SeisPos

OPERATION MANUAL

TECHNICAL SUPPORT

Support for licensed users on any topics covered in this manual and for the use of the software described herein may be obtained from:

Email: support@fgps.com

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1   OVERVIEW

SeisPos is a MS Windows software program for the processing of raw navigation data for marine seismic surveys from OGP P2 raw data format to OGP P1 and SPS final data formats. The application is compatible with all versions of MS Windows.

The installation and licensing of this program is documented separately from this manual.

This operation manual should not be considered as substitute for training. Training courses are run by FGPS on a request basis.

Input data formats supported are OGP P2/86, P2/91, P2/94 and P2/11.

Output data formats supported are OGP P1/90 and P1/11, and SPS revisions 1.0 and 2.1.

1.1 **Data Flow**

The diagram in Figure 1-1 represents the fundamental steps taken when processing a line. These steps follow the ordering of the module icons on the main panel. All modules in this flow must be executed in the processing of a line unless stated to be optional.

When the Automatic Processing option is used this is the flow that is followed, with all modules executed except for the loading of defaults if defaults have not already been saved.

Throughout this process extensive analytical and data manipulation functions are provided. These are described in detail under the appropriate module descriptions. An overview of the main modules is given in the next section.

Further analysis and quality control of the output P1/90 can be performed using FGPS' P1Tools. This application is covered in a separate manual.
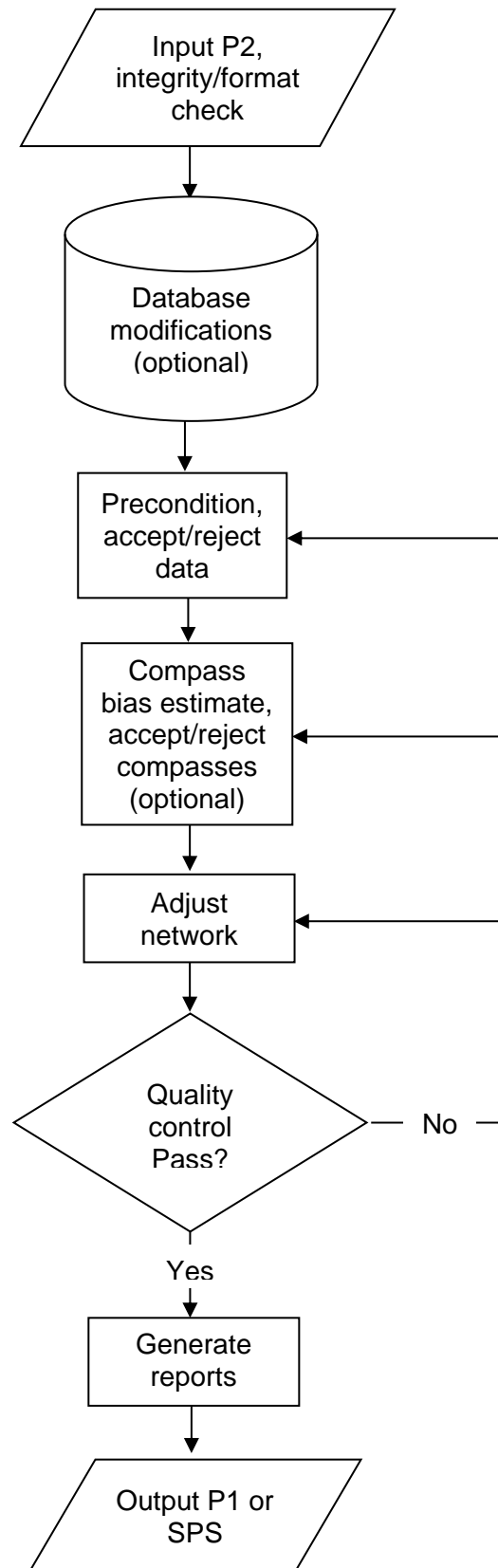
Figure 1-1: Data Flow

1.2   **Main Toolbar**
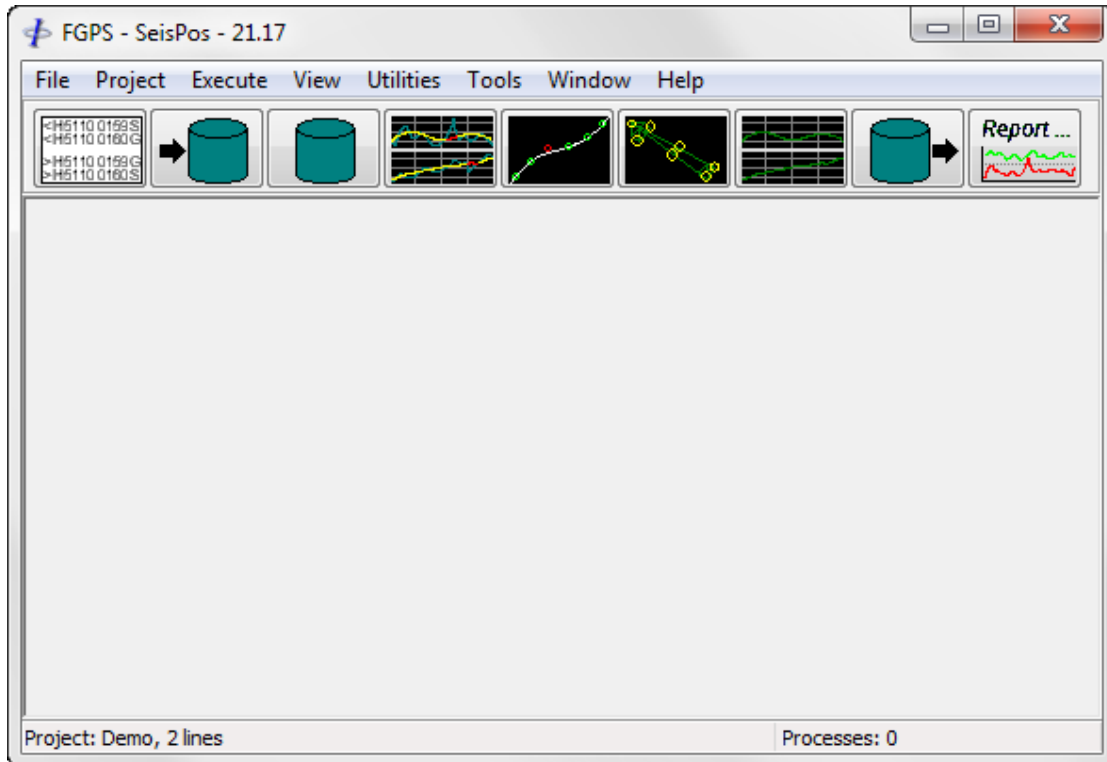
Figure 1.2: Main Window
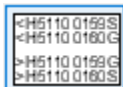
- Displays differences, omissions and additions between header records of selected P2 files.
- Browse/Edit Database

- Builds a proprietary database of nodes and observations from header and raw data from P2 file.
- Performs automated format checking and data integrity checks.
- Optionally start automatic processing.
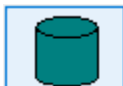
- Interactive relational database of all header and event data.
- Edit data.
- Create records
- Various utilities including acoustic export for OBS survey
- Export data in CSV format.
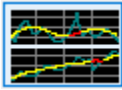
- Interactive time series and preconditioning of data.
- Despiking, editing, filtering, interpolation/extrapolation and de-skew to shot event.
- Dynamically displays detailed statistical data for each observation.
- Display rate of change, delta etc., comparisons and overlays.
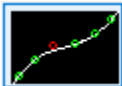
- Perform streamer compass bias estimate by polynomial model or spatial method. Optionally reject compasses.

- Multi-vessel, multi-streamer.
- Fully integrated weighted least squares solution.
- Dynamic interactive graphics.
- Supports multiple network/sub-network configurations.
- User configurable Delft method statistical testing and rejection/weighting.
- Least squares solution for streamer rotation, stretch and acoustic propagation speed.
- Comprehensive QC statistics
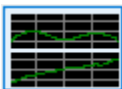
- Interactive time series plots of all adjustment QC data:
- Adjustment unit variance, redundancy and number of iterations.
- Observation value, residual, normalised residual, MDE and SD.
- Node position, error ellipse external reliability and number of observations.
- Node movement in-line and cross-line.
- Streamer rotation, stretch and feather.
- Shot distance, time interval and vessel speed and course made good.

- Outputs user configurable positioning data in P1 or SPS format.

- Configure and print reports and plots
- Perform trend analysis
- View logs
- View warnings and format violations

1.3   **Main Menu**

1.3.1   *File*

Printer Setup: Windows printer setup dialogue.

Exit: Exit the program.

1.3.2   *Project*

New: Define a new project.

Open: Open an existing project.

Edit: Edit/browse an existing project.

Delete: Delete an existing project.

Recent: Select from a list of recently opened projects.

Line List: Display the project line list.

Log: Display the project log.

Open Project Folder: Open the project folder in Windows Explorer

Open Project Input Folder: Open the project input folder in Windows Explorer.

Open Project Database Folder: Open the project database folder in Windows Explorer

Open Project Output Folder: Open the project Output folder in Windows Explorer.

Open Project Reports Folder: Open the project reports folder in Windows Explorer.

1.3.3   *Execute*

Stop Batch Processing: Stop batch processing.

Auto Precondition: Non-interactive, batch, precondition of all observations.

1.3.4   View

Network display: Interactive network view, edit node and observation
                       attributes

Comments: View comments recorded in P2

1.3.5   Utilities

Extract P2:   Extract partial P2 to file. Optionally exclude raw GPS
                       data.

Split P2:   Splits a file containing multiple datasets into individual
                       files, each named according to the line name defined in
                       the header.

List P2:   Produces a line listing from the selected files. Each
                       record contains *filename, line name, Sequence, FSP,
                       LSP, First Shot Time, Last Shot Time.*

View P2:   Open file in ASCII or .zip format in file editor.

View P2 Header: Open file in ASCII or .zip format in file editor, displaying
                       only header records.

Concatenate P2:   Concatenate selected P2 files into a single file, taking the
                       header from the first file only.

                       IMPORTANT: Ensure the files are selected in the order
                                       in which they are to be concatenated.

Coordinate   Start the Coordinate Conversion utility.
Conversions:

1.3.6   Tools

Options:

Databases Folder:	Set location of folder for EPSG database, NADCON files, magnetic variation database, coastline files. Default location is c:\fgps\databases
Check for Updates:	Set the frequency to check for application updates.

1.3.7   Window

Tile:	Tile.
Minimize All:	Minimize all.
Bring to Front:	Bring to front the selected window.
List:	List all child windows. Also enables selection of a hidden window to display.

1.3.8   Help

Manual:	Displays the User Manual (requires PDF viewer).
Release Notes:	Displays the release notes (requires PDF viewer).
Online Services:	Starts the Online Services module for:

Upgrading the program

Compressing/uploading line databases and P2 files to FGPS support.

Licence:	Licensing and un-licensing of the application.
Check for Updates:	Check for application update.
About:	Display version, licence number, number of days remaining on a time limited licence and contact e-mail for technical support.

2   PROJECTS

Before SeisPos can be used a project must be created. The project defines the various locations for file input and output, and maintains a list of lines along with their basic attributes. Typically, a project should be used only for lines from the same survey, contractor, client, vessel and configuration.

Note: *If, during the course of a survey the navigation configuration is changed e.g. nodes or observations are added, removed or altered, it is recommended that a new project be created, specifying a different database folder. This step is not normally required for Ocean Bottom Survey (OBS) projects.*

2.1   Project Files

Each project's parameters is saved to a file *.spproj, located in *<SeisPos_Program_Folder>*\Project. These files can be viewed using a text editor. It is not recommended to edit these files.

2.2   Creating a Project

Figure 2-1: Project – Create

From the main menu select *Project | New*, and enter the following parameters:

Project Name:	Enter an appropriate Project Name.
Use Default Folder Names:	When checked, enter the project folder.
Project folder:	If specified, all other folder names will be created under this folder.
Database folder:	The Project Database Folder where line log files and project-wide parameter files will be kept. This is referred to as *<project_database_folder>* throughout this document. Individual Line Database Folders named by the line name found in the P2 file will be created in this folder. This is referred to as *<line_database_folder>* throughout this document.
P1/SPS output folder:	Default folder for output of P1 and/or SPS files produced by SeisPos.
Reports folder:	Default location for saving report files. This is referred to as *<project_reports_folder> throughout this document.* If not specified then reports will be saved to the appropriate *<line_database_folder>*.
Acquisition System:	Select the navigation acquisition system from the drop-down list. This is used to aid in decoding the P2 file according to various acquisition software differences in dealing with shortcomings, ambiguities or interpretations of the P2 format, or differences in acquisition software, and is used to optimise some processing parameters according to survey type. If the acquisition system / survey type does not appear in the list then select SPECTRA. Refer to section 2.3 for list of acquisition systems.
Create 2D nodes & obs:	Nodes and observations needed for 2D networks are created following the P2 input.

Streamer Towpoint X and Y:	Enabled when *Create 2D Nodes and Observations* is enabled. If processing P2/11 then the offsets from the navigation reference point to the streamer towpoint on the vessel must be entered. If processing P2/94 then these fields have no effect. The value in the P2/94 H21@0 record value for offset A and B to towpoint-on-towing-vessel is used.
Always adjust entire shot range:	The adjustment is carried out on the entire shot range and not the FGSP-LGSP range. This is sometimes needed for OBS surveys when bathymetry data is required to be exported for the entire shot range.
Always load all defaults:	Load the default table, if it exists, for each database table.
Create GPS comparison nodes:	Automatically create GPS comparison nodes and observations following the P2 input.
Circle Line:	Specifies that lines in this project are circular or spiral. This setting affects the use of waypoints for QC.
Create sub-array separation nodes:	Automatically create sub-array separation nodes and observations following the P2 input.
Ignore duplicate shots:	Do not input shot points whose number has already been input.
Fan Mode Tail Width:	For fan mode streamer surveys, enter the total distance between outer streamers at the tail end.
Virtual shot interval:	If the P2 has no E1000, E2,1,0,0 or T2,3,3,# records, then source fired event records will be automatically created at the specified interval in seconds.
Assign gun depth sensor IDs:	Automatically assign gun depth sensor IDs, starting at 1 and incrementing by 1. Data records for each shot must correspond to gun depth sensor header definitions. Applies to P2/91 and P2/94 only.

Assign RGPS Range/Bearing SDs:	RGPS range SDs will be assigned the value specified, RGPS bearing SDs will be calculated from the specified range SD and the median range value.
Assign NFH Node Types:	Near Field Hydrophone node type will be assigned to all nodes which are a) referenced to a gun-array and b) whose name contains the selected string in the *Search String* list. A new string can be added by typing it into the list's edit field.

Gun node name source:	Select from:
	
	     Gun Ref (default)
	     Serial Number
	
	Applies to P2/121 only. Values are taken from the H2,3,1,0 records, fields 6 or 7.
	
	These values are used to create the gun node name from which the gun ID is taken when outputting a P1.

Acoustic output folder:	Default directory for output of acoustic data for use in FBComp for acoustic transponder processing. This option is only available when the acquisition system is set to one of the OBS RECEIVER acquisition systems.
SPS v2.1:	When exporting acoustics for use in the FBComp the line number is taken from the line name in the P2. Enter the start position and length of where the line number appears within the line name. This option is only available when the acquisition system is set to one of the OBS acquisition systems. See also the line name options under section 11.2.

To use an existing project as a template for a new project select it from the *Recent Projects* list then edit the fields as required.

Warning: *Do not create a project specifying the same database folder as an existing project.*

Click the *OK* button. If any of the specified folders do not exist they will be created. The newly created project will become the current project, and its name and the number of lines held (none at this stage) will be displayed in the status bar of the main SeisPos control panel.

2.3   Acquisition Systems

Type	Comment
SPECTRA/ORCA	The default system.
TRINAV	
QMARINE	
GIN2000	
SEAPRONAV	
NAVIPAC	
STARFIX	
GATOR OBS RECEIVER	
GATOR OBS SOURCE	
TRIGGERFISH	
TRIGGERFISH OBS RECEIVER	
TRIGGERFISH OBS SOURCE	
Q-SEABED OBS RECEIVER	
SEAPRONAV OBS SOURCE	
P-CABLE COMPASS	For P cable with compasses
P-CABLE CATENARY	For P cable without compasses
WISDOM	
GATOR ROV	
DOLPHIN OBS RECEIVER	
DOLPHIN OBS SOURCE	

2.4   Opening a Project

Before any processing can be carried out on a previously created, this project must

be opened. This then becomes the current project and its name and the number of lines held will be displayed in the status bar of the main SeisPos control panel.

From the main menu select Project | Open, and select a project from file dialog. Alternatively select a project from the Recent Projects menu item.

Click the *OK* button to open the project and exit the Project dialog.

Note: *While processes on a project are running another project can be opened so that processes on multiple projects can be performed simultaneously. The number of simultaneous processes possible depends on process type and system resources. The currently tested limit is 3 projects.*

2.5 Editing a Project

From the main menu select *Project | Edit*.

All project attributes can be changed.

If the Database directory is changed then this change will affect only lines subsequently input. This would typically be done if there are significant configuration changes.

Click on *OK* to accept changes, or *Cancel* to discard changes.

2.5.1 Update

The update button is used to synchronise the SeisPos project lines with the actual data residing on disk. New line databases found on disk will be added to the project. Project lines for which the *<line_database_folder>* has been manually deleted will be removed from the project.

This is useful, for example, if a *<line_database_folder>* has been sent from the field to the office. The new folder should be copied to the *<project_database_folder>* before using the *Update* feature.

Note: *The Update feature does not preserve the FGSP and LGSP, which will revert back to the full SP range.*

2.6 Deleting a Project

From the main menu select *Project | Delete* and select a project from the list of project names. The entire project will be permanently removed from the hard disk.

The current project cannot be deleted.

Warning: *This action cannot be undone once the OK button has been pressed. All data will be deleted.*

2.7   Project Log

A project log, "Project.log", is maintained in the Project folder. Each time a process is carried out an entry is made in this log. The project log can be viewed by selecting *Project | Log* from the main menu.

2.8   Line List

From the main menu select *Project | Line List*.

Number	Seq	Database Line	Status	FSP	LSP	FGSP	LGSP	P2 File	P1 File
0	1001	1001P1001	Adjustment Complete	977	1469	977	1469	1001P100.p294	1001P100.S01
1	1001	1001P1001_2	Input Complete	977	1153	977	1153	1001P100.p294	
2	1001	1001P1001_3	Input Complete	977	1104	977	1104	1001P100.p294	

Apply Changes   Discard Changes   ⟳ Update   Close

Project: Demo OBN Source, 3 lines

Figure 2-2: Line List

2.8.1   Deleting Lines

To delete all lines in a project right click on the line list and select *Delete All Lines*.

To delete selected lines, highlight the lines with the mouse by dragging down on the Seq column then click the right mouse button. From the popup menu select *Delete Selected Lines*.

The program will prompt to confirm deletion before the lines are deleted. For each line deleted the *<line_database_folder>* and all its contents will be deleted.

A line in a project which has active processes cannot be deleted. All processes for that project must first be stopped before deletions will be allowed.

Warning: This action cannot be undone – clicking the Close/Cancel button does not cancel these changes.

2.8.2   Editing Line Attributes

Right click on the line status field and select from the popup list the desired line status from one of the following:

Inputting
Input
Preconditioning
Preconditioned
Adjusting
Adjusted
QCing
QCed
Outputting
Output
Accepted
Rejected

The line status is mostly used for book-keeping purposes.

2.8.3   First and Last Good Shotpoint

The first and last "good" shotpoint can be set to the required range. This range will then be the default shotpoint range for the following modules:

Compass Bias Estimate
Network Adjustment
Quality Control
Output
Plots
Final Report
Trend Analysis

The Precondition module will still use the full SP range.

2.8.4   Update

The update button is used to synchronise the SeisPos project lines with the actual data residing on disk. See section 2.5.1.

3 P2 HEADER DIFFERENCE

This utility enables detailed comparison between the header records (including comment records within the header) of one P2 file with one or more other P2 files.
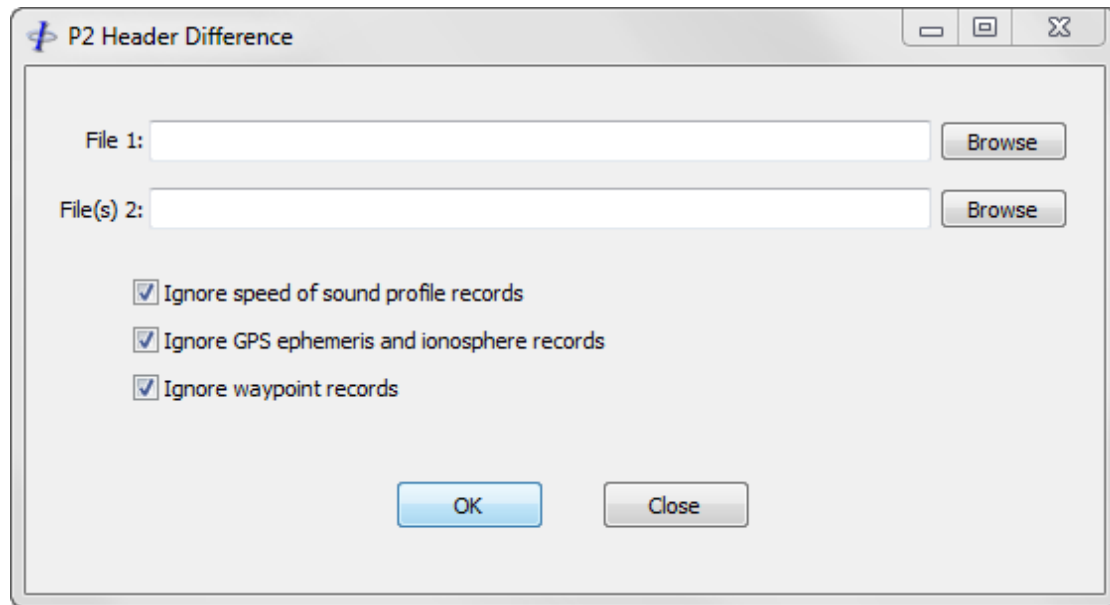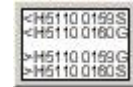
Figure 3-1: P2 Header Difference

3.1 File selection

Select a file for the File 1 field. Select one or more files for the File 2 field. File 1 will be compared with each of the files selected as File 2.

