NMM30

Abstracts of Presentations at NMM30

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Opening Session

Opening Session:
The future role of ECMWF in Europe: Research, weather forecasts and environmental services

Erland Källén, ECMWF, UK

Research and development at ECMWF is focussing on improving the predictive skill on all time ranges, from the medium and up to the seasonal range. An Earth System approach has been adopted where coupled atmosphere-ocean-land models are used from initial time and data assimilation is also developed in an Earth System context. In the next ten years the ECMWF strategic focus will be on forecasting high impact weather events up to two weeks ahead, regime shifts up to a month ahead and global scale anomalies up to a year ahead. Model resolution is still a main driver for improved forecast accuracy, recently both the high resolution model as well as the data assimilation have been upgraded considerably in terms of resolution. Future resolution upgrades will require a more efficient use of computer architectures and scalability is major research theme at ECMWF. The Copernicus Atmospheric Monitoring Service as well as the Copernicus Climate Change Service will be delivering environmental data to European society based on the forecasting and climate reanalysis capabilities at ECMWF.

Arctic Climate Change Research

ACCR1.1 Recent climate developments in the Svalbard archipelago

Kim Holmén, Norwegian Polar Institute, Norway

The Arctic receives a lot of attention as the region that is experiencing climate change both first and fastest. The global surface air temperature rise in the past decade has been small but this is not the case in the Arctic where temperature increases have prevailed. For Svalbard these Arctic developments are even more pronounced both in actual physical parameters but also with regard to attention from mass media and policy makers. The climatic developments in the Svalbard archipelago and adjacent areas will be presented in a broader context than just temperature. The Svalbard temperature has been more than 10 degrees warmer than the normal during the 2015/2016 winter season, remarkable in itself but part of continues period of 5 years with monthly average temperatures above the normal. There are changes in every metric of climate in Svalbard and the changes are all consistent with a rapidly warming planet. Sea-ice observations in the archipelago show a clear decline both in extent and thickness of ice. The sea-ice transported out of the Arctic in the East Greenland current shows a clear trend towards thinner ice during the past decade. There has been a permanent feature of less sea-ice North and East of Svalbard for most of the past decade that is related to the currents bringing Atlantic water to the Arctic. The sea-water temperatures along Western Svalbard have been rising for the past decades which directly influences sea-ice and tide-water glaciers. The glaciers in Svalbard are losing mass both through increased melting in the summer and for tide-water glaciers also increased calving rates. The upper regions of some glaciers are experiencing increased accumulation probably related to increased humidity in a warming atmosphere giving more snow. This increased accumulation does not offset the increased ablation in lower levels of the glaciers. For the mass balance of glaciers there has been fairly constant winter accumulation during the past 40 years but increased ablation during summer. Most of the variability in mass balance loss is related to summer variations for Svalbard glaciers. Snow melting is occurring earlier where snow free conditions are 10 days earlier than 30 years ago in Ny-Ålesund. Permafrost temperatures are increasing and active layers are deepening at all observation points in Svalbard. Weaknesses in the available trend data are notably for clouds and precipitation. This will be discussed in the context of the mass balance for glaciers which often are used as visual examples of global climate change. Measuring snow in cold windy environments remains challenging. Statistics on amount of precipitation coming as rain instead of snow is essentially anecdotal rather than quantitative but the precipitation type has profound influence on the mass balance of glaciers. Changes in cloud cover and type are also poorly known but are important factors for radiation that in turn influence the mass balance of glaciers. This precipitation and cloud problem applies equally to sea-ice where snow cover and radiation are essential factors governing the rate of top-side melting. Svalbard is a region of the Arctic with clear and rapid climate change but there remain fundamental climate elements that need further attention in order to increase our understanding of the physical mechanisms and thus also build better predictive capacity.

ACCR1.2 Arctic sea ice retreat and its impact on large-scale weather patterns in winter

Srdjan Dobricic, Elisabetta Vignati and Simone Russo, European Commission, Joint Research Centre, Ispra, Italy

The ongoing shrinkage of the Arctic sea ice cover is closely linked to the global temperature rise, the enhanced warming in the Arctic, and eventually weather anomalies in the middle latitudes. Here, by applying a novel statistical method based on independent components, we give insight into ongoing dynamical processes connecting global warming, sea ice melting in the Arctic and changing weather in winter. It appears that observed spatial variations of near-surface temperature trends in winter may be approximated by the combined action of only three independent atmospheric components. Due to similarity to well known atmospheric oscillation indices they are named the North Atlantic Oscillation (NAO), Scandinavian Blocking (SB) and El Nino - Southern Oscillation (ENSO). The NAO and SB patterns are directly related to the ongoing sea ice cover shrinkage in the Barents Sea and the hemispheric increase of near-surface temperature. NAO connects sea ice melting with the negative phase of the NAO oscillation, while SB with the negative anomaly of atmospheric temperatures over the tropical Pacific. The impact of the ENSO pattern is limited to the tropical and middle latitudes. The statistical analysis further shows that the ongoing sea ice melting trend may often initiate the formation of large-scale atmospheric processes bringing colder weather to densely populated areas like Europe and North America. This indicates that improving sea ice cover and oceanographic analysis and forecasts in the Arctic may also improve seasonal forecasts of the North Hemispheric weather in winter.

ACCR1.3 Springtime snowfall events in Helsinki city nowadays and in the past

Ilkka Juga, Finnish Meteorological Institute, Helsinki, Finland

The climate at high latitudes is changing as the average temperature rises and the Arctic sea ice decreases. In Finland the mean temperature has risen over 2 degC from the middle of the 19th century to present, although the variability is large. In Southern Finland the snow season is gradually shortening, and heavy snowfall events in the spring are not as frequent as they used to be in the past. This study focuses on springtime snowfalls in the Helsinki city region in Southern Finland during a longer time frame. Snow depth observations have been conducted in Helsinki in the Kaisaniemi Park observation site from 1892 on (except for a break from October 1903 to December 1910). These observations show that there were several heavy snowfall events even in May before the year 1930, but thereafter such events have become rare. During recent decades the number of snowfall events has decreased clearly also in the latter half of April as the monthly mean temperature has risen remarkably. The snow depth observations reveal two heavy snowfall events that occurred in Helsinki late in spring, on 3 May 1915 and on 12-13 May 1916. Both events had a common factor, a low pressure centre moving over the Baltic Sea east and triggering an outbreak of bitterly cold air from the northeast into the precipitation area in Southern Finland, which caused the rain to change into snowfall. In the present climate cold air outbreaks from the Arctic are not as cold as they used to be, because the Arctic ice extent has declined, the ice has become thinner and the ice is retreating earlier in the spring. This factor has probably reduced the occurrence of springtime snowfalls in Finland.

ACCR2.1 Modelling of Arctic climate change

Ralf Doescher, Swedish Meteorological and Hydrological Institute, Sweden

Arctic climate change is embedded and interacting with global scale processes under the influence of growing greenhouse gas forcing of the climate system. As a result, we have observed qualitative changes of sea ice extent and other Arctic parameters. Key processes to understand those changes are sea ice dynamics and thermodynamics, radiative forcing, Arctic atmospheric boundary layer dynamics, ocean in and outflow, and processes contributing to the Arctic amplification of the global climate warming signal. All those processes and feedbacks need to be represented and realisticly balanced in a climate model covering the Arctic climate and its change. An important factor in understanding and simulating the Arctic climate is the interannual variability and the relative importance of its different origins in the large scale climate variability or in Arctic internal processes. A relevant question is to what extent we can project and predict Arctic climate change. The presentation will cover process studies, climate change scenario projections and the state of Arctic climate prediction.

