should be paid to the protection of intellectual property rights, in view of the dramatic growth in the commercialization and privatization of space-related activities. However, the protection and enforcement of intellectual property rights should be considered together with the international legal principles developed by the United

* A/CONF.184/C.1/L.18.

Nations in the form of treaties and declarations, such as those relating to the principle of non-appropriation of outer space;

(b) The feasibility of harmonizing international intellectual property standards and legislation relating to intellectual property rights in outer space should be further explored with a view to enhancing international coordination and cooperation at the level of both the State and the private sector. In particular, the possible need for rules or principles covering issues such as the following could be examined and clarified: applicability of national legislation in outer space; ownership and use of intellectual property rights developed in space activities; and contract and licensing rules;

(c) Steps should be taken to increase awareness of the importance of protecting intellectual property rights as a means of promoting the transfer of technology, or providing developing countries with reasonable access to data, and of fostering spin-off benefits. All States should provide appropriate protection of intellectual property rights involving space-related technology, while encouraging and facilitating the free flow of basic science information;

(d) Educational activities concerning intellectual property rights in relation to outer space activities should be encouraged;

(e) The United Nations, through the Committee on the Peaceful Uses of Outer Space and its Legal Subcommittee, should investigate ways to enhance understanding of the issues outlined above. In view of the highly technical aspects of intellectual property rights, the involvement of other intergovernmental organizations, in particular, the World Intellectual Property Organization, would be highly desirable.

XVIII. Conclusions and proposals of the Special Workshop on Education*

1. The object of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space is to strengthen the capabilities of countries in the use of space applications to promote economic, social and cultural development. Education and training have a major role to play within that objective.

2. The participants of the Special Workshop on Education examined the various key elements that are prerequisites for efficient training in the field of space applications and made the following recommendations:

(a) The involvement of Governments and other public bodies should be encouraged:

(i) To create educational tools to answer the needs of national teaching in primary and secondary schools and to adapt them to the needs of other countries;

(ii) To incorporate knowledge of space applications into educational programmes;

(iii) To create appropriate incentives for teachers;

(iv) To provide and disseminate knowledge and know-how to developing countries;

* A/CONF.184/C.1/L.19.

(v) To encourage cooperation between secondary-level teachers through specialized meetings, forums, summer schools and special networks;

(vi) To examine the recognition of university-level degrees, to facilitate exchanges of students between universities and training centres and to propose courses in the field of space applications;

(vii) To encourage joint courses and diplomas;

(b) Space agencies, space centres and industry should contribute to the expansion of the various areas of space applications for education: remote sensing, communications, planetology, orbitography and so on. In that respect, each new space programme should establish, within its project specifications, educational and training objectives. In order to do so, engineers, researchers and education specialists should together study the financial investment involved, the content of the information and data to be gained and their dissemination. Communication and dialogue between space agencies, universities and industry, directly or through special associations, should increase;

(c) Regional centres in developing countries should be strengthened, as recommended by the General Assembly in its resolution 45/72 of 11 December 1990, with the support of industrialized countries and that of all Member States:

(i) By facilitating exchange of experts, researchers and postdoctoral students;

(ii) By providing materials, teaching know-how and funding to the centres;

(iii) By training teachers to answer the needs of national centres;

(iv) By creating links and cooperation with national centres in order to avoid duplication of effort and to offer a large range of solutions.

More generally, the delegations should give support to universities, institutions and training centres involved in educational development in order to meet the needs of the space sector;

(d) Attention should be given to the creation and dissemination of knowledge and training practices using new information and communication technologies such as World Wide Web sites and CD-ROMs and documents, as well as special systems, including satellite systems (e.g. for tele-education). Special attention should be paid to the development of curricula adapted to the needs of each country, to the technical equipment available and to the country's cultural environment;

(e) Efforts should be made to motivate the younger generation at all levels of education—primary, secondary and university. This has already been started in some countries by industry, space agencies and scientific and technological associations for youngsters and should benefit from:

(i) Increased international cooperation;

(ii) Better synergy with public bodies, industry and Governments.

XIX. Conclusions and proposals of the Workshop on Life Science Activities on the International Space Station*

1. The Workshop on Life Science Activities on the International Space Station noted with satisfaction that over the past decades, life science research activities in space, especially in manned space flight and biological research, had faced a huge development challenge. The Space Shuttle and the MIR manned space station had offered tremendous possibilities for experimentation during both short and long periods of exposure to microgravity. The results of and spin-offs from those experiments had influenced terrestrial research and industrial development. Most of the results obtained were the outcome of international research activities and interdisciplinary cooperation. The satisfactory development of space research opportunities in the first century of the new millennium required the definition of rational methods of coordination of research in space and the provision to all of access to the results. To utilize the potential scientific and industrial outcome and to plan for efficient future development of space life science were the basic goals of the years to come.

2. Problems involved in the internationalization of the International Space Station and the life science research projects being carried out on it constituted a very important issue for the future development of research in microgravity, which concerned space research in general, but more particularly the research on the International Space Station. The new domain of space life science research, its internationalization and the increased opportunities offered by it to use the results for scientific, economic and cultural development would benefit both developed and developing countries. It was only through international cooperation that access could be made available to the wide range of facilities in order to reap maximum benefits from the investments made in the International Space Station and other space life science projects. It was also indispensable to include the space industry in the research consortia, together with governmental and non-profit research institutions.