3.2 Unwanted Record Suppression

Check the checkboxes to ignore processing certain records which are subject to change regularly and have no impact on the compatibility of a dataset with the database. These records are:

Speed of sound profile: H1501

GPS: H631, H632 (ephemeris and ionospheric data)

Waypoints: H00@9

3.3 Execution

The selected files can be full P2 files including data records. Each file will be read only until the first data record is seen, i.e. file processing will stop as soon as a record

is found which does not begin with H, C or L.

Click on the *OK* button to run the comparison.

3.4   Report

Once the comparison has run the report is displayed showing the differences between the two headers. By clicking the right mouse button on the report a popup menu will appear providing standard text processing functions.

The report is automatically saved to the Project Reports Folder. The report file is named after File1, and File 2 if a single file is selected for File 2, or "Multiple Files" if more than one file is selected for File 2.

Differences will be shown as records (or groups of records) from the first file prefixed with "<" followed by the same number of records from the second file prefixed with ">". Records or groups of records unique to a file will have the appropriate prefix, "<" (first file) or ">" (second file) and will stand alone.

In the following sample report a line has been added to each file, and a group of 5 records are different:

```
File 1 (<) is: D:\Data\P291\file1.p2
File 2 (>) is: D:\Data\P291\file2.p2

< C0001 this line added to file 1

< H2310 550      1.0
< H2310 768      1.0
< H2310 958      1.0
< H2310 389      1.0
< H2310 452      1.0

> H2310 550      0.0
> H2310 768      0.0
> H2310 958      0.0
> H2310 389      0.0
> H2310 452      0.0

> C0001 this line added to file 2
```

4   INPUT
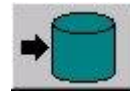
The Input Module is used to input a P2 raw dataset, perform integrity and format checking, and create all the necessary database files to evaluate the data and process the line.

Click the *Input* button in the main toolbar to display the dialog as seen in Figure 4-1.
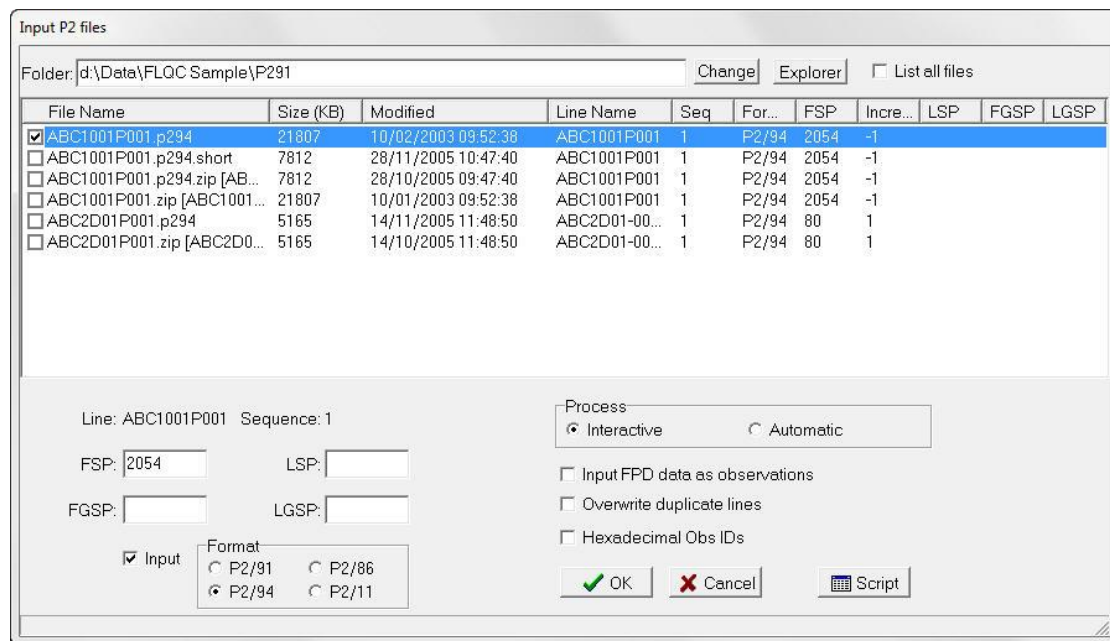
Figure 4-1: Input

4.1   Files

The initial folder whose contents are displayed is that which has been specified as the project P2 folder. Click on the *Browse* button to select files from a different location.

Only valid P2 files are displayed in the list, validity is verified from the header records..

4.1.1   Zip Files

P2 files within zip archives can be input without unzipping. Files within an archive will be listed in the file column in the format *archive name [P2 file name]*. Multiple files within an archive will be separately listed.

To select a file for input check the checkbox on the left of the list. Multiple files may be selected (see section 4.3 below).

4.1.2 Multiple Selection

To flag multiple files for input, as an alternative to checking each individual checkbox it is possible to highlight all required files then check the *Input* checkbox.

4.1.3 Input Script

As an alternative to checking the files displayed, a script can be used to specify files and their SP range to input. To use this option set the click the Script *button*. The format is comma separated and can be either one of the following:

Filename, FGSP, LGSP
Filename, FSP, LSP, FGSP, LGSP

The filename can be either the filename only or the full path. If only the filename is specified then the folder as appears at the top of the Input dialog will be assumed.

Other input parameters as may be required should be set before clicking the *Script* button.

Only uncompressed files can be input using the script option.

4.1.4 Viewing a File

To view a file right click on it and from the popup menu select *View* to view the whole file or *View Header* to view the header. The contents of the browser may be saved by right clicking and selecting *Save As* from the popup menu.

4.1.5 Explorer

Click on the *Explorer* button to view the P2 folder in Windows Explorer.

4.2 **Line Parameters**

For each file selected, the following parameters may optionally be specified by first highlighting the required line then entering the parameters:

First SP: The first shotpoint to input. If left blank input will start from the first shotpoint in the file.

Last SP: The last shotpoint to input. If left blank input will end with the last shotpoint in the file.

First Good SP: The default first shotpoint for all modules except *Precondition*. If 0, or left blank or is outside the range of the shotpoints found in the file then the default will be the first shotpoint.

Last Good SP: The default last shotpoint for all modules except *Precondition.* If 0, or left blank or is outside the range of the shotpoints found in the file then the default will be the last shotpoint.

Format: Specify the file format. If a different format from the one specified is detected the user will be prompted to confirm the format if Interactive Processing is specified.

Note: *The file format is initially detected from the P2 header, therefore this should only be changed if the header is known to be incorrect in this respect.*

4.3 Duplicate Lines

If a line already exists in the database the user may choose between overwriting that line's database or creating a new database for that line by checking or unchecking, respectively, the *Overwrite Duplicate Lines* checkbox.

4.4 Automatic and Batch Processing

Automatic Processing is the processing from P2 to output formats and final report without further user intervention. This may be carried out on one or more files if the individual SeisPos module parameters have been previously set interactively. It follows that Automatic Processing cannot be done on the first line of a project. Individual module parameters must be saved before automatic processing can be carried out.

To implement Automatic Processing set the Process to *Automatic* by clicking on the radio button.

Batch Processing, i.e. inputting or processing more than one line, can be carried out by selecting more than one file to input. If multiple lines are selected and the *Process* is set to *Interactive* then all selected lines will be input into the database only and not processed.

Once *Automatic* Processing has started it may be stopped by selecting form the main menu *Execute | Stop Batch Processing.*

4.5 Field Positioning Data

Field Positioning Data (FPD) ,i.e. node positions recorded in the H12@0 records, may be input as observations by checking the *Input FPD data as observations* checkbox. This may be necessary if no raw data has been recorded to position a required network node, e.g. a tailbuoy. The observation types will be either Latitude and Longitude or Easting and Northing, and identified as types FPD EASTING and FPD NORTHING. If the observations are geographical coordinates then the conversion to grid coordinates will take place automatically in the same way as GPS

observations.

This option is not available for data recorded in the P2/11 format.

4.6   Hexadecimal Observation IDs

There may arise occasions when the observations in the P1 are numbered using hexadecimal numbering (1 to F). Check the *Hexadecimal Obs Ids* checkbox to support this situation.

This option is checked by default when the project acquisition system is set to QMARINE.

4.7   Execution

Click the *OK* button to start the input. For each line input, if the line name found in the file is identical to one already in the database One of the following will occur:

If the *Overwrite Duplicate Lines* checkbox is checked the existing line will be deleted and the new line input.

If the *Overwrite Duplicate Lines* checkbox is not checked the new line will be renamed with "_#" appended where # is a sequential number starting with 1 and incrementing each time a duplicate name is found in the database. The actual line name in the header records will not be changed.

After clicking the OK button Input will commence, and the input log, as shown in Figure 4-2, updated onscreen. The following controls are available from the toolbar on the Log window:

Stop: Abort input.

Pause: Pause input – useful for browsing the log. The *Pause* button changes to a *Resume* button.

Resume: Resume input.

Verbose: Display detailed information during input.

Close: Close the log window once input has completed/aborted.

CPU: Control the CPU priority of the input process.

If the input is aborted for any reason automatic processing, if specified, will no longer be executed.

Note: *Raw GPS data is not input.*

Warning: *Do not attempt any further action on a line that is still being input.*

4.8 **Log**

The following details written to the log as input proceeds:

SeisPos version
Date and time
P2 format
Creation of files
Warnings
Format violations
Shot number

On completion of input, the total number of warnings and format violations will be written to the log, and the date and time of completion.

Checking the *Verbose* checkbox will result in increased detail displayed during input, but may slow down the input process slightly. All log data is still written to the log file which can be displayed from the *Report* module.

4.9 **Integrity Checking**

Warnings for potential integrity errors will be logged. Non-critical warnings are suspended after 1000 warnings have been reported.

4.10 **Format Checking**

Format violations will be written to the log. Although not all format violations are critical to the processing of the line, rigorous checking is implemented in strict accordance with the OGP formats. Some format inconsistencies have been overcome by allowing for all possible implementations of the format where these shortcomings have been found.

Format checks are provided for:

Missing records
Field placement within the record
Data type
Illegal values

Violations are reported in terms of the line number in the file and the column numbers within the record where the violations are detected. The record itself appears immediately after the violation report.

If any format violations are found in the header, this will be flagged, with the option to abort the input.

Only the first 1000 format violations are logged. This is considered sufficient to check the header and the first shot of the line, avoiding the creation of an excessively large

log.
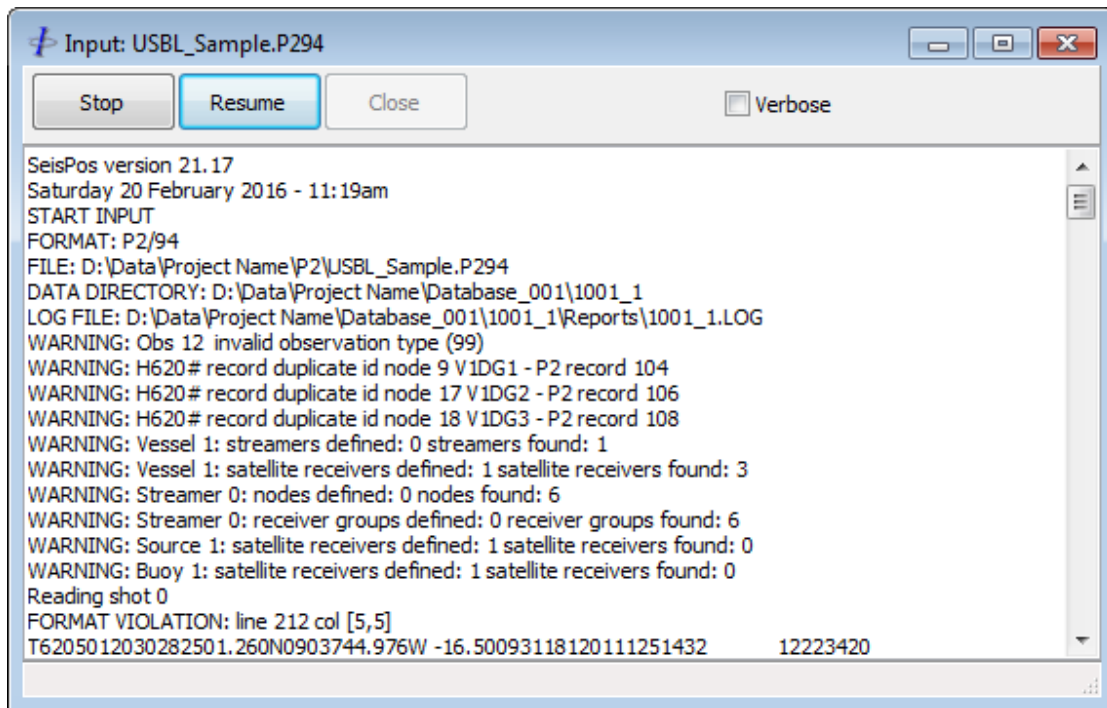
Figure 4-2: Input - Log

4.11 Observation Groups

During input, observations are grouped according to a) the positioning system identifier recorded in the H52 records, and b) the observation type.

Additional groups are created for observations related to the streamers, these typically comprising the acoustic networks. These groups are formed by dividing the streamer into three equal lengths and grouping together all non-inline observations in each length. A further group comprises all inline observations i.e. those whose *AT* node and *TO* node are on the same streamer.

5   DATABASE

Click on the *Database* button in the main toolbar. Select the line from the
list of lines in the project. The database window will be displayed.

There is no limit to the number of database windows which can be displayed
simultaneously. This facilitates the browsing and /or editing of data and enhances the
analytical functionality of the program.

The database is a relational database and popup lists are provided where data is
related to another table, and where the attributes are drawn from a fixed list.

5.1   Tables and Functions

The various tables and functions are described here in the order in which they
appear in the menu.

Only one table can be displayed at one time in a single instance of the database. To
display more than one table simultaneously a separate instance of the Database
Module must be implemented. In this case, caution must be exercised so that
changes saved in one database instance are not undone by saving another.

Certain functions are available, implemented from the toolbar, according to the table
displayed.

A detailed description of every database attribute is not considered necessary here
as most of the attributes are self-explanatory. The Node, Observation and Shot
tables are covered in detail under sections 5.2 and 5.5 below.

Changes that are made are not saved until the user clicks the *Save* button, selects
File | Save, or replies affirmatively to the Save Changes prompt when closing a table.

5.1.1   File

Select Line:	Select Line from list of lines in current project. The line name then appears below the toolbar.
Print to File:	Save the currently displayed table to file in comma separated value (csv) format. The file is automatically named and saved to the database folder. A popup message gives the file name.
Save:	Save any changes that have been made to the current table.
Exit:	Close the database window.

5.1.2   Header

General: Display the General parameters.

Waypoints: Display the line waypoints. Geodetic ↔ Grid coordinate
                           transformations for the waypoint coordinates in the
                           selected column are supported from the toolbar buttons
                           Compute E/N and Compute Lat/Lon.

                           Grid coordinates are displayed in the units defined by the
                           metric conversion factor.

                           The distance and azimuth from the previous waypoint are
                           given.

Coordinate   Displays the *CRS Inspector* and provides utilities for CRS
Reference   management and integrity checking. Refer to the CRS
Systems: manual.

Projection: Display the projection parameters. The parameters shown
                           will vary according to the type and sub-type of projection.
                           Only those parameters for which there is a label in the left
                           column are applicable.

                           Grid coordinates are displayed in the units defined by the
                           metric conversion factor.

Magnetic Variation   Display the magnetic variations points. Points may be
Points: created or deleted using the Create and Delete buttons.
                           Geodetic ↔ Grid coordinate transformations for the
                           station coordinates in the selected column are supported
                           from the toolbar buttons Compute E/N and Compute
                           Lat/Lon.

Echosounders: Display the echosounder definitions.

Speed of Sound   Display the speed of sound profiles.
Profiles:

Speed of Sound Data:	Display the speed of sound data.
Satellite Systems:	Display the satellite system definitions.
Nodes:	Display the node attributes. The table includes all nodes defined in the various P2 header records. The option is provided to create and delete nodes using the toolbar buttons Create and Delete.
	This table is also invoked from the Nodes button in the toolbar.
Observations:	Display the observation attributes. The option is provided to create and delete observations using the toolbar buttons Create and Delete.
	This table is also invoked from the Obs button in the toolbar.
Streamer Sections:	Display the streamer section definitions. Sections may be inserted or deleted.
Receiver Groups:	Display the receiver group positions as computed from the parameters given in the streamer sections.
User Defined Object Types:	Display the list of user defined node types recorded in the P2/11 header. The option is provided to create and delete node types using the toolbar buttons Create and Delete.
User Defined Observation Types:	Display the list of user defined observation types recorded in the P2/11 header. The option is provided to create and delete node types using the toolbar buttons Create and Delete.

5.1.3 Data

General Event:	Display the general event data recorded in the P2/11 E2,1,0,0 records, or in the P2/94 or P2/91 E1000 records.

Source Fired Event:	Display the source fired event data from:
	P2/11 T2,3,3,0 records, or T2,3,3,1 records if there are no T2,3,3,0 records.
	P2/94 or P2/91 E1000 records.
Gun Fired Event:	Display the gun fired event data from P2/11 T2,3,3,1 records.
Observation Time Data:	Display the raw and preconditioned values, time and status flag of the observations recorded. Select the observation to display from the popup list.
	This table is also invoked from the Time button in the toolbar.
	Use the < and > buttons on the toolbar to scroll through the observations.
Shot Event Data:	Display the preconditioned observation values de-skewed to the General Event (P2/11) or Source Fired Event (P2/94/91). Select the observation to display from the popup list.
	This table is also invoked from the Shot button in the toolbar.
	This table will not be available until preconditioning has been carried out.
	Use the < and > buttons on the toolbar to scroll through the observations.
Variable C-O:	Display the variable C-O and scale/propagation speed defined in the H54 records of the P2. Select the observation to display from the popup list. If no H54 records were found for the selected observation a file error will result.
Grid Data:	Display the grid convergence and point scale factor computed from the vessel position computed in the network adjustment

5.1.4   Utilities

Save All Defaults:	Saves a user selection of the following header tables from the currently selected line as defaults to be optionally used for other lines in the project (see sections 5.4.4 and 5.5.4):

General parameters – non-line specific parameters only
Coordinate Reference Systems
Magnetic variation parameters
Echosounder parameters
Speed of sound profiles
Speed of sound data
Satellite system parameters
Node attributes
Observation attributes
Receiver type definitions
Streamer section parameters
User defined object types
User defined observation types

Load All Defaults:	Loads a user selection of default tables that have been previously created for selected lines. See sections 5.2, 5.4.4 and 5.5.4.
Observations:	
Toggle Alias Names:	Toggle between the original/edited observation names and names generated by the names of the nodes associated with the observations and the observation type. This feature is useful when the observations have been inappropriately or insufficiently named in the P2 header.
Compute Nominals:	Re-compute the nominal values of all observations based on observation type, speed, scale and associated node positions. Nominals are used only as an aid in the precondition module and may need to be re-computed if changes have been made to the observation and/or node parameters.
	If the fan mode tail width (project settings) is not zero then this will be used in calculating streamer node X offsets.

Assign RGPS Range/Bearing SDs:

RGPS range SDs will be assigned the value specified, RGPS bearing SDs will be calculated from the specified range SD and the median range value.

Revert to Original Configuration:

Replaces the existing observation table with the original table.

Compute speed of sound:

Compute speed of sound from inline acoustics. Note that if inline observations are uni-directional then Doppler effect may skew the result

Nodes:

Revert to Original Configuration:

Replaces the existing node table with the original table.

Apply Streamer Stretch factor:

Allows application of a percentage stretch factor to all streamer related nodes.

Assign NFH Node Types:

Near Field Hydrophone node type will be assigned to all nodes which are a) referenced to a gun-array and b) whose name contains the selected string in the *Search String* list which appears after this option is selected. A new string can be added by typing it into the list's edit field.

Reverse Compass Names:

When a line is first input the streamer compasses are named s01c01, s01c02… starting from the front of each streamer. Using this utility, the compass naming convention will be reversed so that the last compass on the streamer will be number 1 e.g. s01c01.

Create 2D Nodes & Obs:

Create the necessary nodes and observations for solving a typical 2D network for which insufficient observations would normally exist.