ACCR2.2 Regionalization of Northern and Arctic areas of Russia on natural and climatic conditions of life for modern conditions and model forecasts

Vera Vinogradova, Institute of Geography, Russian Academy of Sciences, Russian Federation

Northern territory is 68% of the Russian territory. In the north and east of Russia the land area of Northern territory is more than 70% of all territories, and in the Far Eastern – 94%. For Northern territories the main factor of their sustainable development is the natural and climatic discomfort of the life conditions.

Investigation of natural and climate conditions in the Northern and Arctic areas of Russia was conducted using the method of regionalization of Russian Federation territory by environment conditions of human life. The regionalization is made on the base of influence degree of the main natural factors: colds, heat, moisture, altitude, catastrophic events (hydrometeorological, seismic, geocriological). Natural conditions of human life are characterized by integral points.

Four zones with unfavorable or favorable influence on the health, living, and labor activity of the population are determined: I – absolutely unfavorable; II – very unfavorable; III – unfavorable; IV – conditionally unfavorable.

We have analyzed nature-climatic conditions of human life in the second part of the 20th century and their changes in the middle of 21st century. The results of numerical experiments on global climate model of Institute of Numerical Mathematics (INM) of RAS, regional climate model of Voeikov Main Geophysical Observatory (MGO) were used. The most fast changeable climatic factors (thermal, cold and wind) were investigated on the basis of the observation meteorological data and results of the model forecast. The modification of boundaries of the nature-climatic discomfort zones in the global warming conditions is shown for the Northern and Arctic areas of Russian territory and in larger scale for mountain areas.

The climate warming in the middle of the XXI century will cause the considerable improving of the natural and climate conditions in Russia. The greatest changes of boundaries of zones of discomfort are expected in the European territory of Russia and in Western Siberia. The least changes will be observed on the coast of the Sea of Okhotsk, in the centre of Yakutia and on Far East. As a result of the expected warming, in the Far Eastern area with unfavorable natural conditions of life is almost unchanged. But redistribution of the areas with extreme conditions into less extreme is possible.

For the mountain regions of Russian Arctic zone worsening of nature-climatic conditions mainly relates to azonal factor impact – elevation, avalanche and mudflow danger and glacier activity. Climate warming will lead to softening nature conditions for humans both for the whole Subarctic and for mountain regions within it. In the mountains changes will be slower than on plains.

ACCR2.3 Threshold and Closing Windows: Risks of Irreversible Arctic Climate Change

Svante Bodin, International Cryosphere Climate Initiative, Sweden

The report"Thresholds and Closing Windows: Risks of Irreversible Cryosphere Climate Change." was released in Paris in December 2016. It is published by the International Cryosphere Climate Initiative (ICCI) and it examines the impacts of current climate pledges (called INDCs) on polar and mountain regions, and the feedbacks of those changes on the Earth climate system.

The "Thresholds" report is based on the findings of the Inter-governmental Panel on Climate Change (IPCC)'s Fifth Assessment, but includes important research published since that sharpens concerns about dynamics that might be triggered within the next few decades, especially in parts of Antarctica and Greenland. This includes the risk of 4-10 meters committed or "irreversible" sea-level rise that would unfold over many centuries, but may be impossible to halt once begun.

Other "thresholds" in the report include loss of 80% of current mountain glacier systems, irreversible carbon release from permafrost, and loss of summer Arctic sea ice – all processes that could be triggered well within the anticipated temperature range of climate pledges that will lead to 2.7 degrees of warming over pre-industrial already by 2100. It also includes possible damage to shell-building organisms in polar oceans that are more prone to acidification impacts, with potential consequences for the food chains of these rich fisheries.

The presentation will focus on Arctic cryosphere changes as a result of global warming. In particular the rapid loss of Arctic sea ice and permafrost as well as melting of the Greenland ice sheet will be examined in relation to the emission reduction commitments of GHG made at COP21 in Paris.

Forecasting

F1.1 MetCoOp, increasing the forecasting capabilities in Sweden and Norway

Ulf Andrae, SMHI, Sweden

The operational cooperation in numercial weather prediction between Norway and Sweden, MetCoOp, has now been in service for two years. The pooling of human and computer resources has allowed Met Norway and SMHI to do much more than each of the services would have been able to do on their own. The MetCoOp system, based on HARMONIE-AROME, will be described as well as experiences from the first years together with some of the challenges we have in forecast quality.

The next important step for the cooperation will be taken when the convective permitting ensemble prediction system, MEPS, will be operational in the fall of 2016. The system is utilizing the full HPC power of Sweden and Norway and has been running in pre-operation model since spring 2016. MEPS will bring a 10 member ensemble based on a new version of the forecasting model and the experiences from the first summer of real time runs will be presented.

It's foreseen that future NWP systems will be based on ensemble assimilation methods. This makes the need for further cooperation between the Nordic countries even larger and some of the ongoing activities in this area will be discussed.

F1.2 Harmonie-AROME model development in the ALADIN-HIRLAM collaboration

Lisa Bengtsson, Swedish Meteorological and Hydrological Institute, Sweden

Within Europe there is a strong history of active collaboration on Numerical Weather Prediction (NWP) in order to develop and maintain numerical short-range weather forecasting systems, for operational use, by the participating meteorological institutes. On December 5, 2005, a cooperation agreement between the ALADIN consortium and the HIRLAM consortium was signed with the prime objective "to provide the ALADIN and the HIRLAM Members with a state-of-the-art NWP-model for Short, and Very Short Range Forecasting including Nowcasting, for both Research and Development activities and Operational usage". The focus on the collaboration has since 2005 been on the convection-permitting scale, adapting the Meteo-France (MF) developed AROME (Application of Research to Operations at Mesoscale) model (Seity et al. 2011), to be used in a common ALADIN-HIRLAM system, in order to make it accessible for all 26 countries in the joint consortia. The use of AROME over various HIRLAM domains throughout Europe has lead to extensive updates in the description of the model's physical parameterizations, in order to reduce existing biases and improve the physical description of cloud microphysics, convection, turbulence, radiation and the land surface model. This presentation will give an overview of the current Harmonie-AROME model configuration (dynamical core and model physics) and an insight to new developments entering the forecast model in the future.

F1.3 Urban Modelling - Towns in HARMONIE

Carl Fortelius, Finnish Meteorological and Hydrological Institute, Finland

Advanced land surface schemes used in weather-models and climate models explicitly account for built-up environments, taking into account local urban characteristics, including the shape and lay out of buildings, presence of vegetated surfaces, building materials, and even properties of HVAC-systems. The Town Energy Balance (TEB) and Building Energy Balance Models (BEM) contained in the SURFEX land surface scheme used by HARMONIE are presented, and their potential for providing specifically urban forecast products is discussed. Examples of applications to Helsinki are shown.