3. The future of life science research in space required enhanced international and interdisciplinary cooperation, scientific excellence and terrestrial applications, which would in turn lead to numerous benefits and industrial partnerships. Wide access to space life science and the efficient organization of the transfer to terrestrial applications of the spin-offs, one of the key points of the life science programmes, were also essential. The technological transfer would provide new and effective solutions to technical problems, expand business opportunities for space industries and create new business and jobs for space and non-space companies. The public needed to be made aware of the benefits of such space programmes and their terrestrial applications. Finally, the commercialization of the spin-offs and their development into practical applications would also make a huge contribution to the growth of space life science research in the twenty-first century.

4. It was noted that, to ensure high-quality research, a coordinated international recruitment, review and selection process would be used to develop the life science research programme to be conducted by the agencies involved in the International Space Station.

5. It was also noted that the life science hardware for space biology and medicine (unified technical and sanitary/hygienic means, as well as specialized medical modules) on the International Space Station would be available to the international research community.

* A/CONF.184/C.1/L.20.

6. Unified international standards for systems of medical support of human space flight, including flight medical supervision systems and systems for prognosticating crew members' state, prevention, diagnosis and treatment of the crew, should be worked out, as should unified standards for life-support systems. There should be international coordination of pre-, in-, and post-flight medical examination and international selection and training of the astronauts and cosmonauts.

7. It was further noted that, given the necessity of space exploration and its benefits to Earth, it was important to continue with the existing plans for a manned mission to Mars and further plans for space exploration such as the creation of a lunar research base.

8. The following proposals were made:

(a) Future space life science programmes should be developed through international and interdisciplinary cooperation, taking into account all space programme elements (i.e. high-quality research, industrial sponsoring, marketing plans for spin-offs and information programmes for the general public);

(b) Access to the International Space Station for researchers from States not represented in the international space life science working group should be facilitated. In view of the enhanced flow of information and the selection process, in the twenty-first century, developing countries should also have better access to research carried out by highly qualified international space experts, by, among other things, having the possibility of sponsoring proposed space life science projects.

XX. Conclusions and proposals of the Workshop on Disaster Management*

1. As part of the workshops organized within the framework of the Technical Forum of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), a Workshop on Disaster Management was organized jointly by the European Space Agency and the National Space Development Agency of Japan. The Workshop provided an opportunity to illustrate the relevance and benefits of space techniques for the improvement of disaster aid and rescue measures implemented by concerned authorities around the world.

2. During the Workshop, participants made presentations describing different cases such as forest fires, volcanoes, floods and hurricanes, which had been monitored by Earth observation satellites. They also highlighted the importance of other space assets, such as telecommunication satellites, which are instrumental in the emergency support to be provided to the disaster scene. Finally, a project on disaster management support was described, which is part of the involvement of the Committee on Earth Observation Satellites in a broader initiative known as the Integrated Global Observing Strategy.

3. Further to a review of the experience gained in recent years in using satellites in the context of disaster management and mitigation activities, all participants at the Workshop came to the following conclusions:

(a) Earth observation, telecommunication, navigation and other services from satellites are effective means to improve monitoring, management and mitigation of disasters around the globe. Those techniques make it possible to limit the suffering of the population and damage to society;

* A/CONF.184/C.2/L.1.

(b) Given the transboundary nature of disasters, international cooperation between operators and data providers of relevant space assets should be enhanced in order to provide the best possible service to improve rescue efforts and the assessment of rehabilitation measures. It is recommended that timely release of data and services offered by space assets be one of the major focuses of such cooperation.

XXI. Conclusions and proposals of the Workshop on Resource Mapping from Space*

1. The conclusions and proposals below concern paragraphs 102-115 and 119-127 of the draft report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (A/CONF.184/3 and Corr.1 and 2).

A. New global developments in technology

2. In the last 100 years, natural resource industries have developed from an economy based on access to land and labour into industries where capital (i.e. investment in equipment) dominates. Today, the most rapidly growing segment of the economy is "information": spatial information derived from remote sensing and geographic information systems can help natural resource managers, in both developed and developing countries, to improve food production and water management, decrease costs or reduce environmental degradation.

B. Resource issues

3. Agricultural statistics clearly show that the world food balance is becoming more and more fragile. Since the mid-1980s per capita food production at the global level has decreased steadily.

4. There will be a considerable shortage of water for drinking, for sanitation and, most importantly, for growing crops in the twenty-first century. Water, being a scarce commodity, needs to be properly managed.

5. The degradation of limited arable land by various processes, namely, soil erosion by water and wind, salinization and alkalinization, waterlogging, shifting cultivation, mining and so on, resulting from over-exploitation has resulted in a significant decrease in per capita arable land.

C. Conclusions

6. The capability to monitor changes in vegetation and land use in the major production regions of the world is important and remote sensing is the only technique offering such a capability.

7. New satellite remote sensing systems are being launched that will be of use at both the local and regional levels for natural resource managers. Those systems offer improvements in spatial, spectral or temporal accuracy. As more satellites are placed in orbit, imagery over a geographical location will be accessible at shorter time periods.

8. Operational low-cost satellites, such as the advanced very high resolution radiometer of the National Oceanic and Atmospheric Administration (NOAA-AVHRR) of the United

* A/CONF.184/C.2/L.2.

States of America, create the possibility to monitor on a daily basis the status of land and water resources and crop performance.