Create GPS Comparison Nodes & Obs:	Create duplicate node pairs for all nodes of type SATELLITE and their reference nodes, and duplicate GPS observations. These node positions are then able to be computed independently of the main network and each other enabling true comparisons between GPS systems.
	Duplicate antenna nodes are suffixed "_ANT" and duplicate vessel reference point nodes are suffixed "_COMP"
Create Sub-array Separation Nodes & Obs:	Create duplicate nodes and observations corresponding to GPS systems on sub-arrays, and nodes representing the centre of each sub-array. The nodes may then be positioned independently of the main network and each other allowing true computation of the sub-array separations. All nodes created are suffixed "_SA".
	Note: the string centre nodes are virtual nodes and therefore have to be fixed to the nodes representing the RGPS pods. This means that the nodes representing the RGPS pods will not be completely independently positioned but their positions will be influenced by other nodes located on the same sub-array.
Extract Acoustic Data for FBComp:	This utility is provided to extract reduced shot event acoustic data for use in the SPSPro FBComp module for computing acoustic transponder positions. See section 5.16.

5.1.5   Edit

Copy:	Copies the selected cells to the clipboard.
	Note: To select a full column click on the column header. To select a partial column, click on the first cell, use the scroll bar to display the last required cell, then holding the <Shift> key down click on that cell.
Paste:	Performs the selected function on the selected cells using the contents of the clipboard as the argument.

Function: Performs the selected function on the selected cells using
                       the value entered at the prompt as the argument.

Correct Time   Only available for *Shot, General Event, Source Fired*
Stamp: *Event* and *Observation Time Data* tables. Enables
                       application of a correction, in seconds and decimal
                       seconds, to all time values in the table.

5.1.6   Search

5.1.6.1   Find

Specify a search string to find in the current table. Options are provided to search by
column (default) or row, and to match case and/or whole cells.

5.1.6.2   Replace

This is an extension of the Find Dialogue to find and replace data in the current table.
In the example in Figure 5-1 the speed of sound for all acoustic observations are to
be changed from 1540.8 to 1541.
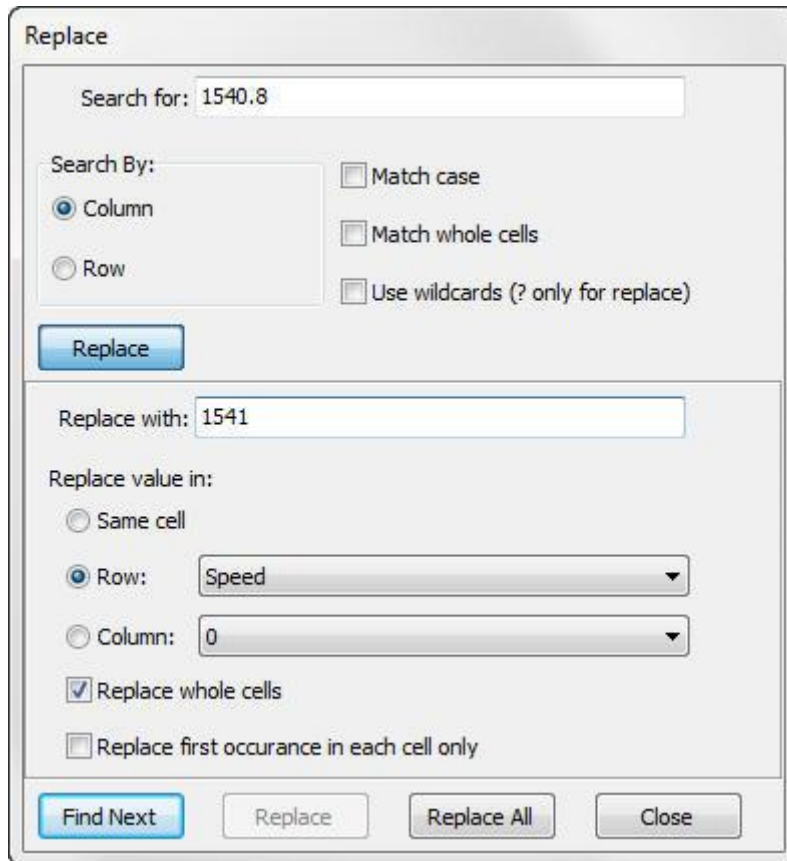
Figure 5-1: Database – Search and Replace

5.1.6.3 Using Wildcards

Wildcards '*' and '?' may be used for searching where '*' denotes a string of characters and '?' denotes a single character.

Wildcards can also be used to perform a masked search and replace operation. In this case the following rules apply:

1. Only '?' can be used
2. The field widths for the search, replace and grid cell must all be the same
3. The position of the '?'s in the search and replace fields must be the same

The search and replace operation will then replace only the non-'?' characters.

E.g.:

Search for: ??14????
Replace with: ??02????

will replace '14' in positions 3 and 4 of each cell of width 8 characters with '02'

5.1.7   Shortcut Keys

<Ctrl> + c   Copy selected text or cells to clipboard.

<Ctrl> + v   Paste from clipboard

<Del>   Delete selected text or cells.

5.2   Loading All Defaults

To load all default header tables:

1. Select from the menu *Utilities | Load All Defaults*.
2. From the line list which appears, select the lines for which default tables are to be loaded.
3. The *Load Defaults* dialog will appear with a list of tables for which the default exists.
4. If the default tables include Nodes or Observations:
    a. Attributes for which differences are found between the default table and respective table for all selected lines are listed in a dialog window (see below).
    b. The values of the attribute which differs between the default attribute and that of all target lines is displayed.
    c. The option is provided the select which attributes are to be replaced with the default values.
    d. The option is also provided to load only manually created (i.e.: non-recorded) nodes or observations.
5. Check the checkbox for each table to load.

Figure 5-2: Load Defaults Dialog

5.3   Coordinate Reference Systems

The *CRS Inspector* and affiliated *CRS Manager*, in keeping with the EPSG and Px/11 geodetic data model, supersedes the old header tables for datums and projection. Refer to the CRS manual.
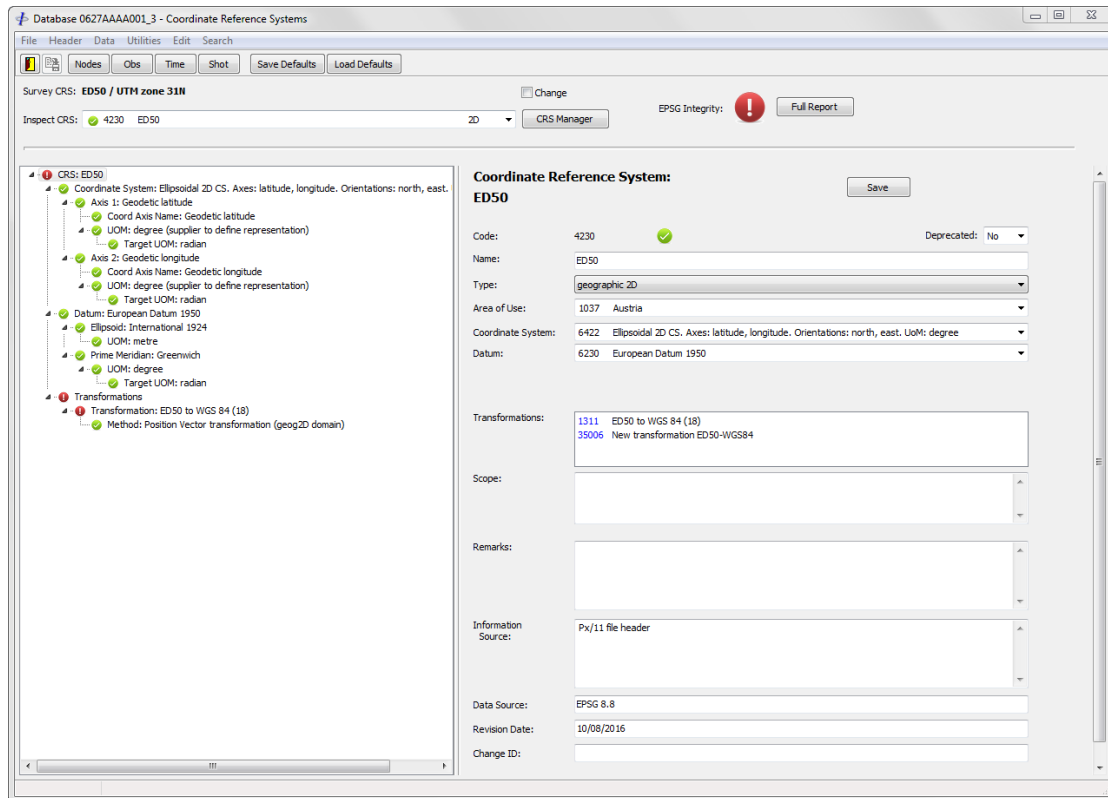
Figure 5-3: *CRS Inspector*

The top panel of the *CRS Inspector* displays the current survey CRS. If there is more than one projected CRS defined then checking the *Change* checkbox enables the user to select from a dropdown list of projected CRSs. All coordinates in the existing CRS will be converted to the new CRS.

The application-wide common features of the *CRS Inspector* and *CRS Manager* are described in he CRS manual.

5.4   **Nodes**

From the Database menu select *Header | Nodes* or click on the *Nodes* button in the toolbar. The node table as appears in Figure 5-4 is displayed.

Node No.	1071	1072	1073	1074
ID	353	326	328	356
Name	S12T17	tb12	TB12R1	TB12R2
Serial Number				
Type	NETWORK	NETWORK	NETWORK	NETWORK
Reference Node	455 Streamer212	753 TB12	753 TB12	753 TB12
Vessel	0 Seismic Vessel	0 Seismic Vessel	0 Seismic Vessel	0 Seismic Vessel
Object ID	0	0	0	0
X (m)	0.000	0.000	0.000	0.000
Y (m)	-5995.400	0.000	0.000	0.000
Z (m)	-0.200	0.000	1.400	1.400
Relation	STREAMER	FIXED	FIXED	FIXED
Local Reference Point				
Volume				
Horizontal Alignment	No	No	No	No
Pitch Alignment	No	No	No	No
Roll Alignment	No	No	No	No
Easting (m)	-175.000	-175.000	-175.000	-175.000
Northing (m)	-6472.400	-6861.300	-6861.300	-6861.300
Height (m)	-20.200	0.000	1.400	1.400

Figure 5-4: Database – Node Table

5.4.1   Node Attributes

The following attributes are displayed for each node:

Node No.:   Unique number assigned by the program used for
                       database relations. This number also appears before the
                       node name in all node lists throughout the program for
                       ease of searching for and identifying nodes. Cannot be
                       edited.

ID: Unique node ID number. For P2/94 these are assigned by
                       the software. For P2/11 these correspod to the OBJREF in
                       the P2/11 format manual. Cannot be edited.

Name: Node name, maximum 63 characters.

Serial Number: Serial number of streamer compass.

Type: Node type, selected from dropdown list. Types are
                       assigned on input by both the P2 header and the program,
                       and can be changed although caution is advised when
                       doing so. See 5.4.2 below.

Reference Node: The name of the reference node from which offsets apply,
                       selected from dropdown list.

Vessel:	The name of the vessel to which the node is ultimately referenced, selected from dropdown list. Should never need to be changed.
Object ID.:	Object ID number for P2/11 nodes. This is referred to in the P2/11 format manual as OBJREF.
X:	Starboard offset from the reference node.
Y:	Forward offset from the reference node.
Z:	Upward offset from the reference node.
Relation:	Defines the relationship between the node and its reference node, initially assigned by the program. Selected from dropdown list. The following Relations are defined:
FIXED	The node is rigidly fixed to the reference node and observations will be derived from the offsets in the network adjustment.
FREE	The node is positioned by observations and the offsets are nominal only.
STREAMER	The node is attached to a streamer at a fixed offset from the streamer reference point given by the Y value.
Local Reference Point:	Description of the local reference point. Applies to P2/11 and P1/11 only.
Volume:	Volume, for nodes of type GUN only.
USBL Horizontal Alignment:	Horizontal alignment flag for USBL system who's transducer is located on this node.
USBL Pitch Alignment:	Pitch alignment flag for USBL system who's transducer is located on this node.
USBL Roll Alignment:	Roll alignment flag for USBL system who's transducer is located on this node.
USBL Horizontal Correction:	Horizontal correction for USBL system who's transducer is located on this node. Correction will be applied if the alignment flag is *No.*

USBL Pitch Correction:	Pitch correction for USBL system who's transducer is located on this node. Correction will be applied if the alignment flag is *No*.
USBL Roll Correction:	Roll correction for USBL system who's transducer is located on this node. Correction will be applied if the alignment flag is *No*.
Easting:	The grid easting in the units defined by the projection metric conversion factor last computed in the network adjustment, or the value from the P2 header in the case of a base station.
Northing:	The grid northing in the units defined by the projection metric conversion factor last computed in the network adjustment, or the value from the P2 header in the case of a base station.
Height:	The value of the Z offset. For base stations the ellipsoidal height.

5.4.2 Node Types

VESSEL	Vessel reference point, from P2 header.
GUN ARRAY	Centre of source, from P2 header.
STREAMER	Streamer reference point, centre of near receiver group, from P2 header.
NETWORK	Network node, e.g. acoustic transceiver, RGPS antenna, from P2 header.
COMPASS	Streamer compass, from P2 header.
BUOY	Towed buoy, from P2 header.
TAILBUOY	Positioning sensor referenced to streamer with range and bearing observations, automatically assigned.
SATELLITE	Satellite antenna, e.g. DGPS, from P2 header.
ECHO	Echosounder transducer, from P2 header.
DEPTH SENSOR	Streamer depth sensor, from P2 header.
STATION	Fixed base station, e.g. Syledis, from P2 header.

ACOUSTIC PINGER	Acoustic pinger automatically assigned when the Project Acquisition System is set to one of the OBC RECEIVER systems.
COMPASS / DEPTH SENSOR	Combined streamer compass and depth sensor unit, from P2 header.
NEAR FIELD HYDROPHONE	Near field hydrophone, manually set only.
GUN	Individual gun, from P2 header.
GUN STRING	Gun string from P2/11 header.
RECEIVER	Ocean bottom node, manually set only.

5.4.3 Creating and Deleting Nodes

There may be circumstances, for example for 2D surveys, when it is necessary or desirable to create a node to which newly created, or manual, observations may be defined.

From the toolbar click on the *Create* button.

The following attributes are mandatory:
Type
Reference Node
Relation

The following attributes are not significant:
ID
Streamer/Gun No.
Easting
Northing
Height

To delete a node click on the *Delete* button. It is not possible to delete nodes which were not manually created as above. A node cannot be deleted if it is a reference for other nodes or observations. When a node is deleted the observation and node definitions are updated when the table is saved in order to maintain correct references.

Warning: *Any change in the number of nodes as a result of creating or deleting nodes will invalidate the coordinate database and the network adjustment will need to be performed again before outputting a P1 or viewing or printing the node time series plots.*

5.4.4   Default Nodes

The number of nodes and their attributes are initially defined by the P2 header records, and the node file is stored in the *<line_database_folder>*. It may be desirable to define a default set of node definitions to use for all lines subsequently processed in the project. For example, node names or types have been modified, or new nodes may have been created.

5.4.4.1   Creating/Saving

To save a default node definition file, first make the necessary changes to the node attributes for the current line, and save. Then click on the *Save Defaults* button or from the menu select *Utilities | Save All Defaults*. The default node definition file, "default.nod" is saved to the *<project_database_folder>*. If one already exists which contains a different number of nodes then a warning prompt will appear and the option to cancel the action is given.

5.4.4.2   Loading

To load the default node table, first select the line for which the default table is to apply from the *File* menu. Then click on the *Load Defaults* button or from the menu select *Utilities | Load All Defaults*.

If any differences are detected between the existing table and the default table then the dialog as shown in Figure 5-5 appears.

For each attribute type that is different a checkbox appears in the upper panel. Checking this checkbox will cause this attribute to be replaced with the default value for **all** nodes when the *OK* button is clicked.

Details of all differences are displayed in the lower panel.

If the default table contains manually created nodes then these may be loaded only by checking the *Load Manual Nodes Only* checkbox, then clicking the *OK* button.
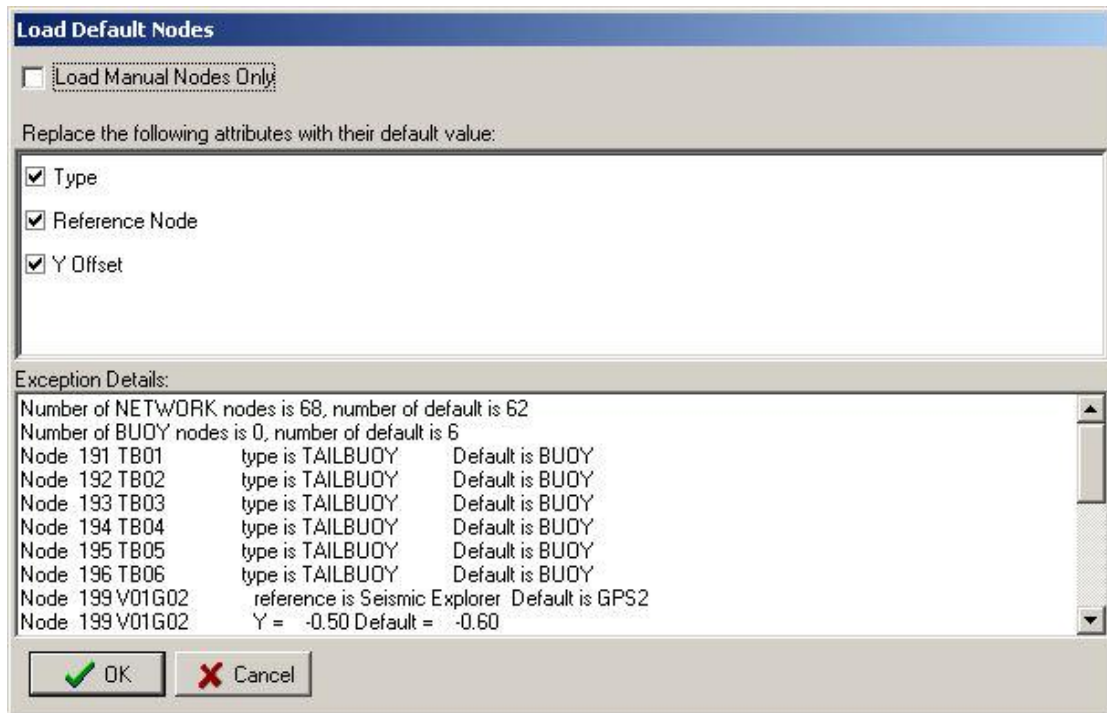
Figure 5-5: Database – Loading Default Nodes

If manually created default nodes exist then they will always be loaded.

When loading default nodes, the original node definition file is saved as "original.nod" in the *<line_database_folder>*.

When Automatic Processing is carried out, if a default node file exists it will be loaded immediately after the P2 file has been input. Any differences found will be written as warnings to the log, and also displayed immediately, although processing will continue.

5.4.5 OBS Receiver Positioning Datasets

When processing OBS acoustic datasets the pinger node is automatically detected and set to type ACOUSTIC PINGER.

5.5   Observations

From the Database menu select *Header | Observations* or click on the *Obs* button in the toolbar. The observation table as appears in Figure 5-6 displayed.

Observation No.	0	1
ID	1	2
Name	V01Gy01THDG	V01Gy02THDG
Type	GYRO	GYRO
At Node	1708 V01Gy01_GYRO_NODE	1709 V01Gy02_GYRO_NODE
To Node	1708 V01Gy01_GYRO_NODE	1709 V01Gy02_GYRO_NODE
To Target Node	1708 V01Gy01_GYRO_NODE	1709 V01Gy02_GYRO_NODE
Units	DEGREES	DEGREES
System	2	3
System Description	EDV_Gyro 1	EDV_Gyro 2
Speed	1.000000	1.000000
Lanewidth/frequency		
Unit length		
Lanewidth or freq		
Scale	1.000000	1.000000
Fixed C-O	-0.180000	-0.670000
Variable C-O	0.000000	0.000000
A Priori SD	0.500000	0.500000
Nominal	59.219970	59.709970
Source	RECORDED	RECORDED
Use	Used	Used
Satellite Datum (GPS obs)		
Rotation Convention (Pitch & Roll obs)		
Angular Variable (Pitch & Roll obs)		
Filter Length (CMG obs)		

R1 C1

Figure 5-6: Database – Observation Table

5.5.1   Observation Attributes

The following attributes are displayed for each observation:

Observation No.:   Unique number assigned by the program used for database relations. This number also appears before the observation name in all observations lists throughout the program for ease of searching for and identifying observations. Cannot be edited.

ID: Unique number assigned by the software for internal use. This is also the name of the observation data file.

Name: Observation name, maximum 27 characters. Can be edited.

Type: Observation type, selected from dropdown list. Types are assigned on input by both the P2 header and the program, and can be changed although caustion is advised if doing so. Refer to section 5.5.2 below for more information.

At Node: The node at which the observation is measured. Select from dropdown list.

To Node: The node to which the observation is measured, if applicable. Select from dropdown list.

To Target Node: Target node for angle type observations etc. Select from dropdown list.

Units: Observation measurement units. Select from dropdown list.

System: Measurement system number as defined in P2 header. Currently not used in the program. Can be edited.

System Description: Measurement system description as defined in the P2 header. For user information only. Can be edited.

Speed: Propagation speed, defined in the P2 header where applicable, otherwise defaults to 1.0. Can be edited.

Lanewidth/frequency: The lanewidth on baseline or comparison frequency, used for hyperbolic and raw GPS observations only. Can be edited.