F1.4 On the role of convection and surface heat fluxes on the development of polar lows. A case study

Ana Genovés, Universitat de les Illes Balears, Spain

By the end of January 2016 some small low centres were identified at the Arctic Ocean. Day by day different low pressure centres evolved in hours or days. The most important one with consequences in damages and wind records was Thorn. The low was first observed some days before it affected Norway and the Shetland.

After Thorn, on 31 January a new low developed at sea level in the same area. Some points are remarkable for this new low, observed in the output of the ECMWF new cycle 41r2 (then not operational). By one hand the initial presence of spread at 500 hPa temperature at the place where the low developed. This could be related to the increase of resolution of the EDA and can be important in relation to the uncertainty for the convection development and its forecasting. By other

hand, at some moments when the low centre was not in the area of jet stream influence, the low continued deepening. The presence of spread only at sea level can reflect the role and the importance of the heat fluxes from the sea.

The implications for the forecasting at medium range, but also for more extended ranges can be definitive at the current scenario of global warning. A first study of this case is presented in this presentation

F2. 1 Ensemble prediction: how is it done and what are the possibilities and challenges for weather forecasting?

Inger-Lise Frogner, MetNo, Norway

Based on the discovery of the sensitivity of dynamical systems to changes in the initial state by E. Lorenz in 1969, the so called Butterfly effect, the field of ensemble forecasting (EPS) emerged in weather science. First for global models in the 1990's, up-until today when we also have operational EPS for convection permitting models. Today the focus is not solely on describing uncertainties in the initial state, but to try to account for the known uncertainties in all aspects of the forecast. That means taking into account uncertainties in the model formulation, in surface, and for limited area models, also for the lateral boundaries. A brief description of the state of the art of available techniques for perturbing different aspects of the forecast will be given. An ensemble prediction system with 10-50 members, typically run 4 times a day, produces huge amounts of data, and the traditional way of forecasting by e.g. choosing the best model/member or editing on model output will be hard to maintain. Calibrated, automated products, based on the whole ensemble, will be increasingly important. This means that the traditional role of the forecaster will change. Challenges and possibilities for the use of EPS will be discussed.

F2.2 Post-processing of forecast data at FMI

Juha Kilpinen, Finnish Meteorological Institute, Finland

FMI has a long tradition in statistical NWP post-processing and other types of post-processing. The motivation was originally the need of forecast parameters what were not available directly in the model output including probabilistic parameters. Later also better forecast quality has motivated the developments.

The recent activity at FMI has been possible in this area due to re-allocation of human recourses inside FMI and success in the race of external funding.

A project concentrating on deterministic NWP data and MOS technique has been going on for some time. First T2m of ECMWF for European area is corrected with multiple other model and static variables. The station based MOS output will be converted to grid format with kriging or optimal interpolation. Kalman filter has been applied for ECMWF T2m for all stations globally. Elevation correction for 2 meter temperature forecast data (ECMWF, HIRLAM, GFS etc.) is made globally to 90 m horizontal resolution.

For ensemble data the calibration work has started. ECMWF ensemble data from day 1 to day 15 will be calibrated using NGR with HIRLAM-C Harp tools.

Heuristic modeling has been used to interpret new parameters. The parameters are then computed from lagged forecast data of multiple deterministic models (Poor Man's EPS) to provide an ensemble and finally new probabilistic products. Some winter weather variables have been made with this method for aviation purposes.

F2.3 The value of "I haven't got a clue" weather forecasts -a drastic example of the importance of being honest about one's forecast uncertainty

Anders Persson, Sweden

All weather forecasters have been there: the situation is extremely unpredictable and nobody has got a clue if it will be dry or wet, calm or windy, sunny or overcast. But the public wants to know and it is tempting (?) to fall for the reporter's flattering invitation: *-It is better that you guess than we, because you are The Expert!*

This presentation will briefly suggest, first from theoretical-mathematical considerations, then from practical-operational, that in the long run it is most beneficial for an individual customer or even the public if they in such a situation are not given a deterministic forecast. Handled cleverly such a strategy might even increase the forecasters' standing in the public's eyes.

F2.4 Forecast Verification – Developments, Challenges and Perspectives

Pertti Nurmi, Finnish Meteorological Institute, Finland

Weather forecast verification has a history almost as long as practical forecasting. Since the earliest references to the evaluation of binary tornado forecasts in the USA in 1884 (so-called Finley case), verification approaches, methods, metrics and applications have made giant leaps – exactly like weather forecasting - to where we stand today. Since the start of numerical weather forecasting in the 1950s the NWP verification has become customary in practically all weather services. It is a natural requirement to have perfect understanding of the quality of NWP guidance products utilized by operational weather forecasters in their practical work. The quality assessment of final forecasts originating from the operational forecasting environment and delivered further to forecast end-users, i.e. the weather service customers and the wider audience has a somewhat shorter history. However, the verification issues encountered in the operational forecasting environment have become more and more relevant in recent times when all activities need to have a sound reasoning to justify existence. The user-oriented forecasts address quite different verification aspects and challenges than what is the case with NWP output. Research and development of new verification approaches, strategies and metrics, revisiting and revising some of the traditional verification methods has recently been in the focus of verification and research communities. The presentation will provide an outlook on some of the recent development in forecast verification topics like extreme, high-impact event verification, spatial, ensemble and probabilistic verification as well as operational verification systems and practices, trying to provide insight on how to apply proper verification practices and interpret verification results.

F3.1 Enhanced cooperation ensures future aviation weather service provision in Northern Europe

Jaakko Nuottokari, Namcon, Finland

The Northern Europe Aviation Weather Consortium (NAMCON), a cooperation between the National Meteorological Services of Denmark, Estonia, Finland, Iceland, Latvia, Norway and Sweden emerged from an increasing pressure on the NMSs as MET service providers to air navigation to at the same time increase efficiency, harmonise production, innovate and develop new services for emerging user applications. The task is for one small to medium-sized NMS a great challenge, and a grouping of seven NMSs can pool together the resources and expertise to meet these challenges much better. The long history of cooperation in NWP, weather radar and training combined with the strong organisational will to create the NAMCON consortium has been and remains the backbone of the cooperation.

The main goal of the consortium is to reduce the cost of aviation weather services in line with the Single European Sky (SES) Reference Period 2 (RP2) targets and beyond. The main tool to achieve this is to join the production of services and products and reduce F3.1Sweden by the Danish

Meteorological Institute and the joint production of the Nordic Significant Weather Chart (NSWC) by the Swedish Meteorological and Hydrological Institute (SMHI) and Finnish Meteorological Institute (FMI). Information management and production methods are also to be streamlined and an example of this is the upcoming launch of the NAMCON Aviation Weather Briefing Portal on 1 December 2015.

There are many challenges for NAMCON to overcome in order to meet its strategic objectives. The single greatest challenge so far has been to adequately resource the very ambitious work plan developed. Due to the fact that there are only a handful of aviation weather experts in the region, progress cannot be achieved fast. By selecting 2-3 key priority projects per year we can focus our efforts to make the biggest gains in productivity. Member NMSs are also in very different political and economic environments and thus all members do not share all issues. Indeed, costs would need to increase in the Baltic States to include research and development costs.