9. With the advantage of providing synoptic coverage of large areas at regular intervals, coupled with the advances made in computer-aided digital analysis and data fusion, spaceborne multi-spectral measurements made by Earth observation satellites offer an immense potential for generating reliable, timely and cost-effective information on natural resources.

10. Judicious use of the full capabilities of Earth observation missions and data should lead to an increase in the quality of remote sensing products, in the information delivered to the customer and in decisions taken by the customer.

11. The continuous availability of free or low-cost data for resource mapping on a global scale (e.g. NOAA-AVHRR, and the Satellite pour l'observation de la Terre (SPOT) vegetation mapper) is an urgent priority for environmental monitoring.

XXII. Conclusions and proposals of the Workshop on Remote Sensing for the Detection, Monitoring and Mitigation of Natural Disasters, organized by the International Society for Photogrammetry and Remote Sensing and the European Association of Remote Sensing Laboratories*

1. The conclusions and proposals below concern paragraphs 34, 41, 42, 44, 69, 74, 75, 79, 80, 82, 86, 90, 91, 94-99, 102, 106-119, 127, 136-139, 301, 302 and 339 of the draft report of the Third United Nations Conference on the Peaceful Uses of Outer Space (A/CONF.184/3 and Corr.1 and 2).

2. Remote sensing provides scientists with the data needed for predictive modelling of natural disasters, for appraisal of the damage caused and for mitigation of the deleterious effects that precede or accompany such disasters. Remote sensing is also recognized as an essential source of information in the initial detection and near real-time observation of the effects of search, rescue and assistance efforts. Many international cooperative activities are now being developed through the efforts of organizations such as the Committee on Earth Observation Satellites and through international bilateral arrangements. The Workshop on Remote Sensing for the Detection, Monitoring and Mitigation of Natural Disasters reviewed the status of those international efforts and offered the following conclusions:

(a) In order to use remotely sensed data effectively in relation to natural disasters, crisis management systems must be in place. That would allow for planning and collaboration between relevant agencies and rapid response to emergencies;

(b) Considerable international cooperative efforts are needed to use remote sensing data and other information to develop indicators of disaster-prone areas and mitigation strategies and scenarios;

(c) Space-imaging, communication and positioning systems can be effective tools for the management of earthquake hazards. Space-borne imaging systems can provide indicators, maps and measurements of quake-prone areas that can be used for evacuation routing, urban planning and vulnerability statistics;

* A/CONF.184/C.2/L.3.

(d) More research is needed on the potential advantages of new Earth observing remote sensing systems with higher resolution, more spectral bands or active sensors (interferometric synthetic aperture radar and light radar (lidar));

(e) Space-borne synthetic aperture radars have demonstrated their effectiveness in producing all-weather remote sensing imagery of oil pollution effects, especially for the detection of oil pollutants, in measuring extent, direction and growth and in identifying pollutant sources in international waters;

(f) Many remote sensing methods have been developed to assess the potential of geological hazards and to appraise the damage caused. They include methods for the integration of multi-sensor data to improve lithological mapping in tropical environments, landslide mapping and analysis of volcanic and associated hazards;

(g) Satellite remote sensing has been shown to be beneficial in identifying environmental indicators to produce risk maps of desertification, soil erosion and desalinization, deforestation, overgrazing and overdevelopment;

(h) Early warning systems rely on satellite imaging systems for the detection of early stages of flooding, forest fires, volcanic eruptions and the effects of certain pollutants;

(i) The detection and characterization of hazardous waste sites require high spatial and spectral resolution remote sensing from visible, infra-red and radar satellite images.

3. Satellite data are used operationally to lessen the impact of natural disasters such as tropical cyclones, flash floods, heavy snowstorms, volcanic ash clouds, sea ice, toxic effects on coastal waters and harmful algal blooms.

4. In conclusion it can be stated that many techniques using Earth observation data are being used effectively to manage natural disasters, but more effort is needed to make disaster prediction a reality and to plan responses. More research is needed to integrate new data sources and to exploit them effectively.

XXIII. Conclusions and proposals of the Seminar on Environment and Remote Sensing for Sustainable Development*

1. The Seminar on Environment and Remote Sensing for Sustainable Development focused on the application of space remote sensing science and technology to issues of importance to developing countries, such as agriculture, infrastructure, environment and decision-making, from the perspective of Governments and private space technology providers, as well as from that of regional representatives of the user community.

2. During the Seminar eight panel members made presentations describing existing programmes and future missions planned with a view to providing data and information products and the potential value of those products to developing countries. Subsequently, participants discussed with members of the panel issues concerning remote sensing and sustainable development.

3. Both the presentations and the subsequent discussion revolved around issues that condition the ability of developing countries to make full use of remote sensing data and information products. Those issues were as follows:

* A/CONF.184/C.2/L.4.

(a) Limitations in the capacity available in developing countries in terms of hardware, software and human resources;

(b) Problems of data pricing, access and standards;

(c) New missions by "space-faring" nations that were likely to have an adverse effect on both of the above factors;

(d) New models for the exploitation of remote sensing that had emerged in Brazil and India.