Unit length: Units for the lanewidth (above). Select from dropdown list.

Lanewidth or freq: Flag to indicate whether the value for *Lanewidth/frequency* is the lanewidth on baseline or comparison frrquency. Select from dropdown list.

Scale:	Scale factor (C/O) from P2 header where applicable, otherwise defaults to 1.0. Can be edited.
Fixed C-O:	Fixed C-O correction defined in the P2 header where applicable, otherwise defaults to 0.0. Can be edited.
Variable C-O:	Variable C-O correction defined in the P2 header where applicable, otherwise defaults to 0.0. Can be edited.
A Priori SD:	Standard deviation defined in the P2 header where applicable, or automatically assigned. The units are the same as the observation units. Can be edited.
Nominal:	Nominal value, in the units in which the observation is recorded, computed by the program based on observation type and location. Used as an aid to data appraisal, or the constant observation value when used for manually created observations..
Source:	The source of data for the observation. Cannot be changed for recorded data but is used when creating observations. Select from dropdown list.
Use:	Flag to use, reject or globally reject the observation. Select from dropdown list.
Satellite Datum:	Coordinate Reference System applicable to LONGITUDE and LATITUDE type observations (see *Type* above). Can be edited. **Note:** this would normally be WGS-84 3D.
Rotation Convention:	For PITCH and ROLL obs only – specifies positive rotation direction.
Angular Variable:	For PITCH and ROLL obs only – specifies whether angle or sine of angle is recorded.
Filter Length:	For CMG obs only – average filter window in seconds when creating an observation of type COURSE MADE GOOD. This value is initially automatically calculated based on the distance of the observation's *AT* node behind the *VESSEL* node.

5.5.2   Observation Types

UNDEFINED	Undefined. This applies to user defined observations or indicates an error in the observation's definition in the P2 header.

The following observation types correspond to types 1 to 12 in the P2/94 format:

RANGE

HYPERBOLIC PHASE

HYPERBOLIC TIME

PSEUDORANGE COMMON BIAS

PSEUDORANGE UNIQUE BIAS

DIFFERENTIAL

COMPOSITE

ANGLE

DIRECTION

MAGNETIC BEARING

TRUE BEARING

DIFFERENTIAL TRUE BEARING

The following observation types assigned by the software during input:

LONGITUDE	Longitude or Easting.
LATITUDE	Latitude or Northing
HEIGHT	Ellipsoidal height (usually from GPS)
X	USBL X or derived X
Y	USBL Y or derived Y

Z   USBL Z

WATER DEPTH   Water depth from echosounder

GYRO   True bearing observation with "to node" as 0, stipulated in
                       the P2 format as being the method of defining a gyro-
                       compass aligned to the ship's head.

DEPTH SENSOR   Streamer or gun depth sensor observation

PITCH

ROLL

HEAVE

**The following observation types correspond to types 20 to 23 in the P2/94
format:**

*GPS
PSEUDORANGE*

GPS CODE PHASE

*GPS CARRIER
PHASE*

GPS DOPPLER

**The following observation types pertain to the P2/86 format and are not
supported in this version of the software:**

*CIRCULAR
LANE/PHASE
COUNT*

*LBL ACOUSTIC
TIME*

**The following observation types are available to be assigned to user
defined observations recorded in the P2/94 format:**

SPEED OF SOUND

JJJHHMMSS.ssssss   For microsecond time.

Automatically assigned to the first observation whose name contains the string "JJJHHMMS" or "DDDHHMMS". The observation data must be in the format

DDDHHMMSS.ssssss

Where:

DDD = day of year
HH = hour
MM = minute
SS.ssssss = second to 6dp.

If this observation exists and is required, but cannot be automatically detected, then the user must manually set the observation type.

UTC Seconds ref
1980:01:06   For microsecond time.

Automatically assigned to the first observation whose name contains the string "Shottime-UTC".

The data value is the number of seconds elapsed since midnight at the start of 06 January 1980.

If this observation exists and is required, but cannot be automatically detected, then the user must manually set the observation type.

The following observation types are assigned to observations input as Field Positioning Data from the P2/94 E12@0 records or the P2/11 H2,5,5,0 (with internally computed flag set) records:

FPD EASTING   Longitude or Easting

FPD NORTHING   Latitude or Northing

The following observation types are for GPS QC data:

SD LATITUDE   Standard deviation of latitude

SD LONGITUDE   Standard deviation of longitude

SD HEIGHT   Standard deviation of height

GDOP

PDOP

HDOP

TDOP

VDOP

GPS MODE | 1 = GPS, 2 = DGPS

SATS USED | Number of satellites used

STATIONS USED | Number of reference stations used.

The following observation types are defined in the P2/11 format:

ELLIPSE SMA | Semi-major axis of error ellipse

PRESSURE

HORIZONTAL RANGE

TEMPERATURE

TIME

TIME DIFFERENCE

SPEED THROUGH WATER

SPEED OVER GROUND

CURRENT SPEED

WATER DEPTH AT TRANSDUCER

LATERAL CONTROL FIN ANGLE

VERTICAL CONTROL FIN ANGLE

VERTICAL ANGLE

*SIGNAL TO NOISE
RATIO*

SALINITY

CONDUCTIVITY

TENSION

*HORIZONTAL
FORCE*

VERTICAL FORCE

GRAVITY

WIND SPEED

WIND DIRECTION

5.5.3   Creating and Deleting Observations

There may be circumstances, for example for 2D surveys, when it is necessary or desirable to create observations.

From the toolbar click on the *Create* button and follow the steps below in order:

1. Enter the observation *Name*.
2. Select the *Source* from the popup list. The following options are available:

    NOMINAL: The nominal value will be used for the observation data.
    COURSE MADE GOOD: The course made good of the vessel to which the observation's *At Node* belongs will be used for the observation data.
    OTHER OBSERVATION: The remainder of the list comprises all the recorded observations from which one may be chosen to be used for the observation data.
3. Select the *At Node* from the popup list.
4. Select the *To Node* from the popup list.

The remaining steps depend on the choice of source, and are described as follows.

Nominal:

1. The *Speed*, *Scale* and *Fixed C-O* automatically default to 1.0, 1.0 and 0.0 respectively.
2. Select the *Type* from the popup list. This would most likely be RANGE.

3. If the *Type* is ANGLE select the *To Target Node* from the popup list.
4. Select the *Units* from the popup list.
5. Enter the *A Priori SD*.
6. Enter the *Nominal*. This is the value that will be used for the observation data. In the case of RANGE type observations the nominal can be easily calculated from the node offsets shown in the network display (see section 0).
7. Optionally enter the *Scale* and *Fixed C-O*, although these parameters would not normally need to be changed if the nominal value is correctly calculated.

Course Made Good:

1. The Speed, Scale and *Fixed C-O* automatically default to 1.0, 1.0 and 0.0 respectively.
2. The *Type* and *Units* are automatically set to TRUE BEARING and RADIANS respectively.
3. Enter the *A Priori SD*.

A filter of type *Averaging* is automatically designated to *CMG* type observations. The filter length, in seconds, is the calculated travel time from the *At Node* t the vessel based on a speed of 4.5 knots. If filtering is not required then the filter must be set to *None*.

Other Observation:

1. The *Type*, *Units*, *Speed*, *Scale* and *Fixed C-O* are copied from the *Source* observation attributes.
2. If the *Type* is ANGLE select the *To Target Node* from the popup list.
3. Enter the *A Priori SD*.

No attributes other than those listed above for the various types of manual observations are required.

To delete an observation, click anywhere in that observation's column and then click on the *Delete* button in the toolbar. It is not possible to delete a recorded observation.

Warning: *Creating or deleting observations will invalidate the observation QC database and network adjustment will need to be performed again before viewing or printing the network observation time series plots or reports.*

5.5.4 Default observations

The number of observations and their attributes are initially defined by the P2 header records, and the observation file is stored in the *<line_database_folder>*. It may be desirable to define a default set of observation definitions to use for all lines subsequently processed in the project. For example, observation names or standard deviations may have been modified, or new observations may have been created.

5.5.4.1   Creating/Saving

To save a default observation definition file, first make the necessary changes to the observation attributes for the current line, and save. Then click on the *Save Defaults* button or from the menu select *Utilities | Save All Defaults*. The default observation definition files, "default.obs" and "default.ob2" are saved to the *<project_database_folder>*.

5.5.4.2   Loading

To load the default observation table, first select the line for which the default table is to apply from the *File* menu. Then click on the *Load Defaults* button or from the menu select *Utilities | Load All Defaults*.

The default observations are first matched with the existing observations, and only default observations with the following matching attributes will be candidates:

- Name
    - If an observation with the same name does not exist in the default table then the requirement to match the name is omitted. * See note below.
- Type
    - If an observation with the same type does not exist in the default table then the requirement to match the type is omitted. * See note below.
- At node
- To node
- To target node
- Unit code
- Source
    - If both existing and default observations are manual observations then the requirement to match the source is omitted.

Note: If both the name and the type cannot be matched then the observation cannot be identified and will not have any default observation loaded.

If any differences are detected between the existing table and the default table then the dialog as shown in Figure 5-7 appears.

For each attribute type that is different a checkbox appears in the upper panel. Checking this checkbox will cause this attribute to be replaced with the default value for **all** observations when the *OK* button is clicked.

Details of all differences are displayed in the lower panel.

If the default table contains manually created observations then these may be loaded only by checking the *Load Manual Observations Only* checkbox, then clicking the *OK* button.

Note: Nominal values for MAGNETIC BEARING and TRUE BEARING type observations are not loaded.
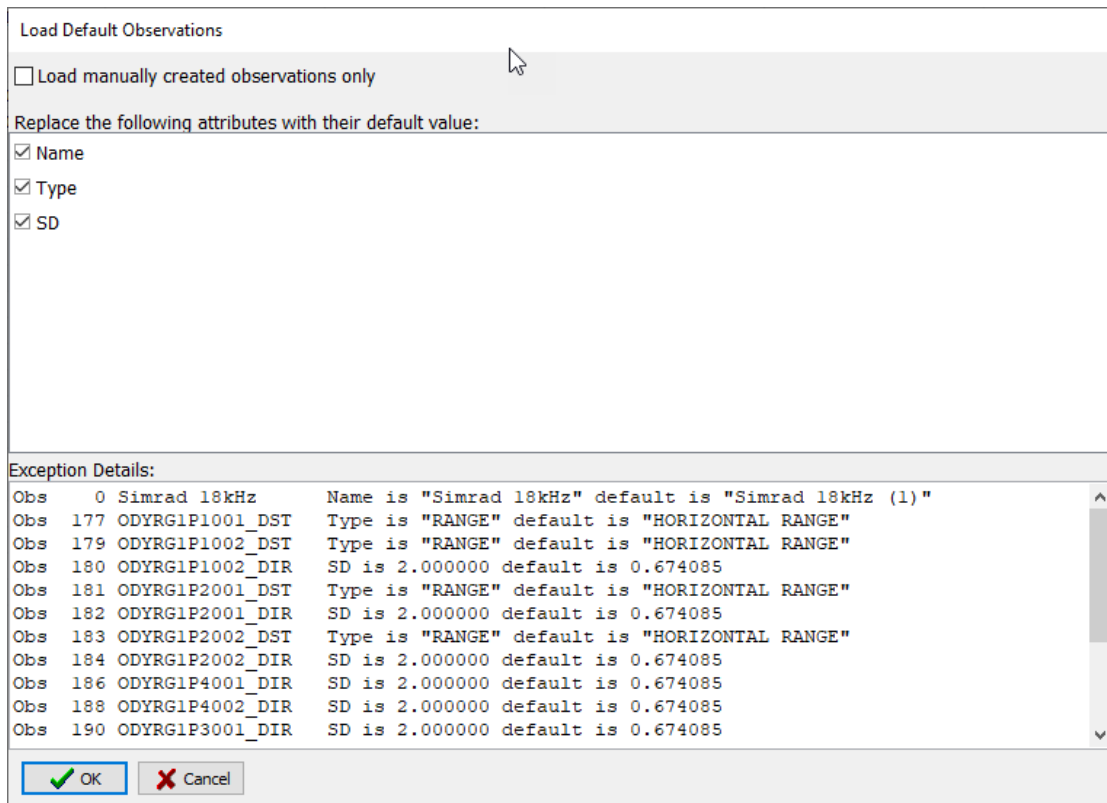
Figure 5-7: Database – Loading Default Observations

If manual default observations exist then they will always be loaded.

When loading default observations, the original observation definition file is saved as "original.obs" in the *<line_database_folder>*.

When Automatic Processing is carried out, if a default observation file exists it will be loaded immediately after the P2 file has been input. Any differences found will be written as warnings to the log, and also displayed immediately, although processing will continue.

When Automatic Processing the following observation attributes will not be loaded:

- Speed
- Fixed C-O
- Variable C-O

5.5.5   User Defined Observations

5.5.5.1   Speed of Sound

Velocimeter data may be recorded in the P2/94 format as a user defined observation.

During input the software will attempt to automatically recognise this and if successful will assign the type SPEED OF SOUND and the units METRES/SEC. If the average data value approximates 1.5 then it is assumed that the units are m/ms and the scale will be set to 1000 This observation may then be used in the Network Adjustment for acoustic observations whose units are MILLISECONDS in place of these observations' *Speed* attribute.

For P2/94 and P2/91 the user must specify the *At Node* attribute for SPEED OF SOUND type observations so that when more than one velocimeter is used the nearest one to each acoustic observation will be used. The P2/11 format allows for velocimeter nodes to be defined.

5.5.5.2   Pitch and Roll

Pitch and roll data may be recorded in the P2/11 or the P2/94 either in the E17 or T17 records, or as user defined observations.

Most user defined observation types are not automatically recognised by the software. In order to make use of pitch and roll from user defined observations in the network adjustment the following should be set in the database:

Type:	Set to either PITCH or ROLL.
At Node:	Ensure that this is a node of type VESSEL on which the pitch or roll observations are made.
Units:	Select the correct units, normally DEGREES or RADIANS.
Rotation Convention	
Angular Variable	

5.6   Streamer Sections

Select *Header | Streamer Sections* from the menu. The following attributes are displayed for each streamer section:

Vessel No.
Streamer ID
First Group ID
First Group Offset
Last Group ID
Last Group Offset
Number of Groups
Group Interval

Note that in the case of P2/94 or P2/91 the defined group interval is limited to 1dp therefore does not have the precision to match the calculated distance from the first to last group. In all cases, the first to last group is used to calculate all group offsets.

Streamer sections may be created and deleted using the toolbar buttons.

5.7   Receiver Groups

Select *Header | Receiver Groups* from the menu. The following attributes are displayed for each receiver group:

Streamer ID
Receiver ID
Offset

This table is derived from the *Streamer Sections* table and cannot be edited. Changes to the receiver group definitions must be done in the *Streamer Sections* table.

5.8   User Defined Node Types

Select *Header | User Defined Node Types* from the menu. The following attributes are displayed for each user defined node type:

Object Type Number
Object Type Name

User defined node types may be created and deleted using the toolbar buttons.

This table is used only for P2/11 datasets.

5.9   General Event Data

Select *Data | General Event Data* from the menu.

This table does not apply to P2/94 or P2/91 and is not available when these file types are input.

The General Event Data provides the time to which all observations are deskewed during Precondition and nodes solved for in the network adjustment. These are also the times for which data is output to the P1/90, and to the P1 and R1 records for P1/11.

The following attributes are displayed for each event:

 Acquisition Line Ref.

 Preplot Line Ref.

 Acquisition Point No.

 Preplot Point No.

 Year

 Month

 Day

 Julian Day   Internally computed

 Time

 Delta Time   Internally computed

Records may be created and deleted using the toolbar buttons.

When events are deleted, the user is prompted to delete the corresponding samples in any observation of type JJJHHMMSS.ssssss. This is because these samples bear a one-to-one relation with the shot and are not interpolated to the shot event.

Warning: Creating or deleting records or editing a time field will invalidate the observation and coordinate databases and Precondition and Network Adjustment will need to be re-run.

5.10 Source Fired Event Data

Select *Data | Source Fired Event Data* from the menu.

For P2/94 and P2/91, the Source Fired Events provide the times to which all observations are de-skewed during Precondition and nodes solved for in the network adjustment. These records provide the times for which all data is output to P1/90,

and to the P1 and R1 records output to P1/11.

For P2/11 the Source Fired Event may not coincide with any General Event. When outputting a P1/11 the times of the S1 records are taken from this table. The source positions are interpolated according to the time difference from the nearest two General Events.

The following attributes are displayed for each event:

Source ID

Seismic Record   P2/11 only

Acquisition Line Ref.   P2/11 only

Preplot Line Ref.   P2/11 only

Acquisition Point No.

Preplot Point No.   For p2/94 and P2/91 this is the same as the acquisition point number.

Event Index No.   P2/11 only

X Offset   P2/11 only

Y Offset   P2/11 only

Z Offset   P2/11 only

Year

Month

Day

Julian Day   Internally computed

Time

Delta Time   Internally computed

Point Code: User specified. The specified character for each record is available to be used as the point code when outputting SPS files. Only the first character is used.

Events may be created and deleted using the toolbar buttons.

When events are deleted, the user is prompted to delete the corresponding samples

in any observation of type JJJHHMMSS.ssssss. This is because these samples bear a one-to-one relation with the shot and are not interpolated to the shot event.

Warning: *For P2/94 and P2/91, creating or deleting records or editing a time field will invalidate the observation and coordinate databases and Precondition and Network Adjustment will need to be re-run.*

5.11 Gun Fired Event Data

Select *Data | Gun Fired Event Data* from the menu.

This table is available only for P2/11 format files.

The following attributes are displayed for each event:

Source Ref No.   Synonymous with ID.

Acquisition Line Ref.

Preplot Line Ref.

Acquisition Point No.

Preplot Point No.

Event Index No.

Year

Month

Day

Julian Day   Internally computed

Time

Delta Time   Internally computed

Gun No.

Gun Mode

Detect Mode

Auto Fire

Static Offset

Gun Delay

Fire Time

Delta

5.12 Observation Time Data

Select _Data | Observation Time Data_ from the menu.

When the _Observation Table_ is displayed, clicking the _Time_ button in the toolbar will display the Observation Time Data for the observation in which the cursor is located.

When _Observation Shot Event Data_ is displayed, clicking the _Time_ button will display

the Observation Time Data for the current observation.

Clicking the toolbar buttons < and > will display the previous and next observation's data respectively.

When this table is displayed, clicking the *Obs* button will display the *Observation* table with the cursor at the currently displayed observation.

The following attributes are displayed for each event:

Raw	Raw data value as recorded in the P2
Processed	Processed data value after application of *Precondition* parameters
Time	Time stamp as recorded in the P2
Flag	Status flag as set by *Precondition*
Shot No.	The number of the nearest SP

Warning: *Creating or deleting records or editing a time field will invalidate the observation and coordinate databases and Precondition and Network Adjustment will need to be re-run.*

5.13 Observation Shot Event Data

Select *Data | Observation Shot Event Data* from the menu.

When the *Observation Table* is displayed, clicking the *Shot* button in the toolbar will display the Observation Shot Event Data for the observation in which the cursor is located.

When *Observation Time Data* is displayed, clicking the *Shot* button will display the Observation Shot Event Data for the current observation.

Clicking the toolbar buttons < and > will display the previous and next observation's data respectively.

When this table is displayed, clicking the *Obs* button will display the *Observation* table with the cursor at the currently displayed observation.

The following attributes are displayed for each event:

Shot No.	SP number
Value	Value – this is the value at the shot time that has been interpolated from the *Observation Time Data*.

A blank field indicates that there is no data for that SP.

Time   Time of SP

Delta Time   Time in seconds from the first SP

Note: *This table displays the data that is used in the network adjustment, before reductions are applied.*

5.14 **Variable C-O**

Select *Data | Variable C-O* from the menu, and select the observation from the list. Only observations for which variable C-O have been recorded will appear in the list.

The following attributes are displayed for each event:

Variable C-O

Variable Scale

Variable Speed

Time   The time from which all variable data in this event will take effect.

5.15 **2D Networks**

2D operations typically do not record all the observations necessary to perform a network adjustment, but may have to rely upon manual laybacks to position the sources and streamers. There are commonly two types of 2D networks: those without an active tailbuoy and those with an active tailbuoy.

The SeisPos Database module provides the means to automatically create the necessary extra nodes and observations. This is automatically carried out immediately after input of the P2 provided the *Create 2D Nodes and Observations* checkbox in the Project dialog is checked (see section 2.2), but if it has not been then this can be done using the menu option *Utilities | Create 2D Nodes & Observations*.

Note: *A maximum of 10 streamers and 10 sources is supported for this operation.*

After creation, these nodes and observations appear in their respective tables in the normal way, and their attributes can be edited if desired.

After creation, the user is prompted to save the Node and Observation tables to defaults. Refer to sections 5.4.4 and 5.5.4.

5.15.1 Source and Streamer Positioning

1. If it does not already exist a node representing the towpoint on the vessel for each streamer and source is created.

    Note: the offsets from the vessel reference point to the towpoints, in the case of P2/8x and P2/9x, is taken from the streamer and gun-array definition records. In the case of P2/11 the user must enter the offset in the project setup and it is assumed that there is only a single towpoint.

2. A range observation is created **from** each streamer head and source centre **to** its respective towpoint. The value is calculated from the nominal offsets as defined in the P2 header. A SD of 2m is assigned.