The consortium is governed by the directors of weather services in member institutions and an executive is appointed from this group to liaise with the consortium manager regularly. The heads of aviation weather and/or aviation customer services form the operational group responsible for the design and implementation of the consortium activities. Directors are briefed annually on the progress and approve the strategy and vision for the consortium. Teleconferences are held in between the bi-annual two-day NAMCON meetings. Task teams carry out all development and deliverables as defined in the annual work plan updated every year. Progress is also communicated regularly to the supervisory authorities and FABs. NAMCON is present in the NEFAB air navigation services consultative board and reports to the 7-State ministerial network meetings. The governmental connection adds political support to the activities carried out.

The NAMCON aims to set the stage for regional service delivery of aviation weather services in Northern Europe by harmonising production and creating joint initiatives. Through incremental and systematic development and cooperation, the challenges of future service delivery can be met while ensuring the continuity of most operations.

F3.2 SmartMet II – a software/tool for aeronautical meteorologist to produce significant weather charts

Paulina Kuokka, Elina Tuhkalainen and Jarkko Hirvonen, Finnish Meteorological Institute, Finland

SmartMet II is a software under development. In near future it can be used to produce significant weather charts for aviation. Meteorologist can study model data with SmartMet II and finally draw meteorological objects such as fronts and areas of significant weather on the same map. The amount of tools meteorologists nowadays need to use is huge and increasing but with SmartMet II only one software will be needed to both study the data and draw the chart. The meteorological objects will be easy to draw since the user will see them in the background.

SmartMet II produces automatically the necessary file formats and the chart can be published with the software. Both corrections and amendments can be produced and published easily by making changes to the already published chart.

With SmartMet II it's possible to develop "first guesfield" for different significant weather chart parameters. For example the temperature zero level and the sea surface temperature can be imported straight from model data and the meteorologist can modify them if necessary. Some parameters such as areas of significant weather or instrument meteorological conditions are more difficult to produce straight from the model data and need more careful development but however can be produced to help the chart production. This way the meteorologist will work more efficient and have more time to concentrate on the challenging things.

With earlier version of SmartMet II the meteorological warnings such as forest fire warnings and wind warnings are produced already at Finnish Meteorological Institute . This software is also used for time-height cross section products for aviation users.

This presentation/poster will demonstrate the parts of the software which are already implemented. And also the key features which will soon be implemented.

F3.3 Runway Visual Range climatology in six airports in Finland based on 2005-2014 airport weather observations

Paulina Kuokka, Toni Amnell and Jarkko Hirvonen, Finnish Meteorological Institute, Finland

This Runway Visual Range (RVR) climatology study is based on the METAR observations from six Finnish airports between years 2005 and 2014. The study shows that RVR below 1000 m does not exist in mid summer months. On the other hand poor (RVR<1000m) and very poor RVR (RVR<300m) conditions do take place throughout the autumn, winter and spring months. The most thig fog cases with the RVR<300m take place on late august early mornings but strikingly also during April. This spring maxima of very poor visibility is thought to be related to melting snow. The software developed to manipulate the RVR-data of METAR observations could be applied to any set of Finnish and also many other METAR data.

F4.1 Communication of forecast and meteorological information: an overview

Anders Doksæter Sivle, MetNo, Norway

Information from weather reports is used by many people to plan their activities. Studying how people make weather-related decisions is important for improving the communication of weather reports. Improved communication contributes to increased information value for users, leading to appropriate actions to protect life, property and well-being. Studies of weather-related decision-making have typically focused on the communication of uncertainty information such as probability of precipitation. Many of these studies have been using economic models, and probabilistic forecast information is usually found to have greater value for users than equivalent deterministic information. However, these studies are concerned with the use of selected pieces of information and severe weather and thus not capturing the more common and everyday decision-making situations. Moreover, there has been a shift in decision-making research the last decades to where information processing models are increasingly used. In these models intuition and emotions are seen as important, in addition to analytical information processing. This approach should therefore be considered also in studies of weather-related decision-making.

The top weather sites in the world are all multimodal, composed of tables, symbols, numbers, maps, diagrams, and verbal text forecasts. In addition to deterministic forecasts, these sites provide uncertainty information. Statistics from one such site, Yr.no, show that 5% of all visits lasted between three and ten minutes, whereas 70% of all visits lasted 30 seconds or less. It seems certain users are capable to make quick decisions, though more elaborate decisions are also made on occasion. The large differences in time consumption indicate different amounts of information to be used in the decision process. People's prior knowledge and experiences in a variety of fields and their abilities to synthesize different types of information are used to interpret information in weather reports. Thus, to improve design and communication, it is important to understand how members of the public interpret and integrate information from weather reports.

New models of science communication recognize that successful communication typically involves interaction and iteration between (forecast) producers and users ("co-production"), and the end users should receive the information they need in a form that they can use.

F4.2 New self-descriptive naming convention and flexible api for climate data

Solfrid Agersten and Hanne Heiberg, Norwegian Meteological Institute, Norway

The presentation will be about a new naming convention for observations and statistical data from the Norwegian Meteorological institute. This naming convention describes self-explanatory metadata to bridge between sciences, applications, stakeholders, and end users.

All institutes seem to have their own naming convention for observed atmospheric and oceanographic elements and the statistical derived elements. This means that data are not so easy to combine because of the different names, and possibly gives a different understanding of what the elements represent. Earlier MET Norway used the letter "X" meaning the max function, but with limited access to information about "max over what". To solve these problems we wanted to use names that are self-descriptive and easily understood. Therefore we decided to use the CF convention if possible, and suggest new CF standard names when the convention does not cover the observed parameters. We have also introduced the cell method into the naming convention to cover the need for describing a function as "max". All in all the naming convention gives a metadata discovery structure in a way that data are easily found, independent of where the data are stored. The timeseries described by the metadata in the new convention can be retrieved from a new flexible and open api (application programmers interface) that also will be described in the presentation.

F4.3 Navigating through the weather jungle with automatic forecasts as GPS (By meteorologist Jesper Eriksen, Danish Meteorological Society)

Jesper Erikson, DMI, Danmark

Nowadays weather forecasts are easily accessible through various sources and media. By a quick look at a smartphone a detailed weather forecast can be given for almost any location worldwide. Despite the fact that weather models has increased dramatically in skill within the last 15 year, the output from the weather models still has shortcomings for certain type of weather parameters in certain weather situations, especially in area with a complex terrain. This fact is well known by the experienced forecaster, but is harder to digest and comprehend for the general public. In this brief presentation I will show some examples of the shortcomings of the automatic forecasts, and try to highlight some communications issues, seen from a user perspective.