4. The Seminar made the following recommendations for incorporation in the text of the draft report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (A/CONF.184/3 and Corr.1 and 2):

Paragraph 139

(a) Insert a new paragraph 139 *bis* to read:

"The questions of access, dissemination and archiving of Earth observation data are growing in importance. Because issues of data policy, and in particular pricing policy, present obstacles to the effective utilization of Earth observation data, greater clarity in statements of data policy by the supplier organizations would be helpful to the development of the Earth observation sector. The advantages and disadvantages of different pricing models should be explored and assessed against the opportunities to use Earth observation data for specific applications, including disaster management and global observations. The experience of those organizations which have already established Earth observation data policies, such as the National Space Development Agency of Japan and the European Space Agency, should be harnessed by national and international Earth observation programmes";

Paragraph 140

(b) Insert a new paragraph 140 *bis* to read:

"To provide a venue for the discussion and resolution of technical and policy matters among data and information users and providers, both public and private, a series of regional forums should be held. To ensure their transparency and credibility, those forums should be organized and hosted by a non-governmental organization such as the International Society for Photogrammetry and Remote Sensing";

Paragraph 142

(c) Insert a new paragraph 142 *bis* to read:

"The work of the Food and Agriculture Organization of the United Nations in using geographic information systems to analyse Earth observation and other environmental data to assist policy and decision makers should be communicated more fully to developing countries through literature, pilot project descriptions, data sets on CD-ROMs and the World Wide Web";

Paragraph 144

(d) Add the following sentence at the end of paragraph 144:

"There should be a wider and more effective communication of lessons learned on the use of Earth observation for sustainable development in developing countries, including India's Integrated Mission for Sustainable Development and the cooperation between Brazil and China to launch their own Earth observation satellite, the China-Brazil Earth Resources Satellite (CBERS)";

Paragraph 218

(e) Add a new subparagraph (e) to read:

"(e) Assisting the centres in developing strategies that would help administrators and managers to understand better the benefits available from the use of remote sensing in sustaining and enhancing the quality of life in developing countries";

Paragraph 283

(f) Add the following sentence at the end of paragraph 283:

"Such cooperation will benefit from public/private partnerships, in appropriate circumstances, with suitable arrangements being made for risk-sharing and for developing operational systems that build on successful research and development activities";

Paragraph 321

(g) Add a new section after paragraph 321 to read:

"(c) Specific action programmes

"Open access to space is essential to the widest possible utilization of all applications that bring benefits to humankind, including sustainable development. Full participation in the information society of the twenty-first century requires that all nations have open access to environmental information gathered by Earth observation platforms. The principle of non-discriminatory access to Earth observation data contained in the Principles Relating to Remote Sensing of the Earth from Outer Space (General Assembly resolution 41/65, annex), in particular principle XII, should continue to be safeguarded and should be enhanced by a clearer definition of its meaning. The United Nations and its Committee on the Peaceful Uses of Outer Space should work with experts in international space law and space policy to define more precisely the issues of practical implementation behind the term 'non-discriminatory access'. That work should include an assessment of how developing countries can put the principle of non-discriminatory access into practice and thereby gain maximum benefits from space-based Earth observation".

XXIV. Conclusions and proposals of the Seminar on Global Health*

1. The Seminar on Global Health considered issues relating to the use of remote sensing and geographic information systems (GIS) to improve human health throughout the world.

2. The Seminar reached the following conclusions:

(a) The use of remote sensing and GIS can help prevent infectious disease, in particular in developing countries;

(b) Remote sensing and GIS are most effective when used to eradicate endemic disease through identification of disease reservoirs and disease vectors.

* A/CONF.184/C.2/L.5.

3. The Seminar made the following recommendations:

(a) States should raise awareness about the possibilities of remote sensing technology and the action required to meet the need for education at the highest level. In that context, the involvement of trained personnel, such as statisticians and epidemiologists, is an efficient and necessary way to speed up the process of capacity-building;

(b) Institutional support and cooperation should be recognized as having an essential role to play in any programmes undertaken;

(c) Programmes at the regional level should be established to prevent the re-emergence of diseases;

(d) Issues relating to the cost of, and timely access to, data should be addressed;

(e) The development of affordable GIS software should be encouraged.

XXV. Conclusions and proposals of the Round Table on Tele-education*

1. The participants in the Round Table on Tele-education noted that more and more countries throughout the world were recognizing education as the key to the development process. Literacy, especially education of females, had been established as a crucial determinant for gender equity, good health and voluntary population control. The full development of the potential of society and individuals was dependent upon education also fostering involvement in decision-making at various levels, giving substance and meaning to the concept of participatory democracy.

2. The participants also noted that, given the huge number of illiterate people in many developing countries and the need to continuously update and upgrade the quality of education, it was quite clear that traditional means of education had been grossly inadequate. In developed countries as well, rapid advances in the accumulation of knowledge had made it necessary to develop new means of providing regular and lifelong education, especially for working professionals.

3. Tele-education, using the tools of the space technology, provided proven solutions to many problems. Satellite communication and broadcasting made it possible to cover vast areas and to reach out to remote and inaccessible places. New technologies and techniques not only made it possible to take distance learning to all corners of a country, but also facilitated true education through interactive communication, apart from two-way audio or even two-way video (videoconferencing). Broadband satellite-based connectivity enabled a user in a remote location to do fast downloads of text, graphics, animation or video clips from the Internet. Those and other capabilities could also be used for applications such as tele-medicine, enabling high-level or expert medical advice to be provided for a patient in some remote location.

4. Experiments, pilot projects and a few operational systems throughout the world had demonstrated the feasibility and potential of a whole range of tele-education options. Elementary education, technical training, adult education, literacy classes, professional education, skill-training and a whole host of other applications had been carried out by the Open University, literacy organizations, educational institutions, industry, non-governmental organizations and others.