3. A bearing observation is created **from** each streamer head and source centre **to** its respective towpoint. If streamer compasses are detected then the near compass data and SD are used for the observation, otherwise the vessel's course made good is used with an SD of 0.5°. A C-O is calculated from the nominal offsets as defined in the p2 header.

5.15.2 Streamer Tail Positioning

5.15.2.1 Without Active Tailbuoy

The last node found which is referenced to each streamer has its *Type* set to *BUOY* and its *Relation* set to *STREAMER*. This is necessary so that the network adjustment automatically creates the necessary derived observations to position the whole streamer.

5.15.2.2 With Active Tailbuoy

1. A node representing the last receiver group on each streamer is created, named "Rec1#" where # is the streamer number.

2. A range observation **from** each tailbuoy **to** its corresponding Rec1 node is created. The value is calculated from the offsets defined in the P1 header. An SD of 99m is assigned.

3. A bearing observation **from** each tailbuoy **to** its corresponding Rec1 node is created. If streamer compasses are detected then the observation uses the data and SD from the last streamer compass, otherwise the vessel's course made good is used, with an SD of 0.5° assigned.

5.16 **Extracting Acoustic Data**

This utility is provided to extract reduced shot event acoustic data for use in the FBComp application for computing acoustic transponder positions.

Only data flagged as GOOD, i.e. a non-blank value in the Shot Event Data table, will be output. The extracted data has all C-Os, scale, speed and conversion to grid units applied. The list of available observations contains only observations of types RANGE (normally ping time) and X, Y and Z (normally USBL).

The output file format is:

<shot line no.> <SP> <JD> <hh:mm:ss> <rcvr line no.> <rcvr id> <rcvr index> <L> <data>

The *L* denotes that the observation type is a slope range. In the case of USBL data this will be replaced with X, Y or Z as appropriate.

Line numbers, shotpoints and receiver Ids are written in the SPS Revision 2.1 format F10.2.

5.16.1 Gator OBS Projects

In the case of GATOR OBS RECEIVER project acquisition systems, the line number is parsed from the comment record written to the P2 by the acquisition system. An example comment is:

```
Line:     Cable 200 is laid as OBC receiver line 1005
```

The columns used for parsing this number are specified as shown in Figure 5-8.

The receiver ID is taken from the last four digits of the name of the *To Node* defined for that observation.

The acoustic transponder and seismic receiver group offsets are written at the end of the data file. These are used in the FBComp application to relate the transponders and receivers for interpolating positions along the cable. These offsets are the Y offsets as shown in the *Node* table and the *Receiver Groups* table respectively.
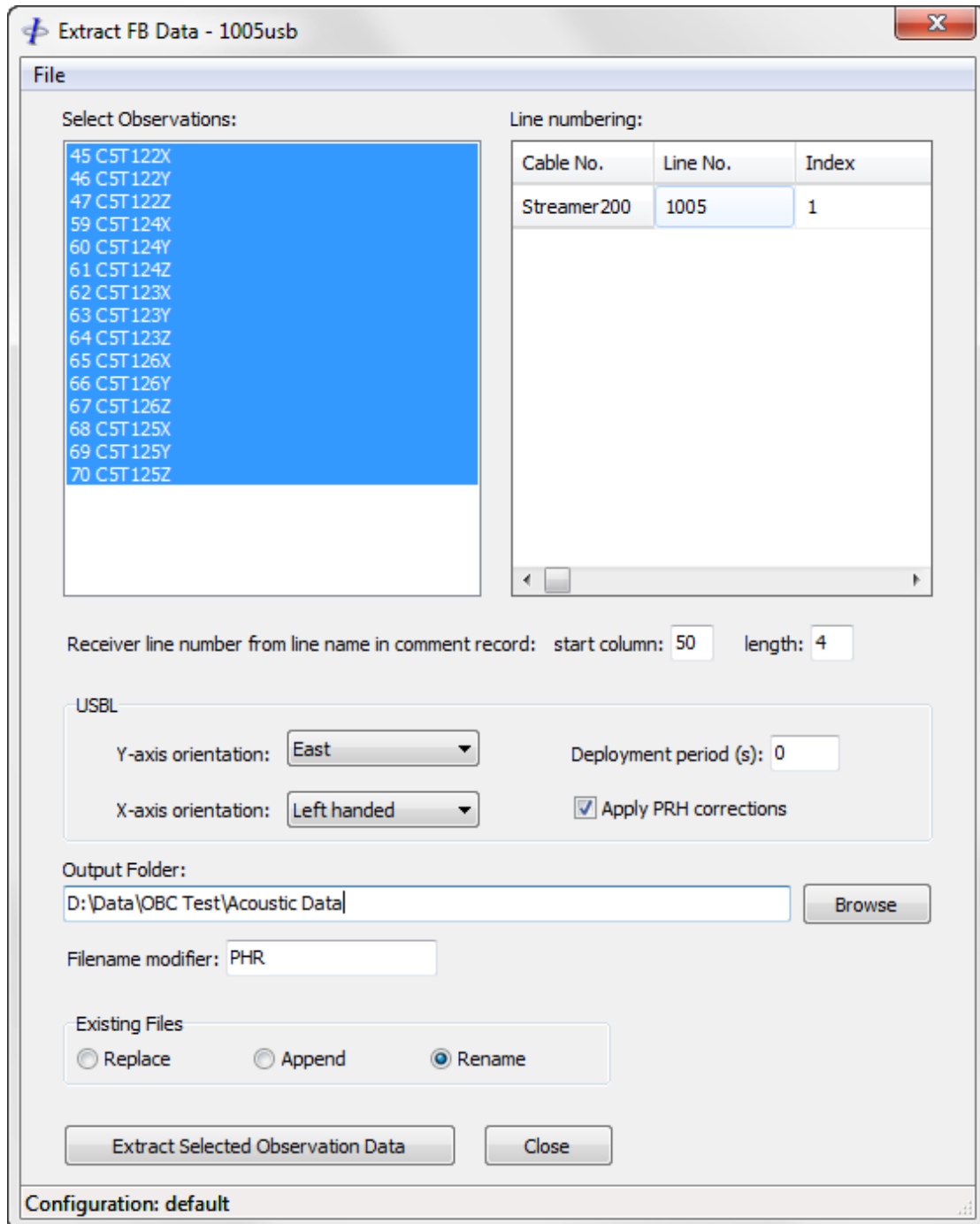
Figure 5-8: Acoustic Data Extraction – Gator Projects

5.16.2 Q Seabed OBS Projects

In the case of Q SEABED OBS RECEIVER project acquisition systems, the receivers must be matched to the corresponding seismic trace. The contractor should provide a trace map with this information which is entered into the Line Numbering grid as shown in Figure 5-9.
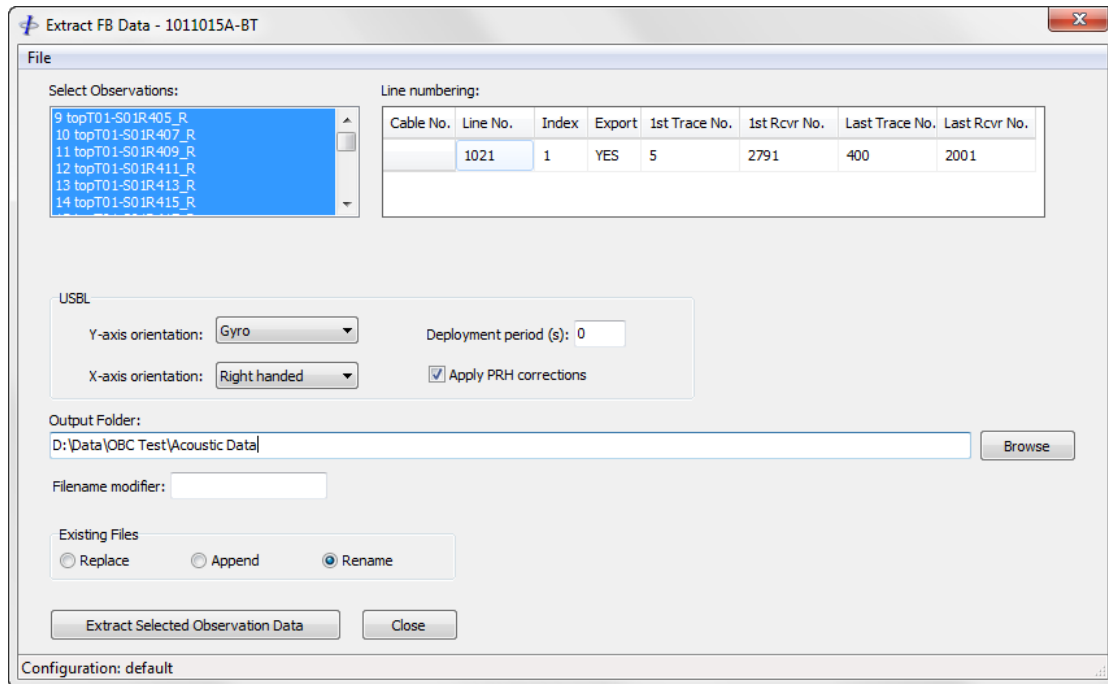
Figure 5-9: Acoustic Data Extraction – Q Seabed Projects

5.16.3 USBL Orientation

When USBL observations are used, the orientation off the USBL coordinate reference system must be specified by setting the appropriate Y-axis orientation.

The X-axis orientation is specified as being either *Right handed* – the X-axis is oriented Y-axis orientation + 90°, or *Left handed* – the X-axis is oriented Y-axis orientation – 90°.

5.16.4 Deployment Period

If the deployment period is non-zero then the first number of specified seconds of data will not be used.

5.16.5 Pitch Roll and Heave

Optionally check the *Apply PRH corrections* checkbox. The initial setting is based on the relevant flags in the P2 header.

5.16.6 Batch Output

To output the data for all acoustic observations for more than one line select from the menu *File | Select Lines*. Note that the observation and cable lists will be disabled and all observations and cables will be selected for output.

5.17 Extracting Field Positioning Data

Field Positioning Data (FPD) which is the realtime network position computed by the acquisition navigation system and recorded in the P2 file is saved in the SeisPos database. These positions can be exported to SPS file.

From the menu select *Utilities | Extract Field Positioning Data to SPS*.
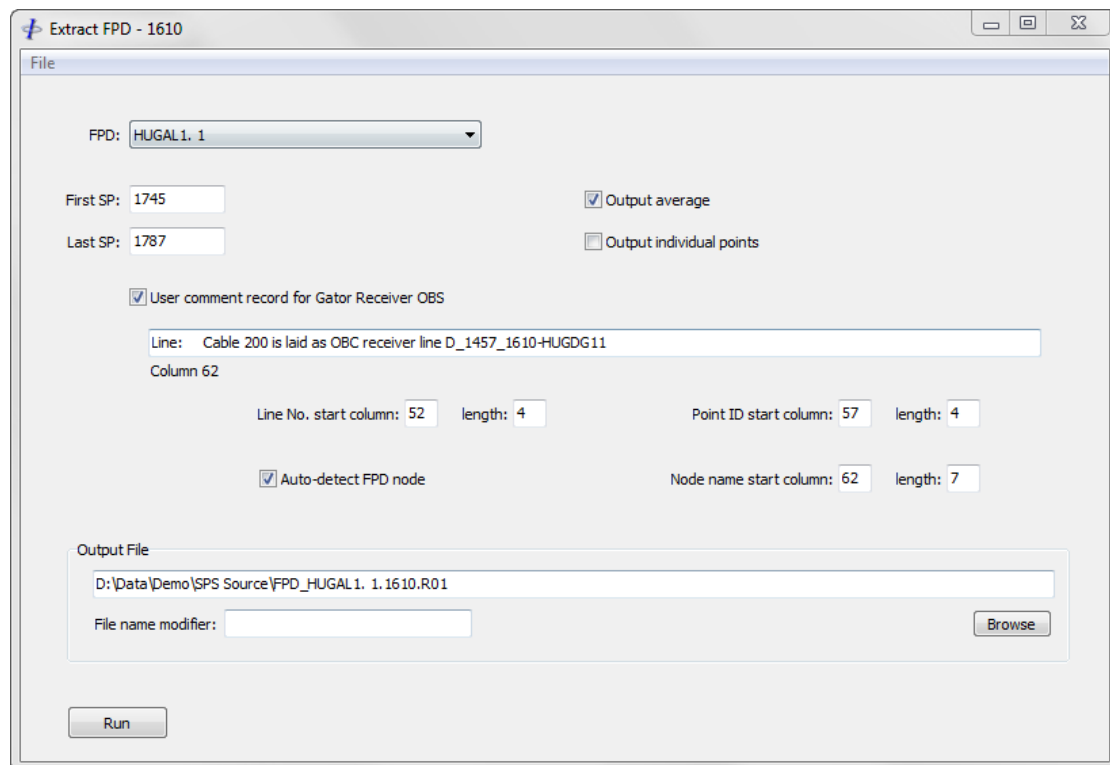
Figure 5-10 - Extract FPD

To select multiple lines select *File | Select Lines*.

Select the FPD data item from the dropdown list.

The specified FSP and LSP will only be used if a single line is selected.

Checking *Output average* will output the average position of all points in the line for the specified node. The SPS record for this value will be given the instrument code "AV".

Checking *Output individual points* will output the position of each point in the line for the specified node. The SPS records for these will be given the instrument code "FP" and will have incrementing indexes.

Optionally edit the output file name. This can be easily done by entering a file name modifier.

Note: All data will be output to the same file.

5.17.1 Gator Receiver OBS Options

The Gator INS writes specific information about USBL positioned ROVs to comment records in the P2 file. These records may be read and used to determine the line number, point ID and the FPD node.

When using these options set the appropriate column and field lengths.

The relevant comment record is displayed and the column numbers may be read from below the display when positioning the cursor in this field.

If the *Auto-detect FPD node* option is used then the FPD node selected from the dropdown list is ignored and is replaced with the detected node on a line by line basis.

6   NETWORK DISPLAY

View Network display displays an interactive scaled plan view of the network, showing all network nodes and observations.
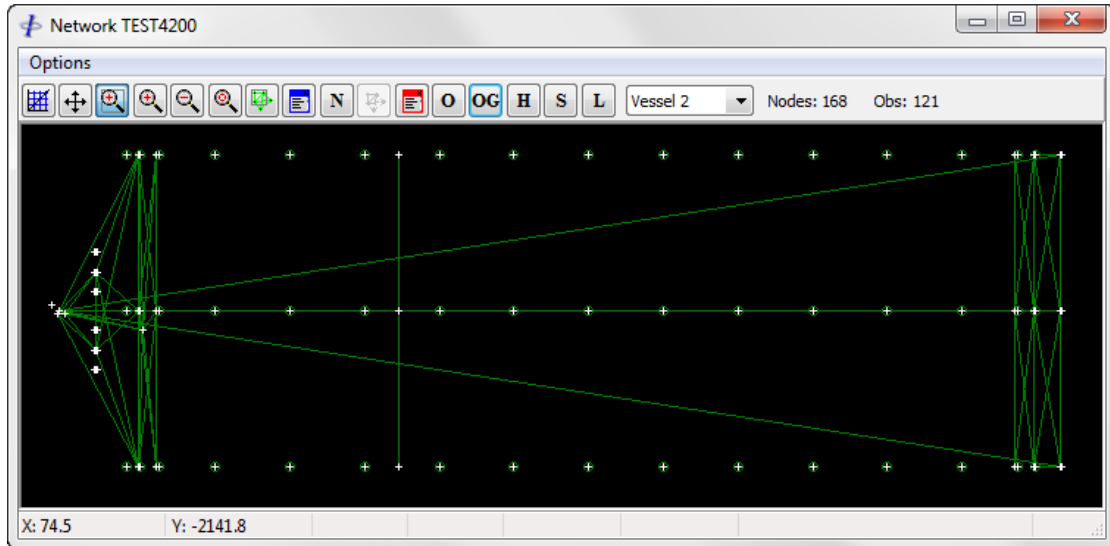
Figure 6-1: Network Display

From the main menu select *View | Network display*, then select the line from the line list.

The Network display automatically appears when the Network Adjustment module is started. During adjustment the network updates node positions and error ellipses and streamer compasses are optionally displayed.

6.1 **Toolbar**

When down, the scale is the same along both axes.

When down, use the left mouse button to pan the display. With the <Shift> key and left mouse button down move the mouse up and down to zoom in and out respectively.

When down, use the left mouse button to zoom in to a rectangle.

Hold down to zoom in

Hold down to zoom out.

Zoom extents.

When down, use the left mouse button to select network nodes. The node list appears with the selected nodes highlighted.

Display the node list. The node list can be used to include and exclude nodes from the current configuration.

Display the Edit Node dialog.

Display the observation list.

Display the Edit Observation dialog.

Display the Observation Group dialog.

When down, plots node heights along the vertical axis.

Plots nodes of type STATION (e.g. radio-navigation or DGPS reference stations).

When down, node labels are plotted. Repeated click scroll the position of each node label through four positions around the node.
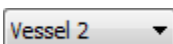
Scroll through individual vessel networks in a multi-vessel configuration.

6.2   **Menu**

Options:

   Save:

     Preview: Prompts for title and displays the network with axes and a white background replacing a black background. All toolbar and mouse functions remain enabled. Enables the save option.

     Save: Enabled only when in Save Preview. Opens the Save dialogue to save the image to a bitmap file (.bmp).

   Print:

     Preview: Prompts for title and displays the network with axes and a white background replacing a black background. The image appears as it would on the selected printer using the current printer settings. The aspect ratio is preserved. Preview must be closed before any further action can be taken.

     Print: Prints the image as it appeared in the print preview.

     Printer Setup: Opens the Windows printer setup dialogue.

   Colours:

     Background: Set the background colour.

     Font: Set the colour of text displayed on diagram.

     Nodes: Set the node colour.

     Good Obs: Set the colour for good observations (available in Precondition module only).

     Interp Obs: Set the colour for interpolated observations (available in Precondition module only).

     Bad Obs: Set colour for bad observations (available in Precondition module only).

     Monochrome: Display in monochrome.

   Labels:

Select:	Select node types for which labels are shown when *Plot Labels* button is clicked.
Increase:	Increase font size.
Decrease:	Decrease font size.
Load Network:	Loads a previously saved network configuration.
Save Network:	Saves the current network configuration. The saved configuration can be used in the *Network Adjustment* module.
Show Toolbar:	Hide/show the toolbar.
Exit:	Exit network display.

6.3   Functions

6.3.1   Coordinate Refrence System

The CRS origin is the vessel reference point. The X-axis is the vertical axis, positive upwards corresponding to starboard. The Y-axis is the horizontal axis, positive towards the left corresponding to forward. When the elevation view (*H* button) is shown, the X-axis changes to the Z-axis, positive upwards corresponding to height above the vessel reference point. The units are metres.

6.3.2   Mouse Functions

The coordinates of the mouse cursor, in terms of the CRS described above, are shown on the left of the status bar below the diagram. The number of horizontal positioning network nodes and observations is always above the diagram, and responds to zooming.

Positioning the mouse cursor over a node will display a label showing the names of all the nodes close to the mouse cursor.

Moving the mouse whilst holding down the left mouse button draws a zoom rectangle.

Measurements are made by moving the mouse whilst holding down the right mouse button to draw a line whose equivalent length, difference in X and Y, and bearing clockwise from the vertical are shown in the status bar.

Depressing the left mouse button whilst positioned over nodes displays the following node attributes:

Number
Name
Type
Relation
Reference node
Offsets from the reference node.

If several nodes are grouped closely together repeated clicks of the left mouse button, keeping it depressed, will scroll through this information for each node.

If the *Edit Node* dialogue is showing it will display the current node. If the *Node List* is showing it will highlight the current node.

6.3.3   Zooming

In addition to the toolbar zoom functions, the mouse wheel may also be used to zoom in and out.

To zoom in on the location of the mouse cursor scroll the mouse wheel up.

To zoom out on the location of the mouse cursor scroll the mouse wheel down.

6.3.4   Node List

Click on the *Node List* button to display the node list. The node list is also displayed when selecting nodes using the mouse (see section 6.1).

The node list is divided into two lists: *Nodes Available* and *Nodes Used*. The nodes used are those which are currently contained in the Network display. The remaining nodes defined are in the Nodes Available list. (See Figure 6-2).
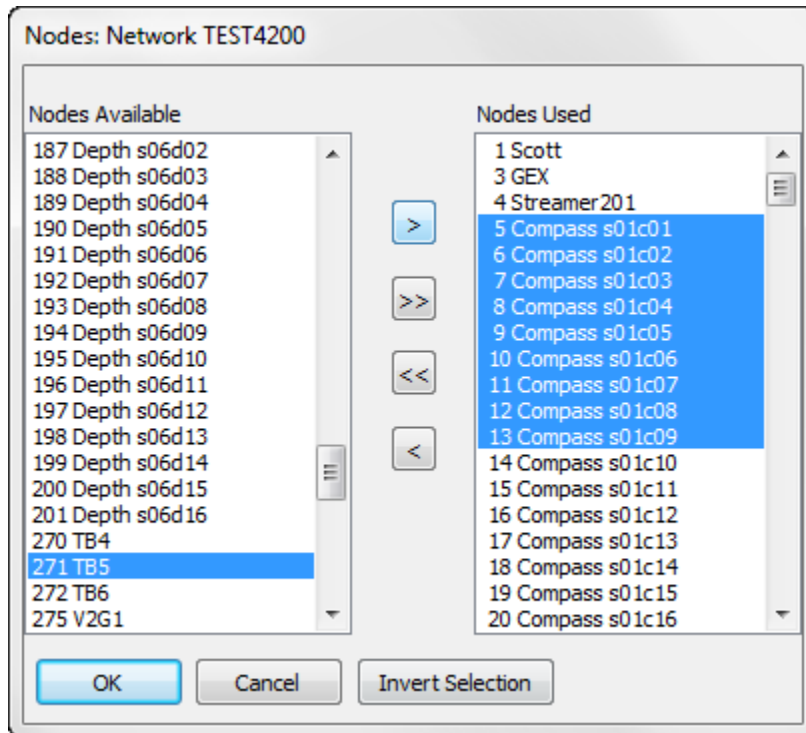
Figure 6-2: Network Display – Node List

Click on the appropriate arrow buttons to move nodes between the two lists. This action automatically updates the Network display.