Meteorological and Climate Services

MCS1.1 Meteorological information for the Energy sector

Jesper Rasmussen, DONG, Denmark

For many years, meteorological information has been important for the players in the Nordic Power Market, especially regarding precipitation (Hydropower) and temperature (consumption). The latest decade development in wind and solar power has made the use for meteorological information even more important. During the session, I will introduce the Nordic Power Market along with some examples of how meteorological information is used in the energy sector today. At the end, I will talk about the challenges of the Power Market the coming years as and the need for meteorological information

MCS1.2 Short-range NWP for direct normal irradiance by utilizing Meteosat Second Generation data

Heiner Körnich, Magnus Lindskog, and Tomas Landelius, Swedish Meteorological and Hydrological Institute

In this work we address short-range forecasts of direct normal irradiance (DNI) for application in concentrating solar power systems as part of the European project DNICast (DNI Nowcasting methods for optimized operation of concentrating solar technologies). While aerosols also play an important role, we focus on the impact of clouds for the forecasted irradiance. The aimed forecast window in this study ranges from 0 up to 24 hours. Observational information on clouds is provided operationally by satellites, especially from Meteosat Second Generation (MSG). In order to utilize this information for longer forecasts than 2 hours, traditionally addressed by conventional nowcasting techniques, we assimilate MSG into the meso-scale NWP system HARMONIE. To this end, we employ different data assimilation techniques such as the assimilation of MSG SEVIRI radiances, cloud initialization with MSG cloud products and 4-dimensional variational 4DVar data assimilation and examine their impact on the skill of the short-range DNI forecasting.

For DNICast, the HARMONIE system is setup with a domain over the Western Mediterranean with a horizontal spacing of 2.5 km and run for April 2013. The domain contains the Plataforma Solar de Almería (PSA) in Southern Spain and the Carpentras station of the Baseline Surface Radiation Network (BSRN) providing surface irradiance observations that are used to validate the NWP forecasts. Furthermore, the standard meteorological observational network is used for forecast verification. A clear improvement in the forecasts for relative humidity and cloud cover can be seen due to the additional assimilation of SEVIRI radiances. The cloud initialization leads to modelled clouds with favorable verification against MSG products, however the forecasted relative humidity and DNI deteriorates. More research into this issue is needed. The 4DVar experiments display promising results.

MCS1.3 Improving The MJO-Based Forecasting Models For Precipitation In Southwestern Iran

Mohammad Jafar Nazemosadat, Arezo Rostampour, Kokab Shahgholian, *Shiraz University, Faculty of Agricultural, Oceanic Atmospheric Science Research Center, Iran*

The Madden–Julian oscillation (MJO) is a large-scale coupling between atmospheric circulation and tropical deep convection explaining a large part of the intra-seasonal (30–90 day) variability in the tropical and extra-tropical atmospheres. Rather than being a standing pattern like the El Niño–Southern Oscillation (ENSO), the MJO is an oceanic-atmospheric moving pattern that propagates eastward at approximately 4 to 8 m/s (9 to 18 mph), through the atmosphere above the warm parts of the Indian and Pacific oceans. Due to its quasi cyclic pattern, the MJO is known as the 30–60 day oscillation, 30–60 day wave, or intra-seasonal oscillation.

Wheeler and Hendon (2004) categorized the whole cycle of the Oscillation into 8 phases namely phase 1 to 8. While phase 1 signifies that the convective activity is mainly centered over the west extremity of the Indian Ocean equator, the convection centers pass the dateline in phase 8 and dying out in the central Pacific. For phases 2 and 4 the region of enhanced rainfall (wet conditions) moves slowly eastward over the Indian Ocean. By phase 4 and 5, it has reached the 'maritime continent' (the archipelago of islands and shallow seas of Indonesia and surrounding countries). In phase 6, 7 and 8, it propagates further eastward over the western Pacific, to be disappeared in the central Pacific. Behind the region of enhanced rainfall is a region of suppressed rainfall.

A number of investigators reported above normal precipitation and more frequent rainy days for southwest of Iran during the phases 1, 2, 7 and 8. On the other hand, dryness and negative precipitation anomalies are mostly associated to the phases 1 to 4 of the Oscillation. In spite of these findings, uncertainty is large for intra-seasoanal MJO-based precipitation prediction during the MJO negative phase; when rainy events are expected. The present study is therefore, motivated to compare some oceanic and atmospheric behaviors during rainy and no-rainy days of phase 1. Such comparison is useful for understanding the mechanism of rainfall production during this phase.

For improving the MJO-based rainfall prediction, the MJO amplitudes during phase 1 was extracted from the Australian Bureau of Meteorology. While the days with amplitudes greater than 1 assigned as the strong events, daily records with amplitudes less than 1.0 are signified as the weak event. The present study decided to analyze the ocean-atmosphere characteristics during the proposed strong events of the MJO phase 1.

Daily precipitation data of nine stations spread in various parts of southwest Iran were extracted from the Iranian Meteorological Organization (IRIMO). The detected MJO strong spells were then matched with rainfall events in each of nine stations. For each of the adopted spell, if total rainfall was 1.0 mm or greater, that spell was assigned as rainy spell; otherwise the spell categorized as dry spell. The MJO-Precipitation composites were constructed for the rainy and dry spells. Precipitation rate, atmospheric circulation was also analyzed for these two distinct splees.

Results indicate that, for improving the MJO-based precipitation forecast in southwest of Iran, not only the phase characteristics, but also the position and intensity of convective activities over the Indian and the Pacific Oceans equators should be considered. In phase 1, rainy periods in southwest of Iran consistently occurred when equatorial convective precipitation centered over the areas between 50o E to 60oE and 5o S to 5o N. For such circumstances the intensity of outgoing long-wave radiation (OLR over these areas) dropped to (-20 Watt/m2) or lower. Non-rainy events of phase 1 were coincided with the episodes that aerial extend of the convective precipitation was larger but precipitation intensity was less than those observed for rainy spells.

MSC1.4 Wind Energy Resource Assessment: Is wind speed at hub height enough or are other meteorological parameters needed as well?

Matthias Mohr, Johan Arnqvist and Hans Bergström, Uppsala University, Sweden

Power production of a future wind farm is calculated using long-term climatological wind speed distributions in every wind direction sector at wind turbine hub height. Usually, software like WASP (www.wasp.dk) or windPRO (http://www.emd.dk/windpro/) is used for that purpose.

Analysis of power production data from existing wind turbines, however, reveals a lot of scatter with respect to the wind turbine power curve provided by the manufacturer. Wind turbine power production obviously depends on air density, which is easily corrected for. However, wind turbine power production also depends on both wind shear and wind veer across the rotor diameter. In order to take such variations into account, the “rotor-equivalent wind speed” was defined. Another factor influencing power production is turbulence.

A lot of wind farms in Sweden are built within forested areas. Forest, however, increases both wind shear and veer as well as turbulence compared to flat and open terrain. These effects are reduced to some degree by increasing turbine hub height up to 150 m height above ground or so. However, data shows that even at these heights turbulence and wind shear/veer effects are important.

In this study, data from very high masts and/or WRF model results are used to investigate the effect that these factors have on annual energy production. It is shown that turbulence effects reduce power production by about 2 - 3% on average over one year. The effect of wind veer and shear has yet to be calculated, but will be presented at NMM 2016.