* A/CONF.184/C.2/L.6.

5. It was noted that, on the threshold of a new century—indeed, a new millennium—the world could not afford pockets of illiteracy and educational deprivation. Space technology offered an important means of eradicating illiteracy and taking people everywhere to a new level of awareness, empowerment and development. The realization of those possibilities must be an important part of the agenda of each nation, and of all nations collectively.

6. Having discussed and noted the above-mentioned issues, the Round Table on Tele-education made the following recommendations:

(a) All countries should recognize the importance of education and acknowledge its crucial role in the growth of the individual, the development of the nation and the sustainability of the social, economic and environmental health of the world;

(b) The United Nations, through the Committee on the Peaceful Uses of Outer Space and its Secretariat, should promote the sharing of best practices and experiences in tele-education among countries by:

(i) Organizing well-structured regional and international seminars;

(ii) Promoting and supporting the documentation of experiments and projects and ensuring the dissemination of reports on those experiments and projects;

(iii) Initiating study-tours of projects of relevance for decision makers and experts;

(c) The United Nations, through the International Programme for the Development of Communication of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Telecommunication Union (ITU), should promote research and studies on the planning, configuration and use of tele-education systems that utilize new and emerging information and communication technologies. The focus of such systems should be on female education, literacy and universalization of elementary education;

(d) The United Nations should draw on its Secretariat, UNESCO, ITU and experts from Member States to undertake a study on the feasibility and desirability of regional and/or international systems for tele-education;

(e) The regional centres for space science and technology education should use and promote tele-education to reach out to more persons in their areas of operation;

(f) The Secretariat should work with the World Health Organization to study the feasibility of tele-health systems, especially in developing countries, for training paramedics and health professionals;

(g) The United Nations should work with ITU on putting together data to convince Member States and bilateral and multilateral agencies of the importance of providing universal access, through individual or community facilities, to means of information retrieval (radio/television sets, telephones, computer access to databases etc.), giving special attention to means of quickly expanding access to the Internet;

(h) The United Nations should promote studies to develop curriculum using space imagery and findings from space science and space exploration to increase awareness of the fragility of the eco-system, humanity's unique place in the universe and the basic oneness of all humanity;

(i) In view of the potential of the Internet, each State should ensure the establishment of a policy and regulatory frameworks that encourage and facilitate the wide use of and access to the Internet.

XXVI. Conclusions and proposals of the Workshop on Small Satellites at the Service of Developing Countries*

1. The Workshop on Small Satellites at the Service of Developing Countries concluded that small satellites were valuable tools in the development of a space infrastructure and scientific and application programmes. They could also have an important role to play in every country's space plan. Small satellites had offered and would continue to offer opportunities for international cooperation.

2. Scientific missions using small satellites could provide very valuable results and make important contributions to advances in knowledge of the Earth's environment and of the universe. Any country that developed or participated in a scientific space mission made it possible for its scientists to contribute to the advancement of science. Small, more focused space missions could yield greater benefits for the national scientific community.

3. In the field of Earth observation, small satellites could carry instrumentation devoted to the particular needs of a country. The data could then be used independently or in conjunction with data from other, larger spacecraft in order to provide information for such applications as mapping, fisheries, agriculture, land use and environmental monitoring. The characteristics of the spacecraft, such as wavelength, resolution, time and frequency of observation, could be tailored to those particular needs.

4. The applications of data collection and message store-and-forward communications had already been used on several spacecraft. Novel types of constellations of small satellites were currently being designed that could serve the development needs of a number of developing countries. Such examples showed that it was important to take into account the particular situation of the country (geography, remote settlements and so on) in order to develop a more appropriate communication system.

5. The Workshop recommended that each country prepare a space plan that identified how space assets could best be used to support its development. In such a plan, small satellites should be considered one of the most valuable tools to initiate and develop an indigenous space capability.

6. Although limited in size and mass, small satellites could still benefit from advances in technology. The development of complex software could be used to enhance satellite missions further. Each country planning to develop a space infrastructure should identify those hardware and software technologies which were most relevant to its current and planned status of development.

7. Small satellites offered an ideal opportunity for training. On-the-job training in cooperative programmes had proved to be a valuable method of learning all the techniques associated with the design, development, manufacturing, testing and operation of a spacecraft. Developing countries were encouraged to include such training programmes in their space plans.

8. Small satellites offered opportunities to developing and developed countries to establish cooperative programmes not only for the purpose of training, but also with a view to preparing scientific or application missions. They also made it possible for developing countries to pool their efforts in building their individual space capabilities. It was therefore recommended that, in preparing its space plan, each country consider incorporating into it an element of international cooperation.

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* A/CONF.184/C.2/L.7.

XXVII. Conclusions and proposals of the Forum on Industrial Utilization of the International Space Station*

1. The conclusions and proposals below concern paragraphs 30, 33 and 34 of background paper 6, entitled "Basic science and microgravity research and their benefits" (A/CONF.184/BP/6, sect. IX).

2. The purpose of the Forum on Industrial Utilization of the International Space Station was to provide countries currently not involved in the International Space Station programme, commercial users and any other interested parties with innovative solutions geared towards the commercial utilization of the International Space Station.

3. This very complex issue was approached by first examining all the common features that could make the commercial exploitation of the International Space Station viable. Those common features were then illustrated by examples of how research in the International Space Station could be applied in different fields that were also of interest in terms of the priorities of countries that had not participated in projects involving human space flight.