Highlighting a node with the left mouse button updates the Edit Node dialogue with the highlighted node, if displayed. The highlighted node can also be changed by clicking on a node in the Network display or changing the current node in the Edit Node dialogue.

Figure 6-2 shows a selection of nodes which has been made by drawing a rectangle in the Network display with the *Select Nodes* button down.

By clicking the *Invert Selection* button followed by the left arrow button (<) the selected nodes may be included in the network and all other nodes excluded.

6.3.5   Edit Node

Click on the *Edit Node* button to display an abbreviated dialogue of node attributes, shown in Figure 6-3, which can be edited. Pressing the *Enter* key or clicking on the *Save* button saves changes to the database, and the network display is updated immediately. Saving is disabled during network adjustment if the Network display has been invoked from the Network Adjustment module.
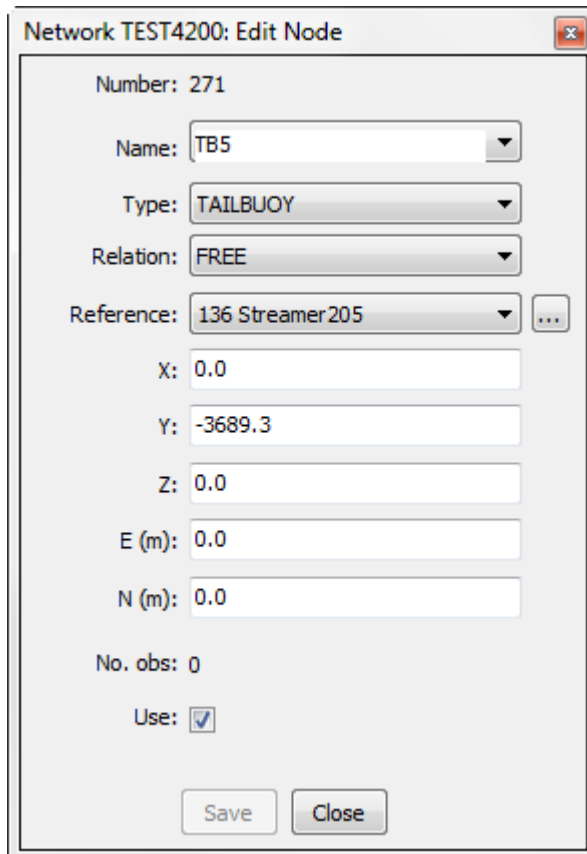
Figure 6-3: Network Display – Node Dialog

The current node in the dialogue is selected by selecting the node from the dropdown list of node names, clicking on a node in the network display or highlighting a node in the node list.

Note: *The grid coordinates are displayed in metres, regardless of the projection metric conversion factor defined.*

6.3.7   Observation List

The observation list enables setting the selected attribute for the selected observations.

Click the *Observation List* button to display the list.
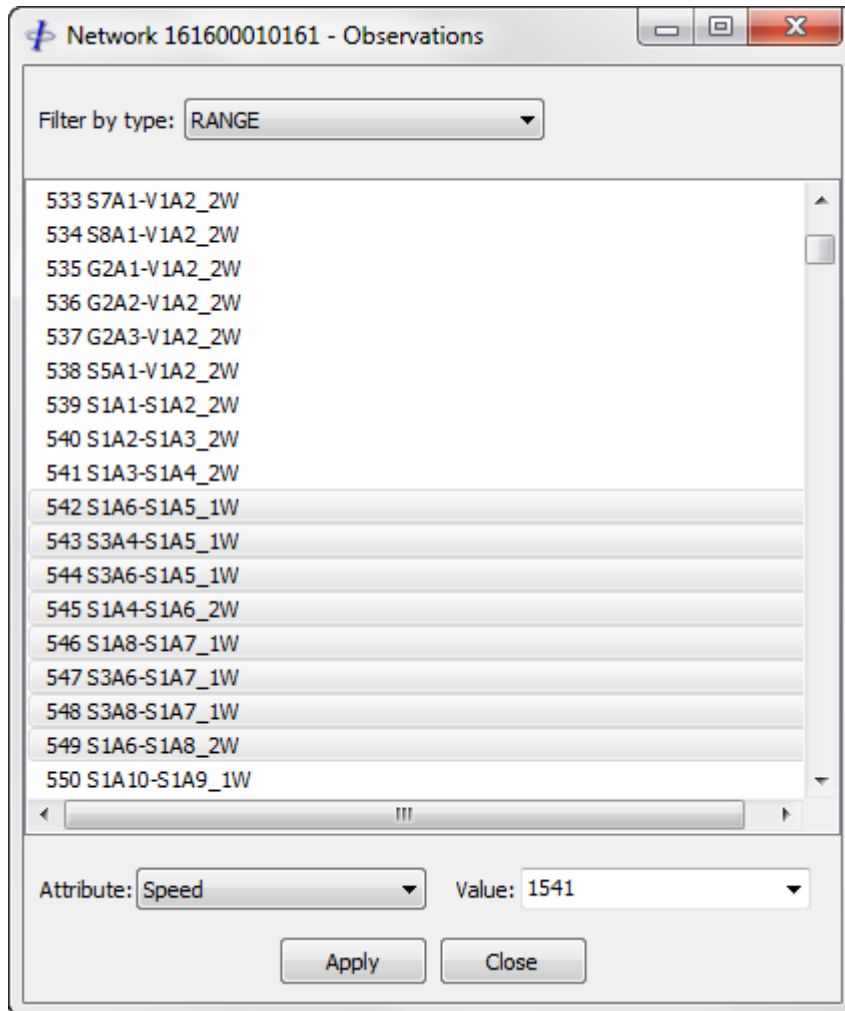
Figure 6-4: Network Display – Observation List

Use the mouse to select observations in the network display, or select items on the list. Optionally filter by observation type. Select the attribute to be changed and enter the new value or select a new values from the dropdown list. Click the *Apply* button to apply changes.

Note: *Before applying changes it is recommended that all other modules be closed first.*
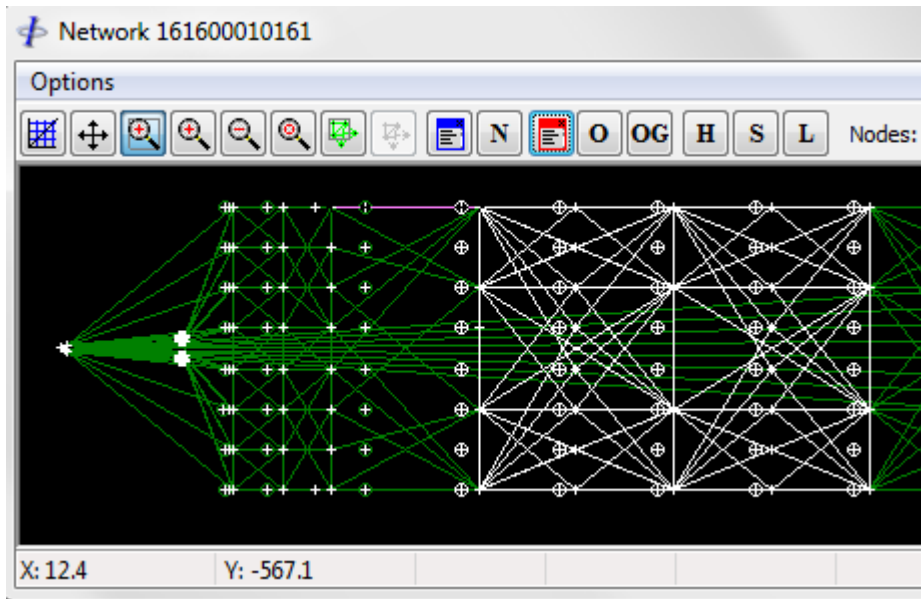
Figure 6-5: Network Display – Selecting Observations

6.3.8 Edit Observation

Click on the *Edit Observation* button to display an abbreviated dialogue of observation attributes, shown in Figure 6-6, which can be edited. Pressing the *Enter* key or clicking on the *Save* button saves changes to the database, and the network display is updated immediately. Saving is disabled during network adjustment if the Network display has been invoked from the Network Adjustment module.

Figure 6-6: Network Display – Observation Dialog

7   PRECONDITION

This module enables interactive or automatic de-spiking, filtering, interpolation, editing and rejection of observation data.
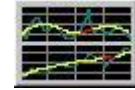
Two options are available:

Interactive, whereby the user has full control over editing and processing of data with all observation time series plots in view.

Non-interactive, whereby the observations are automatically processed using the parameters which have been previously defined and saved from a previous line, or the internal default parameters if none have been previously saved.

7.1 Non-interactive Precondition

Select *Execute | Auto Precondition* from the main menu and select the line from the line list which then appears. Multiple lines may be selected.

The default parameters will be applied to all observations for lines which have not yet been preconditioned. If a line has already been preconditioned then the parameters previously applied to that line will be re-applied. This process runs in the background with the progress displayed at the bottom of the main panel. No further interaction is required.

This option is also used in *Automatic Processing*.

7.2 Interactive Precondition

Click the *Interactive Precondition* button in the main toolbar and select the line from the line list which then appears. The initial window displaying the group and observation lists along with various options appears as shown in Figure 7-1.
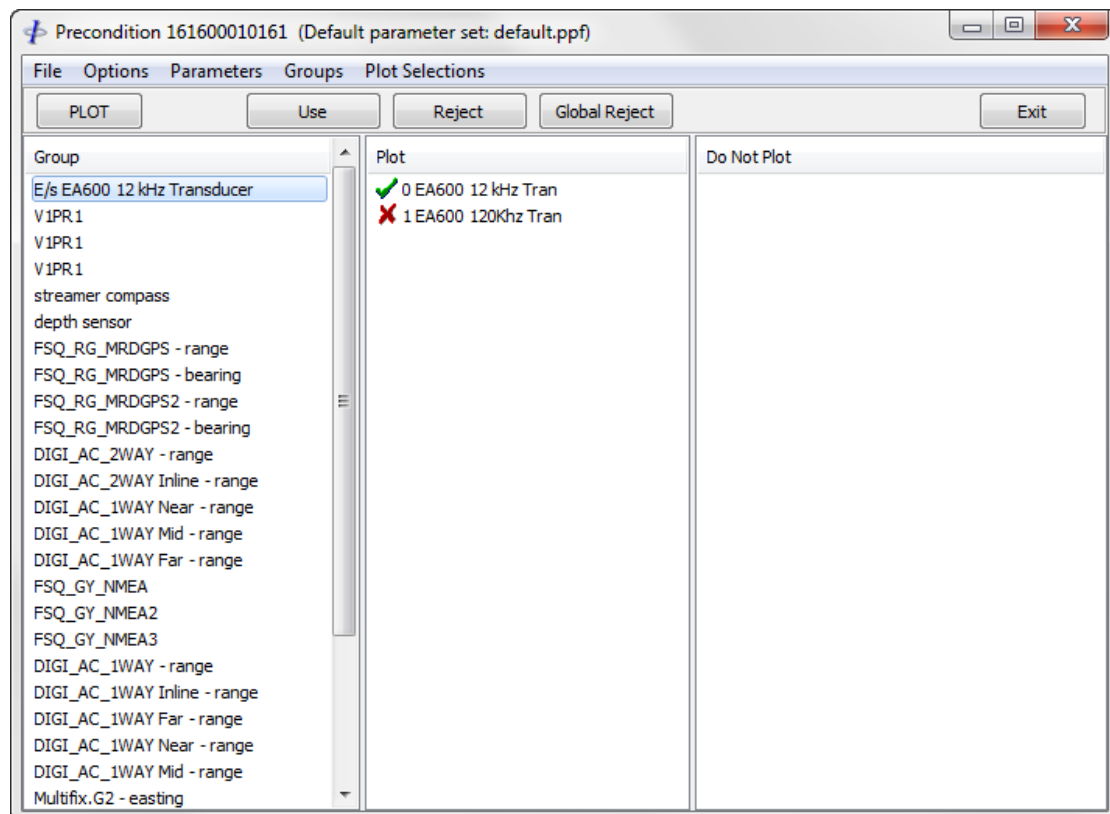
Figure 7-1: Interactive Precondition – Initial Display

Various optional changes may be made at this stage, as described below. To display the plots click the *Plot* button.

7.3   **Groups**

Groups are used to facilitate the application of processing parameters to observations, and to select which observations are to be plotted when using *Interactive Precondition*.

Each observation is allocated a group number during input of the P2, which is made up from the Positioning System Identifier, the observation type and location along the streamer.

7.3.1   Groups Menu

Create new group: Create a new group.

Delete selected groups: Delete the selected groups. A group must be empty before it can be deleted.

Save current groups as defaults: Save the current groups as the default groups. These groups will be automatically applied to subsequent lines input to the project.

Load default groups: Apply the default groups to the current line.

7.3.2   Renaming Groups

To rename a group highlight the group, then either click again on the group label or press the <F2> key, edit the name and press <Enter>.

7.3.3   Moving Observations Between Groups

To move observations from one group to another
1. Select the group(s) containing the observations to be moved. The observations will appear in one or both of the right hand lists.
2. Select the observations to be moved.
3. Using the mouse, drag the selected observations and drop them on the group in the *Group* list to which they are to be moved.

7.3.4   Setting Observation Plot Status

Observations can be selected for plotting or not plotting by moving them into the appropriate *Plot* list or *Do Not Plot* list respectively.

To move individual or multiple observations from one list to another first select the group(s) to which the observations belong. Select the observations and drag them into the desired list.

To move entire groups from one list to another select the groups and then drag them into the required list.

To save the observations' plot status for subsequent instances of *Interactive Precondition*, from the menu select *Plot Selections | Save Current Plot Selections as Defaults.*

To load a previously saved plot selection, from the menu select *Plot Selections | Load Default Plot Selections.*

Note: *Observations in the Do Not Plot list will not be preconditioned.*

7.4   Rejecting Observations

Setting an observation's *Use* attribute will determine if that observation is to be used in the network adjustment. The three attribute values are:

Use:	The observation will be used in the network adjustment for each shotpoint for which a good value is available.
Reject:	The observation will not be used in the network adjustment for the current line.
Global Reject:	The observation will not be used in the network adjustment for the current line and for all subsequent lines until its *Use* attribute is changed.

To set the *Use* attribute select the observations to which it is to apply then click on the *Use*, *Reject* or *Global Reject* button. The observation's icon will appear as a green tick, red cross or red double cross respectively.

Observation status is automatically saved.

7.5   Default Parameters

The use of multiple default parameter sets is provided in order to handle situations where different parameters may have to be applied on a regular basis to handle different environmental conditions e.g. based on line direction or sea surface conditions.

The current default parameter set is shown in the window title bar.

To load a previously saved default parameter set (see section 7.7.1), from the menu select *Parameters | Load Precondition Parameter Set*.

After a new default parameter set has been loaded, when the *Plot* button is clicked all observations will be re-processed using the new parameter set.

7.5.1   Default OBS Acoustic Parameers

To change the default parameters for OBS Receiver (see section 2.2) acoustic data select from the menu *Parameters | Set Default OBS Acoustic Parameters*.

7.6   **Options Menu**

Auto Rejection:	Global parameters applied to all observations.
Minimum percentage:	Enter the minimum required percentage of samples. If an observation has less that this number of samples as a percentage of shot points in the whole line then it will be rejected The default value is 10.
Maximum SD of Delta:	The standard deviation of the sample-to-sample differences (DSD) of the processed data can be used to automatically reject an observation. If an observation's DSD is greater than the specified value then it will be rejected. The default value is 5.
	For Latitude and Longitude observations the DSD of rate of change is used.
Plot by Group:	Sort the plots by observation group.
Plot by Node:	Sort the observations by their *At Node*.
Exclude Observations with No Data:	Observations which have no samples of recorded data will not be plotted.
Exclude Vessels with No Data:	Observations ultimately referenced to a vessel for which there is no recorded data will not be plotted. This option is typically used when processing OBS data from datasets in which several ancillary vessels with observations are defined but do not record data.
Remove Bad Data:	Removes samples that have a value very close to 0 (± 1e-9). Does not apply to QC statistics or angular observations.

7.7   **Plots**

Click the *Plot* button shown in Figure 7-1 to display the plots for the selected observations in the Multiplot interface as shown in Figure 7-2.

Note: *The general behaviour of the Multiplot interface is described in the* MultiPlot manual. *The remainder of this section describes the functionality specific to the Precondition module.*
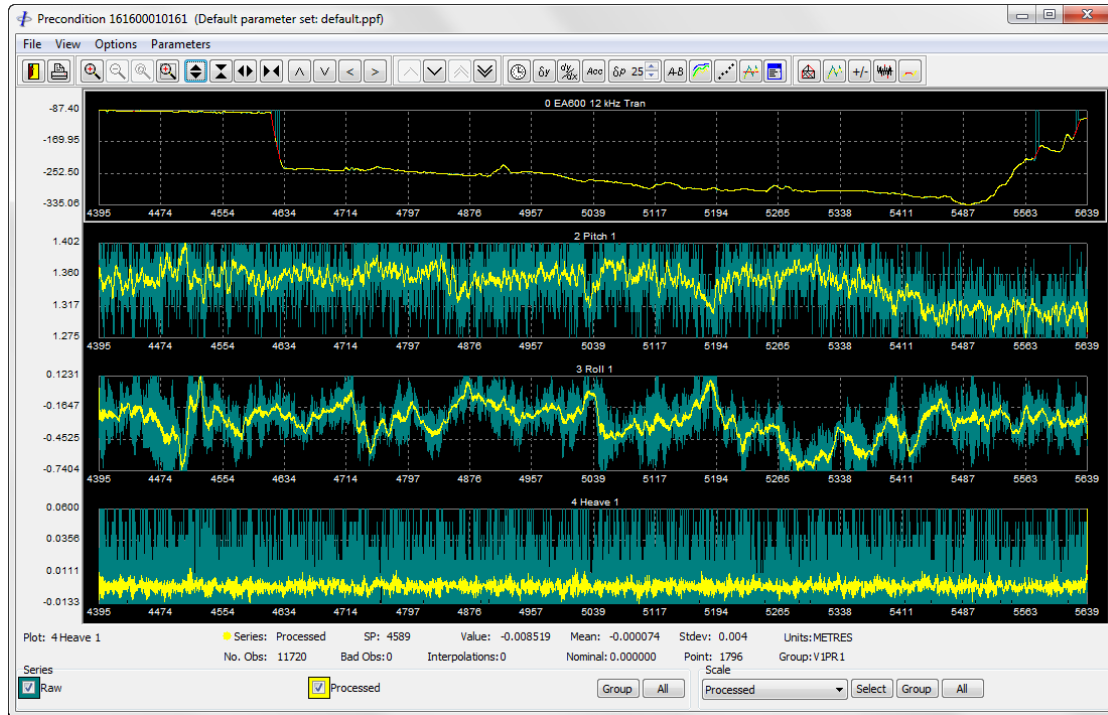
Figure 7-2: Interactive Precondition – Multiplot

7.7.1 Menu

Options:

Hotkeys: Set the Hotkeys for deleting data using the edit line and toggling the use/reject status of an observation. Multiple key combinations are not supported.

View:

Network: Display the network (see section 0 for details).

Time as Metres: Display in metres observations of type RANGE which have been recorded in time units e.g. acoustic ranges recorded in milliseconds.

Note: *processing parameters must still be specified in the observation's original units.*

Parameters:

Save Precondition Parameter Set: Save the current parameter set (interpolation, gate and filter parameters) for all observations.

Save Precondition Save the current parameter set under a new name.
Parameter Set As:

7.7.2 Toolbar

Show the Network Display.

Display the processing parameter dialogue with values pertaining to the *Selected Plot*.

Invoke a dialogue box allowing negative values for the *Selected Plot* or all plots to be rectified. This option is used specifically for Digicourse one way ranges which are flagged by being recorded as negative in legacy datasets.

Toggle plotting of raw minus processed data.

When depressed enables the left mouse button to be used to edit existing data or create new data by dragging inside the plot area. Data samples are created at 5 second intervals. The direction of creation is set by the initial mouse movement.

7.7.3 Series

For each observation, two series are defined:

Raw: Raw time-based data as recorded in the P2 file. This data can be edited. Original data is restored using the *Undo All Edits* option from the popup menu. Default colour is blue.

Processed: Raw time-based data with the current processing parameters and edits applied. Default colour is yellow.

By default both of these series are visible and the *Active Series* is the processed series.

7.7.4 Popup Menu

The basic Multiplot popup menu functions are described in the *MultiPlot manual*. The following functions are specific to the Precondition module:

Delete Above: Delete all processed data on the *Selected Plot* above the *Edit Line*. The default shortcut is 'q'.

Delete Below: Delete all processed data on the *Selected Plot* below the *Edit Line*. The default shortcut is 'z'.