MSC1.5 Projection of Actual Evapotranspiration by GCM and EH50M Models during the Growth Season by 2040

A.A. Sabziparvar, A. Keikavoos, M.J. Nazemosadat, M. Khdamorad Pour, Iran Babaeian

Evapotranspiration (ET) is one of the key elements of hydrologic cycle and its determination is important for water resources management; in particular, for arid and semi-arid regions facing water shortage. Measurement of ET (actual and potential) by lysimeter is very costly and the coverage of ground-based monitoring is not proper for long-term climatological studies. In this study, the general circulation model (EH5OM) is coupled with RegCM3 (Regional Climate Model) downscaling model. Moreover, projection of actual evapotranspiration (ETa) is made by BATS-1e (Biosphere-Atmosphere Transfer Scheme) as a land surface scheme in RegCM3 (Regional Climate Model) in Grand Karkheh Basin (GKB), located at south-west Iran for the present (1960-1990) and future (2010-2040) climatic periods. Comparing the annual ETa simulations in the two periods shows decrease in the ETa by 2040 in most area of the basin for the future period, with about 230 mm decrease in the whole basin. The mean monthly ETa during the agricultural growth months (April to September) indicates 30% reduction in the maximums of the ETa during the growth months. Additionally, a geographical shift of the maximums of evapotranspiration from the North-western, and central areas of the GKB to the east of the basin was observed. The predicted ETa during growth period showed an increase in available moisture for some parts of the eastern GKB by 2040. This result is crucial and should be considered in the planning of agriculture and water resources in regions facing arid and semi-arid climates.

MCS2.1 Development of Climate Services for Adaptation

Kirsti Jylhä, Finnish Meteorological Institute, Finland

Climate services for adaptation aim at reducing the vulnerability of societies to the adverse impacts of climate variability and change. A goal is also to aid in making use of the potential benefits of the changing climate. A proper and timely adaptation to climate change and its impacts should be based on the best available knowledge of past, current and future climate.

Collaboration and communication between climate change researches and users of climate information are required to crystallize which knowledge and material are most essential and how to best apply them.

Early forms of climate services focused mainly on the past and present climate and included monthly overviews of previous weather conditions (in Finland since 1881) as well as meteorological yearbooks and climatological statistics and charts. Regarding future climate services, a recently-conducted worldwide online survey indicated that four activities were most strongly supported by the respondents (about 2200 in total, mostly users of reanalysis data). These activities were "interpolation and production of gridded data sets based on observations", "provision of statistics based on observations", "homogenization of weather station data" and "research and communication of climate change uncertainties".

Globally, many of the most vulnerable countries to the impacts of climate change tend to have only very limited national climate services, if any. In the World Climate Conference-3 in 2009, it was agreed that every country and every climate-sensitive sector of society should become capable of accessing and applying climate prediction and information services. Since then, a large number of global, regional and national climate change adaptation information services, platforms and portals have been initiated or activated. In Finland, for example, Climateguide.fi web portal was created in 2009-2011 and is continuously updated and developed.

This presentation will give examples of and experiences from developing tailored climate scenarios for the purpose of climate change impact, adaptation and vulnerability research in various sectors of society. The scenarios have been used for raising awareness and understanding of the problem of climate change, for national adaptation strategy development and policy formulation, and also for regional and municipal level adaptation strategies. Users' experiences and reported problems in using climate scenarios will also be discussed.

MSC2.2 Production and use of regional climate model projections – a Swedish perspective on building climate services in practice

Erik Kjellström, Lars Bärring, Grigory Nikulin, Gunn Persson and Gustav Strandberg, Swedish Meteorological and Hydrological Institute, Sweden,
Carin Nilsson, Centre for Environmental and Climate Research, Lund University, Sweden

This study describes the process of building a climate service centered on projections from the Rossby Centre regional climate model RCA4. The climate service has as its central facility a web service provided by the Swedish Meteorological and Hydrological Institute where users can get an idea of how future climate change in Sweden may look like from a suite of maps, diagrams, explaining texts and user guides. We present the contents of the web service and how this has been designed and developed in collaboration with users of the service in a dialogue reaching over more than a decade. We also present the RCA4 climate projections that provides the fundamental climate information presented at the web service. In this context, RCA4 has been used to downscale nine different coupled atmosphere-ocean general circulation models (AOGCMs) from the 5th Coupled Model Intercomparison Project (CMIP5) to 0.44º (c. 50 km) horizontal resolution over Europe. We also investigate how this ensemble relates to the underlying GCM ensemble and to the wider multi-model CMIP5 ensemble.

We find that the iterative approach involving the users of the climate service has been successful as the service is widely used and is an important source of information for work on climate adaptation in Sweden. The RCA4 ensemble samples a large degree of the spread in the CMIP5 ensemble implying that it can be used to illustrate uncertainties and robustness in future climate change in Sweden. The results also show that RCA4 changes results compared to the underlying AOGCMs, sometimes in a systematic way.

MSC3.1 The Copernicus Climate Change Service (C3S) in the making

Jean-Noël Thépaut, ECMWF, UK

Copernicus is the European Commission's flagship Earth observation programme that delivers freely accessible operational data and information services. ECMWF has been entrusted to operate two key parts of the Copernicus programme, which will bring a consistent standard to the measurement, forecasting and prediction of atmospheric conditions and climate change.

The Copernicus Climate Change Service (C3S) routinely monitors and analyses more than 20 essential climate variables to build a global picture of our climate, from the past to the future, as well as developing customisable climate indicators for relevant economic sectors, such as energy, water management, agriculture, insurance, health….

C3S has now taken off, the technical infrastructure is being developed and the first industrial activities have been kicked off. Climate monitoring information is routinely produced and available at climate.copernicus.eu, while multi-model seasonal forecast products are being developed. In addition, a number of proof-of-concept sectoral climate services have been initiated. This paper will focus on the most recent achievements of the Service, with a focus on the description and expected outcome of the proof-of-concept activities as well as the definition of a roadmap towards a fully operational European Climate Change Service.

MCS3.2 Urban SIS – Climate information for European Cities

Heiner Körnich, Patrick Samuelsson, Esbjörn Olsson, Jorge Amorim, David Segersson and Lars Gidhagen, Swedish Meteorological and Hydrological Institute, Sweden

Urban SIS is a proof-of-concept project within Copernicus Climate Change (C3S) Service 441 Lot 3, running from 2016 to 2017. The main objective is to facilitate downscaled Essential Climate Variables (ECV) on the urban scale, consisting of hourly data on 1x1 km^2 spatial resolution. Within the project, data from Pan-European re-analysis and regional climate projections will be downscaled with a Numerical Weather Prediction system. The high-resolution weather data serves to drive air quality and hydrological models with output on the same temporal and spatial resolution, which all together form the basis for user-driven climate impact indicators serving the health and infrastructure sectors.

The project utilizes the Numerical Weather Prediction system HARMONIE for the high-resolution urban simulation. Lateral boundaries are provided by the UERRA/HARMONIE reanalysis that is generated as a preparation for C3S for the historical period. Detailed urban land-use is included through the implementation of the Urban Atlas into the ECOCLIMAP2-dataset which is used by HARMONIE. Surface data assimilation is employed to initialize the surface state in HARMONIE's surface component SURFEX. For UrbanSiS, five to ten year long periods of historical data will be produced for the urban environments of Stockholm, Bologna and Amsterdam-Rotterdam. Uncertainty estimates will also be provided.

This presentation will show preliminary results from the historical period for Stockholm and Bologna. The model data will be validated against local observations. Examples for urban ECVs will be given addressing needs for urban infrastructure, health and water management. The benefit of the high-resolution data will be examined.