4. Some typical applications were medicine (development of new medicines by means of protein crystallization in space), technology (testing and demonstration of new space communication technology) and the examination of properties of high-precision materials.

5. It was noted that commercial users of the International Space Station would expect low cost, short deadlines and ensured access for the services that they would purchase. Utilization of the International Space Station must be transformed into routine business. There was a discussion on how the transition might be managed, how potential commercial users viewed space-based opportunities and what they expected to receive for their investment in space-based investigations. The discrepancies between what existed and what was needed were highlighted. An outline was presented of an approach to making the transition from the current system to a system that could mesh with the established mechanisms of industrial capitalism.

6. There was a discussion on mechanisms for sharing the use of the International Space Station with the general public and for encouraging the involvement of developing countries in its utilization.

7. The Forum on Industrial Utilization of the International Space Station agreed on the following conclusions and proposals:

(a) International partnerships and cooperation between countries and companies involved in the operation and utilization of the International Space Station and those countries not yet participating in that endeavour should determine how to utilize the Space Station for their benefit;

(b) Information about access to use of the International Space Station needed to be disseminated throughout the world in order to increase awareness of the matter in countries not yet participating in that endeavour;

(c) Mechanisms for improving accessibility from a technical and financial point of view (for example, loans from the World Bank) should be established to simplify utilization of the International Space Station, especially for developing countries.

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* A/CONF.184/C.2/L.8.

XXVIII. Conclusions and proposals of the Workshop on Developing Indigenous Earth Observation Industrial Capabilities in Developing Countries *

1. The discussion concerned technical and policy-related issues dealt with in the draft report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (A/CONF.184/3 and Corr.1 and 2, paras. 29-31, 36-38, 44, 46, 47, 82, 83, 91-96, 102-117, 119, 129-131, 136, 142, 235-243, 245-249, 252-254, 258, 260, 261, 270, 274, 276-280, 282, 283, 285 and 290). Furthermore, the discussion was directly concerned with the draft Vienna declaration on space and human development (A/CONF.184/3 and Corr.1 and 2, chap. V).

2. Presentations were made by individuals representing both developed and developing countries in Africa, Asia and North America. Those attending included individuals from countries in those regions, as well as in Europe and South America.

3. It was noted that space technology had successfully contributed to the development of the necessary baseline, exploratory and monitoring information on all aspects of human needs.

4. It was agreed that, whereas maps and geospatial data derived from a combination of Earth observation information and other data were as much a part of a nation's infrastructure as the transportation network, the health-care system, telecommunications and education, the creation of a national geospatial infrastructure should be accorded the same level of support as the other elements of national infrastructure.

5. It was noted that the need for geospatial infrastructure suggested that Governments should become knowledgeable customers and users. Governments should look to indigenous industry to support government requirements, to improve the ability to extract knowledge from data and add local understanding and to identify and develop new markets. Furthermore, the creation of an indigenous industry would reduce countries' dependence on imported technology and services.

6. Experience had shown that indigenous private sector activity could help developing countries to meet, in a cost-effective manner, not only their own real information needs, but also those of the agencies that served them. Accordingly, it was proposed that Governments foster an environment in which private industry could operate better, in which it could develop international partnerships. Such indigenous industrial capabilities had been developed with direct and continuing benefits to countries as diverse as Brazil, Mongolia and the Philippines.

XXIX. Conclusions and proposals of the Workshop on Global Navigation Satellite Systems**

1. The objective of the Workshop on Global Navigation Satellite Systems, organized by the European Tripartite Group (the European Commission, the European Space Agency and the European Organization for the Safety of Air Navigation), was to demonstrate how navigation and positioning technology could help solve problems of regional or global significance, given that global navigation satellite systems (GNSS) are considered one of the key technologies in stimulating economic and social development, especially in

* A/CONF.184/C.2/L.9.

** A/CONF.184/C.2/L.10.

developing countries. The Workshop also served to contribute to education and awareness about satellite navigation technology in global user communities.

2. The Workshop noted that two satellite navigation systems existed at present, the Global Positioning System (GPS) of the United States of America and the Global Orbiting Navigation Satellite System (GLONASS) of the Russian Federation, which were originally developed for military purposes and currently did not fully meet civilian user requirements. The international user communities (transport, timing, geomatics, agriculture and disaster management and so on) were becoming increasingly convinced of the need to develop a GNSS that provided a safer, more reliable navigation and positioning service for civil use. That implied improving the performance of the current service in terms of accuracy, integrity, continuity and reliability.

3. The main conclusions of the Workshop were as follows:

(a) International cooperation at both the political and the technical level is needed for the successful implementation of satellite navigation and positioning technology. System provider nations, potential contributor and end-user States, industry, service providers, users and international organizations need to cooperate closely to ensure the provision of a safe, seamless global satellite navigation and positioning system;

(b) Since it is universally accepted that differences in the pace of development around the world should not lead to incompatibility between elements of navigation and positioning systems, it is intended to achieve full compatibility and inter-operability of regional satellite navigation systems throughout the implementation process;

(c) A public-private partnership approach is recommended in Europe as the way forward for infrastructure and service development. Industry has also been examining ways to provide value-added services and applications. A strong institutional framework has been put in place to enable industry and users to benefit from satellite navigation;