Delete Between: Delete all processed data on the *Selected Plot* above and below the *Edit Line*. The default shortcut is 'a'.

Block Shift: On selecting a sub-menu item, a dialog will appear prompting for the correction which will be added to the data. This correction will be applied to both raw and processed data.

Above: Add the correction to points on the *Selected Plot* for which the processed data lies directly above the *Edit Line*.

Below: Add the correction to points on the *Selected Plot* for which the processed data lies directly below the *Edit Line*.

Between: Add the correction to points on the *Selected Plot* for which the processed data lies directly above or below the *Edit Line*.

Block Scale: On selecting a sub-menu item, a dialog will appear prompting for the scale correction by which to the data will be scaled This correction will be applied to both raw and processed data.

Above: Apply the correction to points on the *Selected Plot* for which the processed data lies directly above the *Edit Line*.

Below: Add the correction to points on the *Selected Plot* for which the processed data lies directly below the *Edit Line*.

Between: Add the correction to points on the *Selected Plot* for which the processed data lies directly above or below the *Edit Line*.

External Data: Import data from a file to replace the data along the length of the *Edit Line*. Refer to section 11.5.8.2 for file format specification.

Undo Last Edit: Undo the last deletion only performed on the *Selected Plot*.
                        This function is only available as long as the plot remains in
                        view.

Undo All Edits: Undo all deletions, corrections, creations and external
                        imports for the *Selected Plot*.

Redo Last Undo: Revert the previous *Undo* operation. This function is only
                        available as long as the plot remains in view.

Set SD: Set the selected observation's a priori standard deviation.

Use Obs: Toggle on/off use of *Selected Plot* for the network
                        adjustment. The default shortcut key is 's'.

Global Reject: Toggle on/off use of *Selected Plot* for the network
                        adjustment. When globally rejected, an observation will
                        remain rejected for subsequent lines input into the
                        database.

Network: Display the network display for the shotpoint at the cursor
                        position, highlighting the observation in the *Selected Plot*.

7.7.5   Plot Statistics

The following statistics are specific to the Precondition module:

- Number of samples.
- Number of bad samples.
- Number of interpolated samples.
- Nominal value (calculated from node offsets).
- Observation group.

7.8   Processing Data

For the first line input in the current project, an internally generated set of parameters
will be applied. For subsequent lines the current set of *Default* parameters will be
applied (see section 7.5).

Click on the *Parameters* button to invoke the Precondition Parameters dialogue as
shown in Figure 7-3 below. For each of the three processing categories, click on
Apply to apply these parameters to the *Selected Plot;* click on *Apply to Group* to

apply these parameters to the group of observations to which the *Selected Plot* belongs.

To apply all three processing categories to the group click the *Apply to Group* button which appears in the lower panel of the Precondition Parameters dialogue.

7.8.1   Processing Categories

Three categories of processing parameters are applied to each observation: Interpolation/extrapolation, Gate and Filter. These are described in detail in the following sections.

7.8.2   Layers

For each of the parameter categories up to 10 layers of parameters may be applied. The manner in which these layers are applied depends on the parameter category and is described in the following sections.

Each layer is associated with a set of parameters and a shotpoint range over which these parameters are applied. For layer 1 this is the entire shotpoint range and cannot be changed.

To add a layer for the whole shotpoint range, click on the observation plot to select the observation, then in the parameters window right click on the layer dropdown list to invoke a popup menu and select *Add New Layer*. Enter the desired parameters.

The new layer will be added when the *Apply* or *Apply to Group* button is clicked.
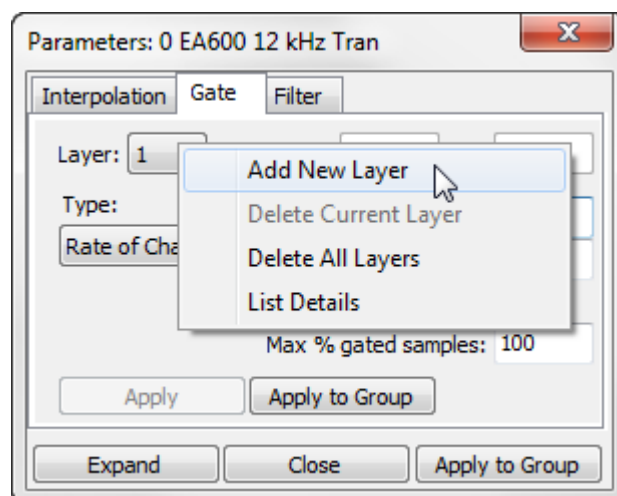

Figure 7-3: Precondition – Layers

To add a new layer for a partial shotpoint range first use the left mouse button to draw a line on the plot over the desired shotpoint range, then add the layer as described above.

To delete a layer first select the layer from the layer dropdown list then select *Delete Current Layer* from the layer popup menu.

Note: *Layer 1 cannot be deleted.*

Note: *When applying to group, all layers will be applied to all observations in the group, and existing layers will be removed.*

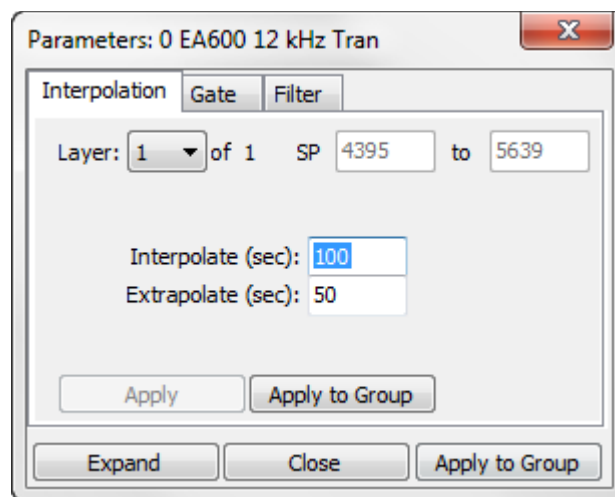*7.8.3   Interpolation and Extrapolation*

Figure 7-4: Precondition – Interpolation

Interpolation and extrapolation apply to edited, gated and missing data.

"Missing" data is an arbitrary term which depends upon the sample interval. E.g. if the interpolation threshold is set to 10s then shot events which fall between any consecutive samples which are more than 10s apart will not be interpolated. The interpolation threshold should therefore be set to at least the shotpoint interval.

To apply interpolation and/or extrapolation enter the thresholds in seconds and click on *Apply* or *Apply to Group*. Gaps or missing data up to the specified threshold will be interpolated.

Subsequent layers will replace existing layers over the selected shotpoint range e.g. to disable interpolation over a sub-range add a new layer for that shotpoint range, set the threshold to 0s, and apply.

If only the data sample nearest to the shot event is required then interpolation and extrapolation should be set such that the value entered is less than the time between consecutive shots and greater than the time between the data sample and the shot event.
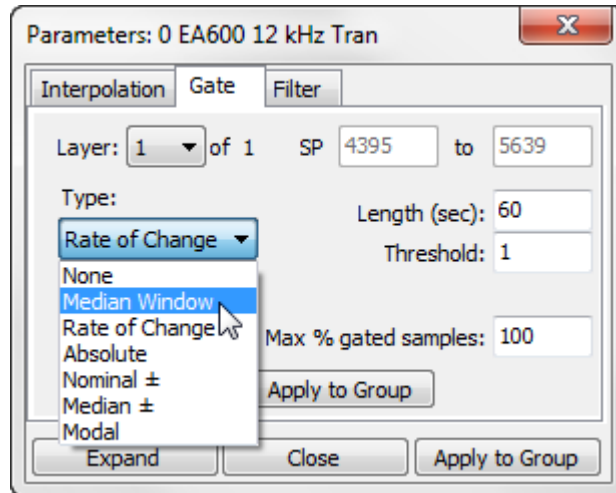
7.8.4   Gate

Figure 7-5: Precondition – Gating

The following methods are supported:

Median Window: Enter the window length in seconds and the threshold in the units of the observation. Click on *Apply* or *Apply to Group.*

A data sample will be gated if the absolute difference between its value and the median value of all samples in the window centred on that point exceeds the specified threshold.

Rate of Change: Enter the window length in seconds and the threshold in the units of the plot. Click on *Apply* or *Apply to Group.*

A data sample will be gated if the absolute value of the difference between its rate of change and the median value of the rate of change of all points within the window exceed the specified threshold.

Absolute: Enter the upper and lower thresholds in the units of the observation. Click on *Apply* or *Apply to Group.*

A data sample will be gated if its value falls outside of the specified thresholds.

Nominal: Enter the absolute value of the threshold in the units of the observation. Click on *Apply* or *Apply to Group.*

A data sample will be gated if its value falls outside of its nominal value ± the specified threshold.

Median: Enter the absolute value of the threshold in the units of the observation. Click on *Apply* or *Apply to Group.*

A data sample will be gated if its value falls outside of the median value of the entire dataset ± the specified threshold.

Modal: Enter the number of modes, the window length in seconds and the threshold.

A data sample will be gated if its value falls outside of the lowest mode in the specified window ± the specified threshold.

Subsequent layers will **augment** existing layers e.g. the first layer may specify a median gate of large length and high threshold to gate large unwanted excursions in the data, and a subsequent layer may specify a smaller threshold and length to eliminate higher frequency smaller outliers.

The *Max % Gated Samples* parameter is the maximum number of samples allowed to be gated above which the observation will be automatically rejected.
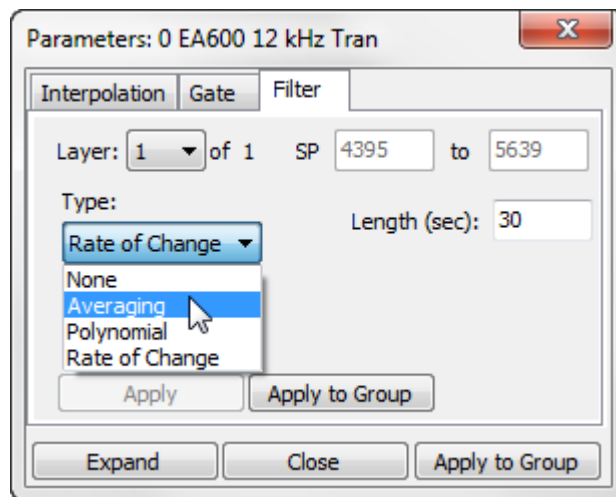
7.8.5   Filter

Figure 7-6: Precondition – Filtering

The following methods are supported:

Averaging: Enter the window length in seconds. Click on *Apply* or *Apply to Group*.

The value of each data sample will be replaced with the mean value of all samples falling within the specified window.

Polynomial: Enter the length in samples and the order of polynomial. Click on *Apply* or *Apply to Group*.

The value of each data sample will be replaced with the value of the best fit polynomial of the specified order and range of samples centred on that data sample. If the order exceeds the sample range it will be automatically replaced with the sample range.

Rate of Change: Enter the window length in seconds. Click on *Apply* or *Apply to Group*.

The value of each point will be replaced such that its mean rate of change equals the mean rate of change of all points within the window.

Subsequent layers will replace existing layers e.g. to remove all filtering from a sub-range of data select that range, add a new layer, select *None*, and apply.

7.8.6 Deleting Data

With the *Zoom Window button* up, draw a line on the plot using the left mouse button. Use the appropriate Hotkey, or right click and select from the popup menu one of the following:

Delete Above: Data samples falling above the line will be deleted.

Delete Below: Data samples falling below the line will be deleted.

Delete Between: Data samples falling above and below the line will be deleted.

These actions may be repeated as many times as required to delete data from different areas of the plot. After editing, deleted data will be immediately interpolated and filtered if applicable.
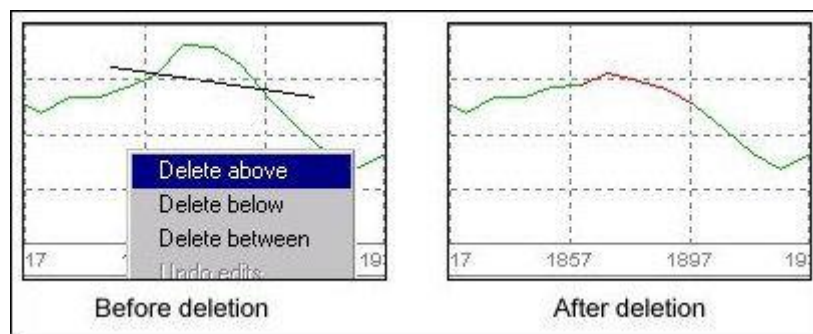

Figure 7-7: Precondition – Manual Editing

Figure 7-7 shows the effects of deletion, interpolation and filtering.

To undo all deletions on a plot, click the right mouse button on the plot and select *Undo All Edits*.

To undo the last deletion on the selected plot, click the right mouse button on the plot and select *Undo Last Edit*. This option is only available as long as the plot remains in view.

To redo the last undo click the right mouse button on the plot and select *Redo Last Undo*.

7.8.7   Correcting Data

Erroneous data for which the error is known may be corrected rather than deleted.

In the case of an addition or subtraction operation, for example to correct data from swapped laser targets, the *Block Shift* function should be used. In the case of a scale operation, for example to correct multiple echosounder returns, the *Block Scale* function should be used.

With the *Zoom Window button* up, draw a line on the plot using the left mouse button. Right click and select from the popup menu one of the following:

Block shift/scale | Above: Data samples falling above the line will be corrected.
Block shift/scale | Below: Data samples falling below the line will be corrected.
Block shift/scale | Between: Data samples falling between above and below the line will be corrected.

These actions may be repeated as many times as required to apply corrections to data in different areas of the plot. After correction, corrected data will be immediately interpolated and filtered if applicable.

Note: *Both the raw and processed data series are corrected. Original raw data is backed up so that the operation may be undone.*

Figure 7-8 shows the effects of correcting, interpolation and filtering. In this example all data above the *Edit Line* has been shifted by -10.

To undo all corrections on the selected plot, click the right mouse button on the plot and select *Undo All Edits*.
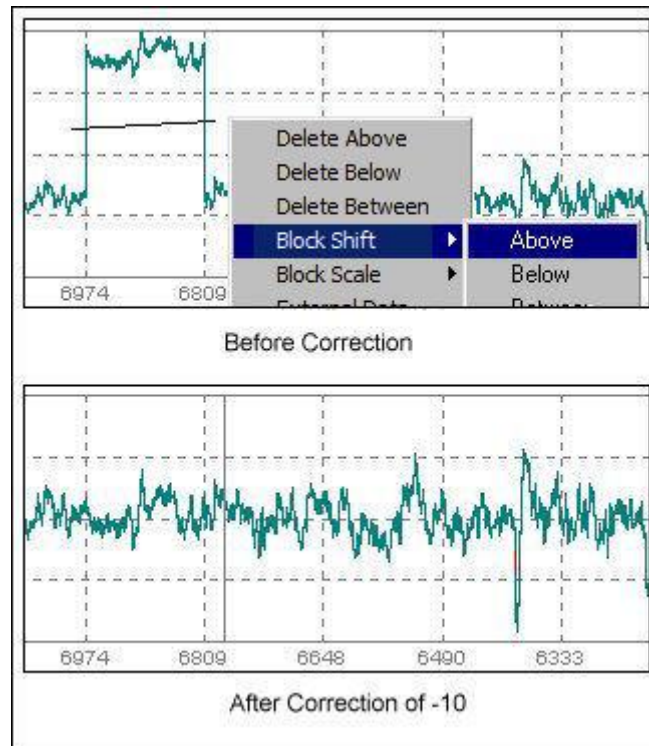
Figure 7-8: Precondition – Block Shift

7.8.8   Data Table

Data can be edited from the data table. To do this, right click on the plot in the region off the data to be edited and from the popup menu select *Table*. In the data table the raw values may be edited. When edits have been made right click on the table and select *Apply Edits*.

To undo all edits on the selected plot, click the right mouse button on the plot and select *Undo All Edits*.

7.8.9   Creating Data

To create data to replace the existing raw data series depress the *Create Data* button, then use the left mouse button to draw the new data. When the mouse button is released existing raw data is replaced with the new data where coincident, and the gating and filtering parameters are applied. This action can be repeated as many times as necessary. New data samples are created at 5 second intervals.

To undo all creations on the selected plot, click the right mouse button on the plot and select *Undo All Edits*.

7.8.10 Importing External Data

Data recorded in an external file may be imported to replace existing data or missing data. Once imported, this data is treated in exactly the same way as original data from the P2 dataset.

The external data must conform to the following:

- The file must be in ASCII.
- Data, and either hours, minutes and seconds or shotpoint fields must be present.
- Fields must be either of consistent fixed width or delimited with a character or string of less than 256 characters.
- Each record must end in a carriage return/ line feed.
- The data must be in the units specified in the observation definition.
- At least some of the times must fall within the period defined by the edit line prior to importing.

To import external data perform the following steps:

1. Using the left mouse button draw an edit line across the area of the plot which is to be replaced with external data.
2. Right click on the plot and from the popup menu select *External Data* to invoke the External Data Dialog (see Figure 7-9).
3. Enter the file name containing the data.
4. Enter the format string, format type and the field delimiter if applicable. The contents of the data file are displayed for reference. See section 7.8.10.3 below.
5. Click on the *OK* button.

To revert back to the original dataset select *Undo All Edits* from the popup menu.

7.8.10.1 Timing

The time stamps of the external data are defined by the year, day, hour, minute and second fields. These are used to compute the time of each data sample since the first shotpoint of the line. If any of these are not present then the corresponding attribute (year, day etc.) of the first shotpoint in the line will be substituted.

Only data with times which fall within the period defined by the edit line will be imported. All existing data within this period will be replaced.

Warning: *It is the responsibility of the user to ensure that the time data used is valid. If, for example, the line started shortly before midnight on day 100 and the external data was from after midnight. i.e. day 101, and no Julian day was present in the records, then the external data will be incorrectly assumed to have been recorded on day 100, i.e. the day of the first shot, and not day 101.*

7.8.10.2 Large Datasets

SeisPos imposes limitations on the number of data samples in a series in order to conserve memory use. The situation may arise when the number of external data samples exceeds this limit, in which case the user will be notified. If this does occur then it will be necessary to exit and re-start Precondition upon which the memory allocation for that observation will be automatically increased, and to re-import the external data. For very large external datasets it may be necessary to do this several times.

7.8.10.3 Format Strings

The format string allows the following format specifiers:

```
y = year
d = Julian day
h = hour
m = minute
s = second
p = shotpoint
x = data value
Any other character = do not import
```

Delimited:
Each data field, regardless of length, is represented by a single format specifier. Refer to Figure 7-9 below for an example. In this example year and Julian Day are not present in the records.

The field delimiter used to separate the data fields must be specified.