MCS3.3 UERRA Regional Reanalysis systems developments and production for pre-operational Copernicus climate change services

Per Undén, Martin Ridal, Esbjörn Olsson, Heiner Körnich, Jenelan Bojarova, Ulf Andrae Swedish Meteorological and Hydrological Institute, Sweden

The FP7 Project UERRA (Uncertainties in Ensembles of Regional ReAnalyses) has developed three full upper air Regional European Reanalysis systems and two 2-dimensional ones. They are now in production phase and the long reanalyses have been run for several years since 2015. The 4 year project will run through 2017 so all reanalyses will be completed during that year.

The reanalyses cover the period from 1960 until today (2016), for which the global ERA40 and ERA-Interim reanalyses exist and which provide boundary forcing. UERRA has much higher horizontal grid resolution, about 11 km (5 for surface parameters) than the global at 125 or 78 km respectively. This gives much more detail in precipitation, temperature and wind near the surface and statistics of this will be shown.

SMHI has run 2006-2010 with two model versions; Météo-France downscales these in different ways producing precipitation and near surface temperature reanalyses on a 5.5 km grid using all available SYNOP and CLIMATE stations. Efforts have been made to fill data gaps in the archives

In addition, SMHI has developed and runs a consistent 25 year cloud cover analysis and off-line hydrological models to evaluate the reanalyses.

The Met Office and University of Bonn are both running 20 ensemble members but their systems are quite different: The Met Office has set up the ensemble of individual but expensive 4-dimensional variational assimilation and at half resolution (24 km) whereas the University of Bonn uses the ensemble nudging assimilation for their ensembles with the COSMO system. Due to the expense in computational resources, the Met Office will produce a 35+ year period from 1978 and Bonn will produce 5 years 2006-2010. It deserves to be pointed out that none of the above systems map onto any operational systems in their respective weather services; all of the reanalysis systems are unique for UERRA, in terms of domain, resolution and model version or assimilation method.

The resulting analysis and forecast fields are stored in a common MARS archive at ECMWF, in GRIB2 format with a common set of parameters. This is a new way of defining the data. Surface, model, pressure and also high vertical resolution height level data will be stored in the lowest 500 m above ground. Evaluation methods to gauge the quality and uncertainties of reanalyses against independent observations and high resolution national gridded data sets have been developed and tested on some prior existing data.

MSC3.4 CLARA-A2: An updated global cloud, surface albedoand surface radiation dataset derived from 34 years of NOAA/Metop AVHRR data

Karl-Göran Karlsson, Swedish Meteorological and Hydrological Institute, Sweden

The second version of the cloud, surface radiation and surface albedo dataset CLARA (Karlsson et. al. 2013) is released in 2016. It is based on global satellite data from the Advanced Very High Resolution Radiometer (AVHRR) covering the time period 1982-2015. It was produced within the framework of the EUMETSAT Climate Monitoring Satellite Application Facility (CMSAF) project where SMHI is responsible for the methods to derive the basic cloud products.

The dataset, its methods and the latest validation results will be briefly presented. A particular strength of the dataset is the long-term coverage of Polar daytime conditions over the Arctic and Antarctic regions which will be demonstrated.

(Reference: Karlsson, K. -G., Riihelä, A., Müller, R., Meirink, J. -F., Sedlar, J., Stengel, M., et al. (2013). CLARA-A1:The CMSAF cloud and radiation dataset from 28 yr of global AVHRR data. Atmospheric Chemistry and Physics, 13, 5351–5367, http://dx.doi.org/10.5194/acp-13-5351-2013.)

New Observation Sources and Systems

OBS.1 New data sources replacing and complementing the old ones

Elena Saltikoff, Finnish Meteorological Institute, Finland

For decades, “weather observations” meant SYNOPs: an experienced professional reading the meters and assessing the condition of the sky. Remote sensing sneaked in via the corner of the forecaster’s office, first in black and white, black and green and finally colourful displays providing more information you could ever understand.

Now the “state of the art” means dual-polarization radars, and Meteosat producing every 5 or 15 minutes multichannel composites. Vertical profiles of the atmosphere do not come only from radiosoundings and satellites, but we have wind profilers, Doppler lidars, backscatter lidars, GPS delay and aeroplanes as an instrument.

At the same time, the citizens make, share and use more and more observations, either consciously in mPing and other volunteer programmes, or even unconsciously in the wilder data acquisition projects.

Many of the new sources provide same parameters (such as wind and humidity) but at better resolution than the traditional ones. Some of them provide completely new parameters, which we often try to process to replace expensive and less exhaustive manual observations.

Much of the new development is related to mesoscale phenomena, which by one definition are "…too small to be caught in synoptic net, yet too large to be understood from a single point observation".

The growth of observed data grows hand in hand with needs and opportunities of data assimilation in numerical weather prediction models. The forecaster still needs to build the 4D image of atmosphere in his/her head, but there are new tools to help in this.

OBS.2 Sunshine, light and heat in the atmosphere - Theory and observations

Kristian Pagh Nielsen, Danish Meteorological Institute, Denmark

Sunshine - or shortwave irradiance - is the primary energy source for all meteorological processes.The shortwave irradiance is transmitted through the atmosphere, it is scattered and absorbed by molecules, clouds and aerosol, and reflected and absorbed at the surface. All of these processes depend on the colour - or wavelength - of the shortwave irradiance. Less than 50% of the shortwave irradiance is in the form of visible light. Most of the absorbed shortwave irradiance is re-emitted as heat - or longwave irradiance. The longwave irradiance is also wavelength dependent, so that specific "colours" of longwave irradiance are absorbed by specific greenhouse gases.

The solar and longwave irradiances are listed as Essential Climate Variables (ECVs) in the recent WMO report: "Status of the Global Observing System (GCOS) for Climate". Despite this there is a lack of high quality solar irradiance measurements. Longwave irradiance measurements are even more sparse. They can be estimated from satellite measurements, but these satellite-derived irradiances have temporal and spatial issues that make them highly uncertain, especially when they are not combined with high quality ground-based measurements. Beside climate observations, irradiance observations are important for both existing and upcoming solar energy technologies. The newest instrumental developments will be presented and strategies for implementing them in the observational networks will be discussed.

OBS.3 Boundary-layer radiosonde and UAV sensors

Anders Petersson, Ali Wajahat, Sparv Embedded, Sweden

Windsond is a new, miniature radiosonde specialized for low altitudes, where it only needs 30 liters of helium and an 8 gram balloon. This enables a new level of portability such as releasing a radiosonde through a rolled down car window. The sondes are easily recovered and reused.

Windsond is becoming popular for meteorological reseach.

Researchers have also started using Windsond for different special projects which we will present. Stripping down the sonde and attaching it to fixed-wing and rotary-wing UAVs is becoming quite popular. We took inspiration from this to start development of a "sensor kit".

The sensor kit is specialised for making it trivial to integrate a range of sensors on UAVs, balloons and other mobile platforms. Weight, size and power consumption are designed to fit even the smallest RPAS. A large number of sensors of the same or different kinds can be connected at the same time. The kit hides the electrical and programming details of sensors, making them plug-and-play. Data is synchronized with GPS, logged and optionally transmitted as real-time, long-range telemetry. For telemetry, Android and Windows devices can receive the data on the ground, with option to add support for Mac, Linux and iOS. The kit is very adaptable to new sensors, radio modems, etc.

We will show the possibilities of our solutions. We also want to know for example, what sensors the research community would find useful.