(d) In selecting new or upgrading existing technology, many States (especially from the developing world) are facing difficulties in securing financing. Different innovative approaches, supported by cost-benefit analyses and solid business cases, have proved to be helpful in convincing banks and other lending institutions to invest in the aviation infrastructure;

(e) In order to increase awareness in developing nations of the benefit of GNSS, the Committee on the Peaceful Uses of Outer Space should consider the expansion of the United Nations Programme on Space Applications to include support for appropriate workshops, seminars and internships in conjunction with other relevant international organizations and institutions such as the members of the European Tripartite Group, the International Civil Aviation Organization, the International Maritime Organization, the World Bank and the European Bank for Reconstruction and Development. Service provider nations should accept the responsibility for funding such new activities;

(f) Issues related to a general GNSS liability and certification regime commensurate with the expectations of users should be developed, notwithstanding the increased role of the private sector in the provision of GNSS services;

(g) Satellite navigation services require protected frequency bands. It is therefore recommended that public and private sector frequency spectrum experts within the GNSS community urge their respective Governments to adopt a common approach to spectrum issues before the World Radiocommunication Conference in the year 2000. That should serve to maximize the protection and use of spectrum for current and future GNSS services.

XXX. Conclusions and proposals of the Workshop on Clean and Inexhaustible Space Solar Power*

1. The Workshop on Clean and Inexhaustible Space Solar Power arrived at the following findings:

(a) Solar power facilities in space can provide abundant and clean new electric power for Earth;

(b) Solar electric power from space can:

(i) Accelerate ongoing global electrification;

(ii) Lead to decreasing electric energy costs through ongoing technological advances in electronics;

(iii) Progressively reduce the pollution and uncertainties associated with present large-scale commercial power systems (oil, coal, natural gas, nuclear and terrestrial renewables);

(c) Some 2 billion people now live without the services that commercial energy provides. Without a new supply of abundant, clean and low-cost power, that number will increase, with attendant poverty and worldwide inequity;

(d) The concerted efforts of many individuals and organizations internationally are required to ensure provision of new and renewable global energy, including space solar power.

2. The Workshop made the following recommendations:

(a) The Committee on the Peaceful Uses of Outer Space should examine how to facilitate the development and demonstration of clean and inexhaustible space solar power;

(b) The Committee should consider taking the following action:

(i) Encouraging organizations around the world to investigate further the technical and economic feasibility of space solar power over the next few years and in particular to perform demonstrations on the ground and in space that can validate needed technology advances and engender familiarization with space solar power worldwide;

(ii) Encouraging countries to examine ways in which space solar power might be uniquely suited to meeting a portion of their energy needs;

(iii) Examining how space solar power will improve the quality of life in all countries of the world (e.g. cleaner air, cleaner water, better communications and higher standard of living);

(iv) Stimulating international collaboration, cooperation and data-sharing regarding space solar power;

(v) Working with the appropriate national and international organizations responsible for standards and regulation in order to ensure due consideration of space solar power matters, for example, as they concern health, the environment, spectrum management, orbit allocations and other topics;

(vi) Organizing and sponsoring an international conference on space solar power involving both developing and developed countries;

* A/CONF.184/C.2/L.11.

(vii) Forming a standing committee for the long-term consideration of space solar power.

XXXI. Conclusions and proposals of the Workshop on Telemedicine*

1. The Workshop on Telemedicine highlighted the significance of telecommunications in general, including space-based communications, to the health sector and medical services. It was agreed that the pace and impact of developments in that area were such that telecommunications would come to be such a routine support to health and medical care that the prefix "tele-" would become superfluous.

2. The Workshop stressed the need for harmonization and collaboration between local and global programmes in telemedicine and tele-health, both in the technical and in the medical and health-care sectors. Special emphasis was given to cooperation with and support of developing countries and the requirements for global services. Easy access at affordable costs to space infrastructure such as low-Earth and geostationary Earth orbit satellites for communications and Earth observation (such as climate and biotop monitoring for disease prediction and prevention) was considered a key prerequisite for the necessary quick implementation and dissemination of telemedicine services.

3. The Workshop made the following recommendations:

(a) Telemedicine should be promoted in a way that enabled developing countries to adapt their health-care systems to their own specific needs and local conditions (environment, economy, social structure and so on);

(b) Telemedicine should be implemented with a view to improving work in two areas of concern:

(i) Care for the individual citizen, in particular in the under-served population, by introducing electronic patient records, electronic prescriptions and concepts of shared and integrated care;

(ii) Health-care systems as such (cost containment and better and faster information services with better generation and dissemination of knowledge);

(c) The continuous improvement of the health-care system must be based upon cost-benefit analyses, efficacy and efficiency and should take into account national socio-economic characteristics;

(d) Basic and continuous medical education for professionals and awareness programmes for the public should be an integral part of the telemedicine solutions promoted and adopted. Those programmes should be developed on the basis of international cooperation and should be made part of national medical education activities;

(e) Existing regional applications and networks should be supported and made to interlink with each other;

(f) Appropriate technical and medical standards need to be agreed upon;

(g) The international cooperation within the framework of the International Space Station programme should be seen as a unique chance to foster international and multicultural collaboration and the interoperability of services and technologies;

* A/CONF.184/C.2/L.12.

(h) Summarizing the results of the ongoing experiments of global medical emergency networks and their evaluation and promotion should be organized. Such networks should offer services to governmental and non-governmental organizations in the case of natural and/or man-made disasters;

(i) A unique, globally valid emergency call number should be established that is available to individual citizens worldwide;

(j) Space nations and agencies should offer access points within their space and terrestrial infrastructure for services that support the daily needs of citizens.

4. The Workshop also recommended that continuous concerted efforts be made by the working groups of the Group of Eight and by the World Health Organization, the International Telecommunication Union and the United Nations with a view to:

(a) Defining and promoting concepts for a flexible technical infrastructure, adaptable to health services in different economic and cultural environments, including developing countries, and based on a clear vision of the existing and the emerging growth of telecommunications and information-processing capabilities;

(b) Defining a generally acceptable legal and ethical framework that would also cover aspects of privacy and confidentiality to enable cooperation and the cross-border exchange of services;

(c) Orienting the above activities to the needs of patients and to criteria of cost-benefit and sustainability.

5. The Workshop strongly recommended support for the organization and funding of concerted action to achieve the above objectives.

XXXII. Conclusions and proposals of the Session on International Standardization for Space Systems*

1. Representatives from regional and national space agencies, a major systems contractor, a commercial satellite communications corporation, and the International Organization for Standardization (ISO) presented the major areas of current activity in standardization for space technology. It was reported that some of those activities were being conducted using the ISO international consensus procedures. There were two ISO committees devoted to the purpose; Space Data and Information Transfer Systems (TC20/SC13) and Space Systems and Operations (TC20/SC14). The Consultative Committee for Space Data Systems conducted all of the technical work of the first committee.

2. A presentation was made of the work of the ISO committees and regional standards bodies in the space field in the areas of satellite communications, man in space, data transfer and data archiving. Topical details focused on how the results of standardization could benefit all nations, with emphasis on developing countries.

3. The session submitted the following conclusions to the Conference:

(a) The results of international standardization not only provided obvious benefits to the major space agencies and corporations, but also facilitated the sharing of organizations in developing countries in the benefits of such extraterrestrial endeavours.

* A/CONF.184/C.2/L.14.

A comprehensive set of standards for space systems would accelerate achievement of that goal;

(b) The concept of open standardization permitted smaller organizations to participate in the use of space assets, including off-the-shelf products in the least expensive manner;

(c) International standards for space systems and operations also made possible the utilization of space programmes and services in the broadest possible manner through common design of experiments, spacecraft interfaces, ground stations and product-qualification methods. The principle of universality ensured that the needs of developing countries were integrated into standards;

(d) The session recommended that the Committee on the Peaceful Uses of Outer Space formally endorse open standards as a mechanism to enable developing countries to gain access to space and recognize ISO and affiliated organizations for their efforts towards achieving this goal.

XXXIII. Conclusions and proposals of the Workshop on Mars Exploration*

1. The Workshop on Mars Exploration underscored the extraordinary cooperative effort among nations that was developing in current and continuing robotic exploration of Mars. The questions that needed to be answered about the planet's climate history, which might ultimately address the possibility of past or even present life on Mars, would be one element of an exploration programme with synergistic and ever-expanding international components.

2. On the Mars Polar Lander nearing Mars, a Russian instrument, the Lidar, would measure atmospheric dust and haze. The Lidar was the first Russian experiment on a planetary mission by the United States of America. The Planetary Society's microphone was part of that instrument and was the first instrument on a planetary mission to be funded by a public interest group. In future years, the proposed framework for the exploration of Mars would not be the sole domain of any one nation. The French Ariane-5 would supply the means for a Mars surface sample to be returned to Earth, cored from Mars by a drill supplied by the Italian Space Agency, on board two upcoming missions, Mars Surveyor 2003 and 2005, of the National Aeronautics and Space Administration of the United States.

3. In addition, Ariane-5 would deliver micro-missions, including four Netlanders, to the surface of Mars, which would study the interior of the planet and further track the evolution of water on it. An aggressive study of both exobiology and geochemistry was required to address the issue of past or present life on Mars. International contributions by the European space agencies and European countries ranged from experiments to determine why no sedimentary meteorites from Mars had been found on Earth to high-accuracy position location on Mars identifying samples returned to Earth. All nations would have access to the returned samples in a peer review process. The Japanese Nozomi mission, with its new arrival date on Mars, would also be complementary to the Mars Express of the European Space Agency which had the ability to map "backwards" to reconstruct the loss of surface water on Mars.

4. The issues of planetary protection from contamination of Earth by Mars samples and contamination of Mars samples by Earth bacteria, the protection of astronauts from

* A/CONF.184/C.1/1.

radiation and the concept of an Internet-enabled Mars all posed new challenges, with a better informed public than perhaps at any time in the past, but also with a continued need to educate and engage the public on planetary exploration missions, with announcements of opportunity in Mars robotic exploration open to all nations and with developing nations encouraged to participate. A virtual armada of missions with an infrastructure based on international cooperative efforts on and around Mars would carry forward the commitment to Mars exploration.

5. The Workshop recognized that all national participation in missions was subject to the vagaries of political and economic support from Governments. The economic difficulties of the Russian Federation had prevented its completion of a national programme to explore Mars; Europe had had a long period of uncertainty with Mars Express and there was a need for national agencies to support their respective country's role in the international Mars sample return; and, even as the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space was being held, the United States' programme was under attack in Congress and Mars exploration was being threatened with potential cutbacks. International cooperation and global participation were valuable added benefits of Mars exploration and should be included in efforts to build public support for such exploration.