OBS.4 Development of satellites and other remote sensing systems

Anke Thoss, Swedish Meteorological and Hydrological Institute, SwedenI

The use of satellite data in synoptic scale NWP has matured over recent decades. Development in both global and regional NWP is going more and more to towards resolving mesoscale and local weather systems. This development is aided by new generations of both geostationary and polar orbiting satellite systems, giving more detailed information of the atmospheric state in terms of information content and spatial and temporal resolution.

Future European Satellite systems, to be launched in the 2020 timeframe, will supply an unprecedented amount of information to be exploited for both Nowcasting and NWP. This is a challenge we need to take advantage of, and prepare for in time.

An overview of the METEOSAT Third Generation and METOP Second Generation Missions capabilities and envisaged products will be given with reference to existing and planned European, American, Chinese and Japanese satellite systems.

Also a short overview of missions on environmental satellites relevant to meteorology, as some of the ESA sentinel satellites will be given.

Just as exploitation of current and future satellite systems needs joint international efforts, the efficient exploitation of ground based remote sensing systems such as weather radars requires international collaboration such as in OPERA and BALTRAD.

NMS are challenged to make best use of rapidly growing wealth of information, while resources for development and exploitation remain in the same order of magnitude. This challenge can only be met by efficiently pooling resources on an international level and through efficient regional collaboration.

OBS.5 SWERAD Modernization - From Doppler Radar to Dual Polarized Radar 2016 – 2018

Ingemar Carlsson, VP Congestus Weather Radar Consulting AB, Sweden

The Swedish Weather Radar Network, SWERAD, includes 12 doppler weather radar from the 80-ties. Two radars are modified today and one or two more will be modified this year. The modernization is done by Saab AB with EEC as subcontractor.

I will present how the modernization is done, which parts that are reused and which parts that are replaced. Quality improvements and new products from the modernized radar will be exemplified.

My opinion is that Radar Data is far from used in an optimal way which will be commented in the presentation as well as ideas how weather radar data could be complemented.

Poster Sessions

Forecasting

PSF.1 A Case Study: The 2015 November snow storm in Copenhagen.

M. Bjerring Fournier[1], R. Ferretti [2,3], A. W. Hansen [1], C. Petersen[2] and B. S. Andersen[2]

[1] Niels Bohr Institute, University of Copenhagen, Denmark
[2] Danish Meteorological Institute, Denmark
[3] CETEMPS-Department of Physics, University of L´ Aquila Italy

A snowstorm associated with a shallow cyclone occurred in Denmark from the 21st to the 22nd November 2015. It produced one of the most intense November snowfalls of all time in Denmark. The DMI operational non-hydrostatic mesoscale NWP model, ALADIN-HIRLAM shared system, did not correctly predict the snowstorm at all, whereas the DMI operational hydrostatic large scale NWP model, HIRLAM, did it.

This study investigates the meteorological characteristics of the snowstorm and seeks an explanation for why the operational model HARMONIE-AROME configuration did not succeed in forecasting it. The investigation is carried out by using observational data and model outputs. An 'ad hoc' simulation using HARMONIE-AROME with reduced grid resolution (1km) is performed and compared with both observational data and outputs from HIRLAM. It is found that the snowstorm was driven by a strong convective element with two trigger mechanisms: convergence associated with the low pressure system and the intrusion of cold and dry air from the north. This preliminary results suggest that the reason why HARMONIE-AROME did not correctly forecast the snowstorm are: 1. It did not predict the dry air intrusion, which turn in missing an important trigger mechanism for convection, 2. the snow (with big and wet snow flakes) present at higher levels in the atmosphere probably melted before reaching the ground and/or the rate of evaporation from the rainfall might not have been fast enough resulting in the temperature being too high at lower levels.

PSF.2 A new production system for Low Level Forecasts for general Aviation developed by SMHI and DMI

Per-Olof Ganerlöv, Swedish Meteorological and Hydrological Institute, Sweden

The **low level forecast** is a forecast for general aviation flying according to VFR (Visual Flight Rules). Detailed forecasts for surface winds, cloud base, visibility and weather, along with wind and temperature at higher levels and the risk of turbulence and icing is presented in text format and in graphic format. LLF.2 is a new production system aiming for a more rational and flexible production of aviation forecasts. It is planned to be operational in the autumn 2016.

PSF.3 An example of weather analysis to support Finnish Safety Investigation Authority

Matti Heinonen, Finnish Meteorological Institute

On the 8th of November 2012 at 17 UTC a small one man piloted, Cessna, aircraft ascended from the airport of Joensuu (EFJO) flying in visual flight rules. Immediately after take off pilot flew the plane into a dense snow shower. Pilot lost the control of aircraft which resulted into a collision to terrain. Pilot lost his life and the aircraft was destroyed.

This poster describes the procedures using the above mentioned case as an example that are committed in the Finnish Meteorological Institute to support the Finnish Safety Investigation Authority in their work of accident investigations.

New Observation Sources and Systems

PSNOSS.1. The ICOS Sweden technology

Achim Grelle, Alexander Bergsten, and Bengt Norén, In Situ Instrument AB, Sweden

In ICOS Sweden, 6 sites are equipped with novel, standardized systems to measure GHG concentrations and fluxes of energy and GHGs along with environmental variables. Turbulent fluxes are determined from 20-Hz data of wind components and scalar concentrations, sampled digitally and synchronously by a new digital datalogger (ISDL). Vertical concentration gradients of GHGs are measured by an IRGA through a multi-level sampling system. Components of the radiation balance are measured at different levels above ecosystems and along transects below canopies. To determine energy storage within vegetation, thermocouples are installed in different parts of selected trees. At several locations, groundwater level and depth profiles of temperature and soil water content are measured. Driving variables such as air temperature profiles, air pressure, and precipitation are measured at each site. With regard to the ICOS long-term perspective, the system is constructed with emphasis on reliability, durability, and robustness with respect to wearing and strain in harsh Nordic environment. A lightning protection system prevents instrument damage and data gaps. Thereby, the ICOS Sweden system represents the high end of technological requirements for measurements in all European regions and climatic zones, providing a new standard for harmonized data collection along climatic and geographic transects.

PSNOSS.2 New components for reliable environmental measurements

Alexander Bergsten, Achim Grelle, and Bengt Norén, Situ Instrument AB, Sweden

In ICOS Sweden, 6 sites are equipped with novel, standardized systems to measure GHG concentrations and fluxes of energy and GHGs along with environmental variables. To meet the requirements of ICOS Sweden, several novel system components have been constructed that provide secure, accurate and reliable data acquisition. An innovative digital datalogger (ISDL) samples digital high-frequency data from various eddy-covariance sensors, and sophisticated ventilated radiation shields and air intakes assure accurate profile measurements. Newly developed, heated radiation shields and roller-bearing systems for tower booms facilitate reliable measurements and easy tower operation even during harsh Nordic winter conditions. Heated, insulated tubing systems and blending volumes have been refined and adapted to 150-m high towers. Advanced systems for power backup and lightning protection extend reliability of data collection even under adverse conditions such as power failures or thunderstorms, thereby minimizing data gaps. In addition to ICOS, these system components can even be integrated in any existing or projected measurement system to improve data quality, reliability, and accessibility.