To suppress import of a field use any character not listed above e.g.:

```
DATA RECORD:    100,2001,49,12,02,20.9,$XYZ,1234.56
FORMAT STRING:  #ydhms#x
```

In this example the 1st and 7th fields, 100 and $XYZ, will be ignored.
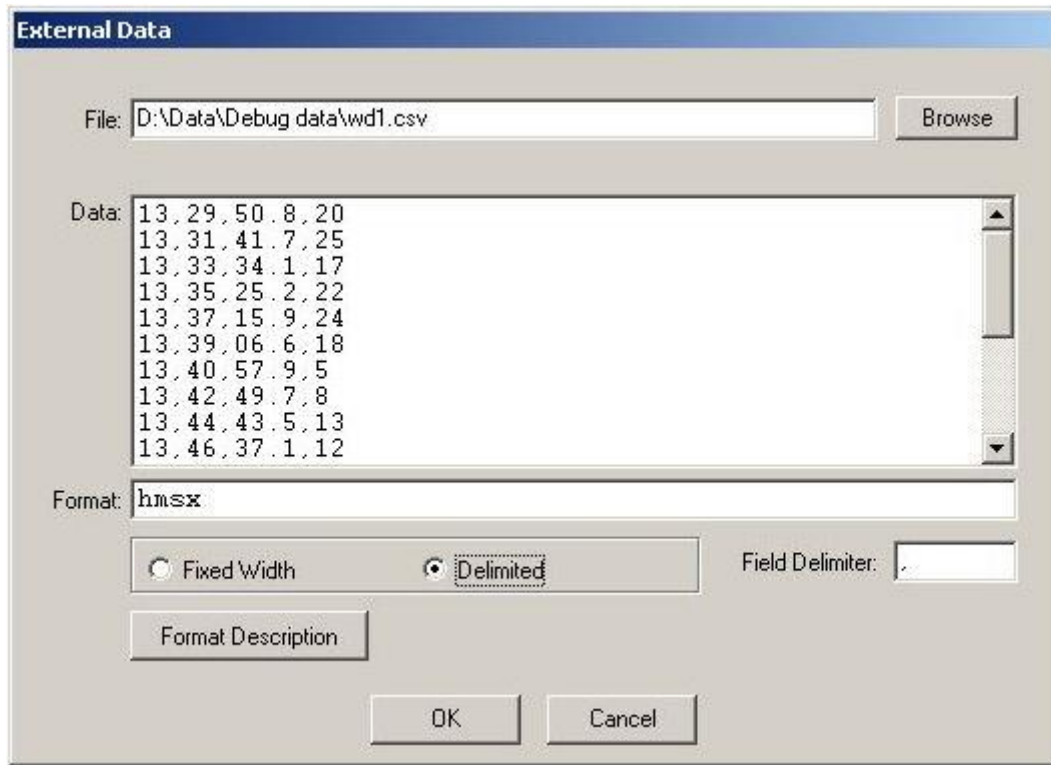
Figure 7-9: Precondition – External Data, delimited

Fixed Width:
Each data field is represented by a group of the same format specifiers representing the exact position and width of the field. The field delimiter is not used. Refer to Figure 7-10 below for an example. In this example space characters have been used to indicate the positions in the data records to be ignored.
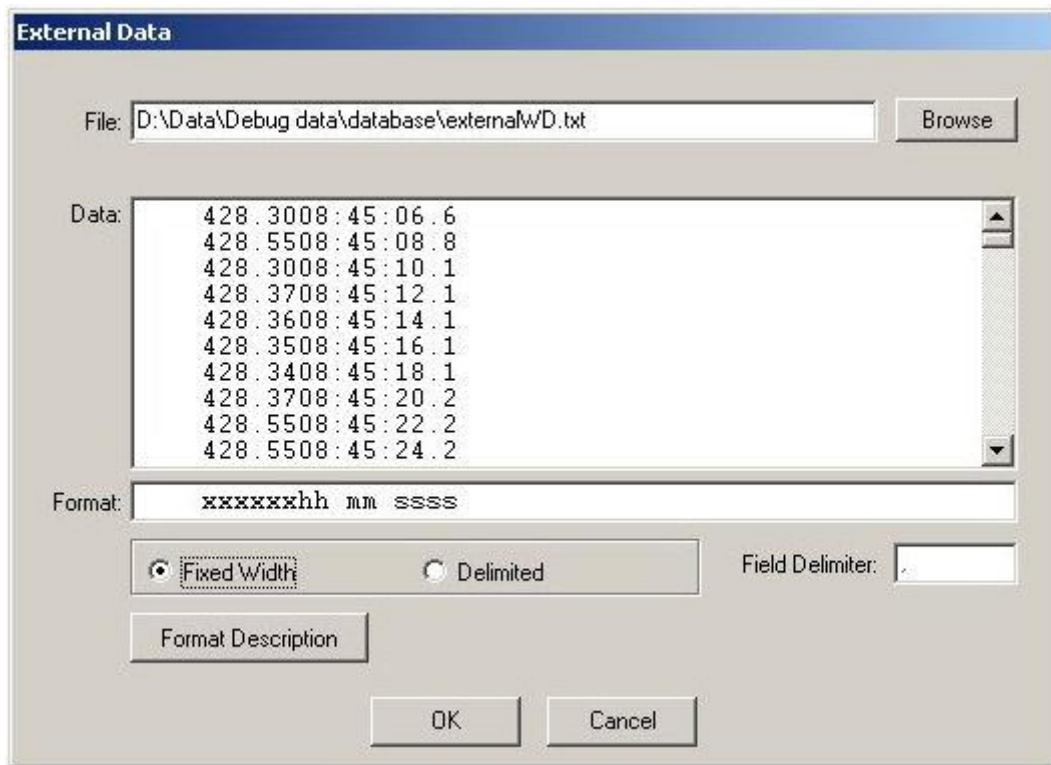
Figure 7-10: Precondition – External Data, fixed width

7.8.11 Missing Data

If data has been gated, edited or is missing for a period greater than the interpolation threshold, a red line will be drawn along the bottom border over the area of affected data. This line is extended by 5 pixels either side of the affected data so that even single affected data samples will be highlighted thus.

7.9   Network Display

Click on the *Network* button to display the network display.

Refer to section 6. for a description of the common functions available. Functions unique to the Precondition module are described as follows.

7.9.1   Toolbar

   Link observation: when this button is down, click on an observation in the network display to display its time series plot. Repeated clicks will scroll through co-located observations.
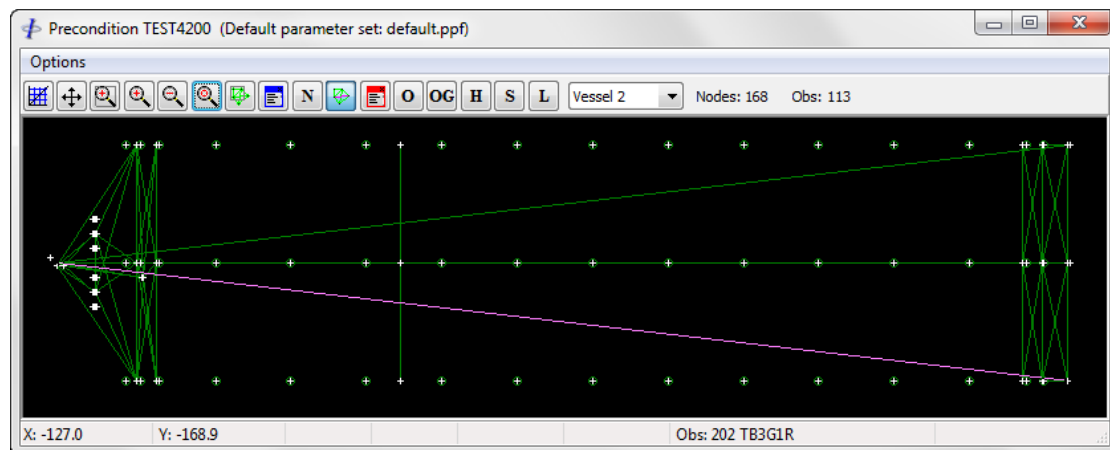
7.9.2 Display

Figure 7-11: Precondition – Network Display

The information on the toolbar displays the number of nodes and observations for which nodes are currently visible in the diagram. This will be therefore changed by zooming in.

When the mouse is clicked on a plot in the main Precondition window the observation is highlighted on the network display.

7.10 **Summary Report**

Each time the Precondition module is exited, or Auto-Precondition is executed, a Precondition Summary Report is generated. The latest report can be viewed by selecting *Report Module Chronological Reports | Precondition Summary*.

For Auto-Precondition all observations are in the report. For interactive Precondition only observations which have appeared in the plots will be included.

The precondition summary report gives the following information for each observation:

Observation number:	The zero based index number.
Observation name	
Number of observations:	The total number of data samples regardless of status flag.
Number of bad observations:	The number of data samples flagged as GATED or EDITED.
Maximum bad block:	The size, in data samples, of the largest contiguous block of data samples flagged as GATED or EDITED.
Min:	The minimum of all good or interpolated data samples.
Max:	The maximum of all good or interpolated data samples.
SD:	The standard deviation of all good or interpolated data samples.
Mean:	The mean of all good or interpolated data samples.
Nominal:	The nominal value.
Diff:	The mean minus the nominal.
Max Delta:	The maximum difference between any two consecutive good or interpolated data samples.

8   COMPASS BIAS ESTIMATE
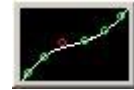
Streamer compass bias estimates can only be computed after the line has been preconditioned because only compass data deskewed to the shot event is used.

From the main menu select *Execute | Compass Bias Estimate* and select the line from the line list.
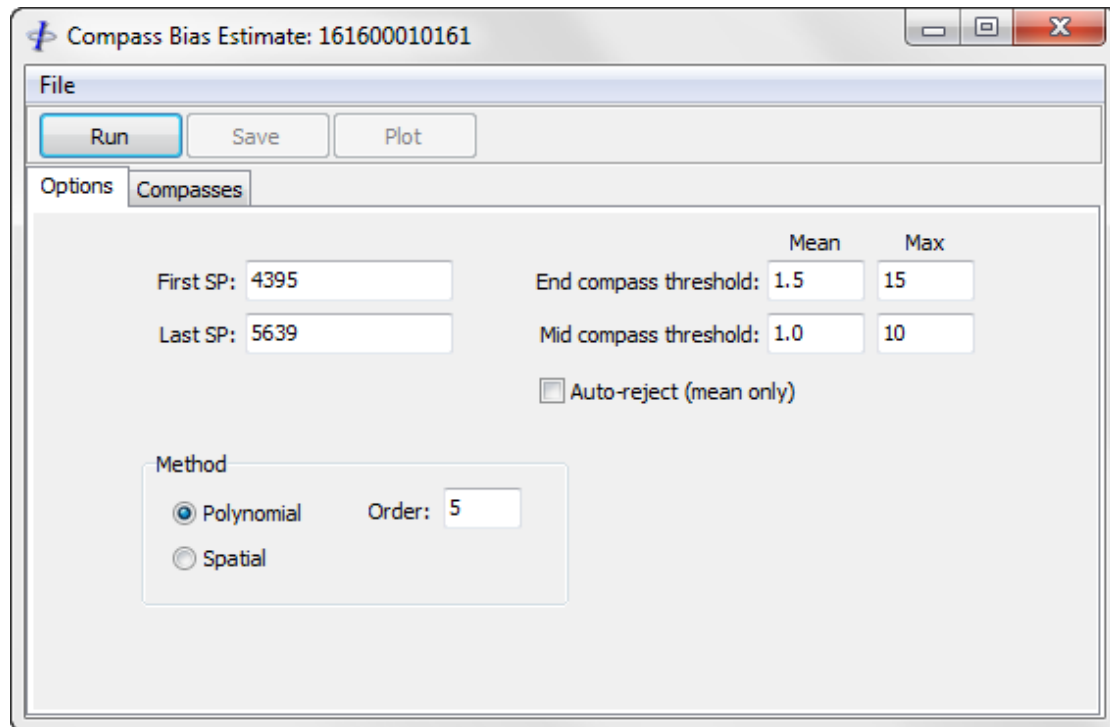

Figure 8-1: Compass Bias Estimate

8.1   Options

Referring to Figure 8-1, the options available are:

First/Last SP: The shotpoint range for which biases are to be computed. The default range is the first and last good shotpoint for the line shown in the project.

End compass thresholds: The thresholds for which the first and last compasses on a streamer whose absolute mean or maximum bias values respectively exceed will be highlighted in the report with an asterisk.

The default values are 1.5° and 15°. The mean value for Q Marine projects is increased to 5°.

Mid compass thresholds: The thresholds for which all except the first and last compasses on a streamer whose absolute mean or maximum bias values respectively exceed will be highlighted in the report with an asterisk.

The default values are 1° and 10°. The mean value for Q Marine projects is increased to 5°.

Auto-reject: Compass observations for which the mean computed bias exceeds the specified threshold will be automatically set as rejected and not used the network adjustment.

Refer section 8.3.1 for details.

Polynomial: Compute biases are computed by modelling the streamer shape with a least squares fit polynomial of the specified order. The bias is the actual value minus the modelled value.

Order: The order of polynomial to be used for the polynomial method. The default value is 5.

Spatial: Compute biases are based on the assumption that all compasses on a streamer should have the same value at any one geographical location. The bias is the actual value minus the mean of all compass values when passing through a fixed location.

P Cable Polynomial Order: Enter the polynomial order for P Cable compasses.
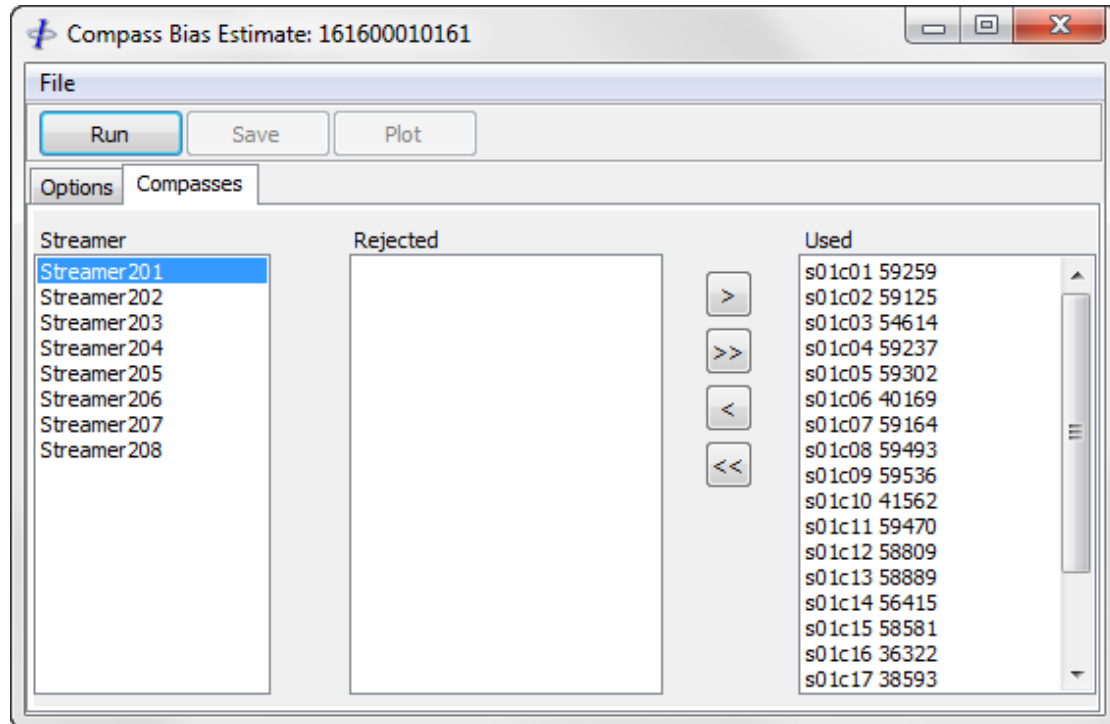
8.2   Compasses

Figure 8-2: Compass Bias Estimate – Compass List

Referring to Figure 8-2, the compasses used in the bias computation for each
streamer are all those which have not been manually rejected. Compasses can be
rejected or accepted by inclusion in the *Rejected* or *Use* lists respectively. If any
changes are made the *Save* button is enabled. Clicking on the *Save* button will save
the Use/Reject status of each compass as will apply in the network adjustment.

8.3   Execution

After setting the options as required click on the *Run* button. The computation runs in
the foreground and should not take more than a few seconds depending on the
amount of data and CPU speed. On completion the report is saved to a text file in the
database and displayed. For each compass the number of observations, mean bias,
maximum bias, minimum bias, standard deviation of biases and delta standard
deviation is given.

Delta standard deviation (DSD) is the standard deviation of the differences between
consecutive readings for a compass, and provides an estimate of noise.

An excerpt from a sample report is given below. In this example Compass S1C5 has
been flagged as exceeding the specified bias threshold.

```
Strmr  Compass Name                 N_Obs    Mean     Min     Max      SD    DSD
```

```
Line: 161600010161
Method: Polynomial order 5
Auto reject: off
Rejection criteria: end 1.5° mid 1°
Shot range: 4395 to 5639

1       1       s01c01 9606             1514    0.31    -0.01   0.79    0.02    0.006
1       2       s01c02 11468            1514    -0.13   -0.34   0.04    0.00    0.004
1       3       s01c03 17397            1514    -0.10   -0.47   0.26    0.02    0.002
1       4       s01c04 12637            1514    -0.21   -0.49   0.25    0.02    0.002
1       5       s01c05 12959            1514    1.03    -0.42   0.42    0.02    0.021 *
1       6       s01c06 20480            1514    -0.02   -0.32   0.24    0.01    0.001
```

Click on the *Plot* button to display time series plots of the computed compass biases.

8.3.1   Auto Reject

A biased compass will sometimes cause adjacent unbiased compasses to fail the test.

To deal with this situation, when the *Auto-reject* option is used, of all failed compasses on a streamer only the compass with the highest mean bias will initially be rejected. The computation for this streamer is then reiterated without the rejected compass until there are no more failures.

8.4   **Time Series Plots**

After the bias estimate has been run it is possible to view time series plots of the biases by clicking the *Plot* button. Refer to the *MultiPlot manual* for details of the plotting functions.

The time series plots can be useful in identifying compasses which may be biased for a part of the line, but whose mean bias for the whole line does not exceed the threshold. This situation may arise for example when a compass is ensnared by flotsam for a short period of time.

9   NETWORK ADJUSTMENT

To start the Network Adjustment module, click on the *Network Adjustment* button on the main toolbar.

9.1   Overview

The network adjustment can be computed only after the line has been preconditioned as only data de-skewed to the shot event is used. The adjustment method is the fully integrated weighted least squares method.

A network is a set of nodes selected from all available nodes in the database, joined by observations. Nodes with fixed offsets are joined by derived observations which are automatically computed. Different networks comprising a sub set of all the available nodes may be defined and saved.

On entering the Network Adjustment, the Network Display and the control panel are displayed.

The Network Display, when the module is started for the first time in a project, initially shows the whole network. The Network Display toolbar contains controls for defining and displaying networks

The control panel contains controls for the adjustment process and quality control.

9.2   Nodes

Each node's type and relation to its reference node determines how that node is used in the adjustment. These attributes are normally defined in the P2 header or automatically assigned by the program. If manual nodes have been created then it is the operator's responsibility to set them appropriately.

9.2.1   Node Types

The following are all the node types that may be present in a network.

VESSEL   Vessel reference point, from P2 header.

GUN   Centre of source, from P2 header.

STREAMER   Streamer reference point, centre of near receiver group, from P2 header.

NETWORK   General network node, e.g. acoustic transceiver, RGPS antenna, from P2 header.

COMPASS	Streamer compass, from P2 header.
BUOY	Towed buoy, excluding tailbuoys, from P2 header.
TAILBUOY	Towed buoy referenced to streamer, usually positioned independently from the streamer and used to compute streamer rotation and stretch, automatically assigned.
SATELLITE	Satellite antenna, e.g. DGPS, from P2 header.
ECHO	Echosounder transducer, from P2 header.
STATION	Fixed base station, e.g. Syledis, from P2 header.
ACOUSTIC PINGER	Acoustic pinger used in OBS cable positioning, automatically assigned.
COMPASS / DEPTH SENSOR	Combined streamer compass and depth sensor, automatically assigned.
GUN	Individual gun.
OBN RECEIVER	Ocean bottom node.

9.2.2 Node Relations

The following are the types of relation that relate a node to its reference node.

FIXED	The node is considered to be rigidly fixed to its reference node and observations will be automatically derived from its X and Y offsets.
FREE	The node is positioned by its observations and its offsets are used only to calculate its initial estimated position.
STREAMER	The node is attached to a streamer at a fixed offset from the streamer reference point given by its Yoffset which is used to derive range observations and, if streamer compasses are present, bearing observations.

9.3 **Networks**

When the Network Adjustment module is started for the first time in a project, the network comprising all defined nodes of the types listed in section 9.2.1 is displayed. and is automatically saved as "Whole".

If the Network Adjustment parameters have been previously saved with a network configuration then that configuration will be automatically loaded each time the Network Adjustment is started.

To load a previously defined network select *Network | Load Network* from the control panel menu, and select the network configuration file.
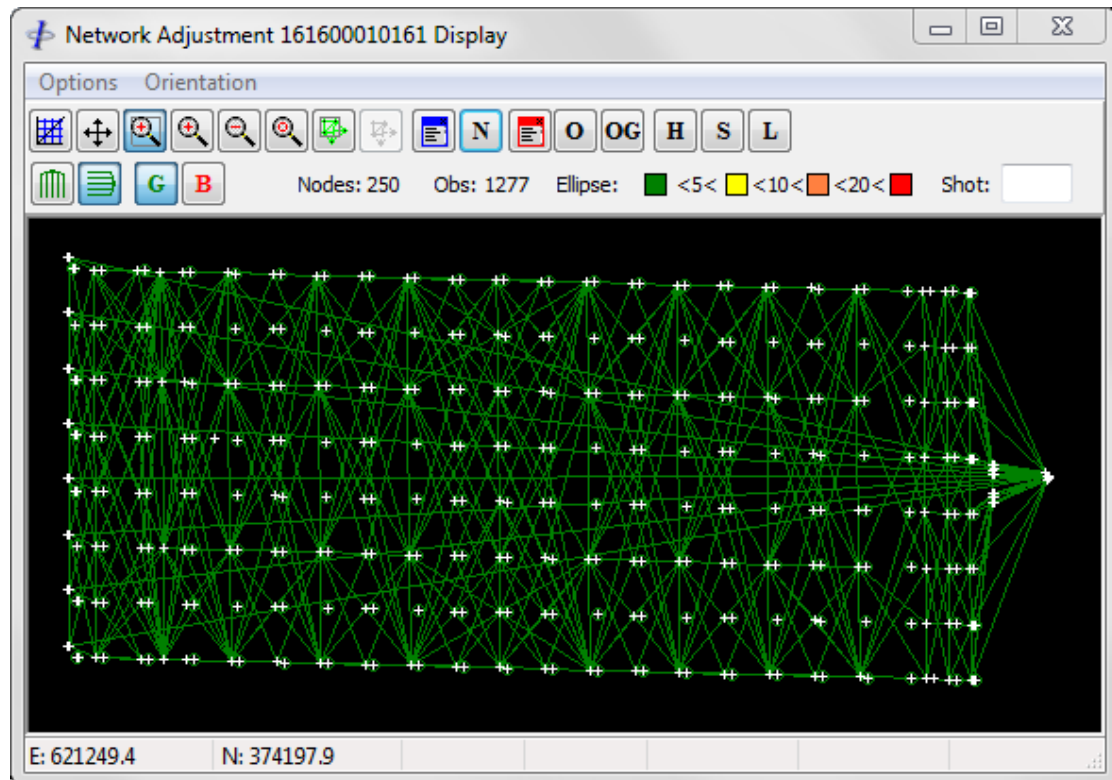
9.3.1   Network Display

Figure 9-1: Network Adjustment – Network Display

Refer to sections 6.1 and 6.2 for descriptions of the common Network Display toolbar and menu functions. Functions specific to the Network Adjustment module are described below.

9.3.1.1   Menu

Orientation:

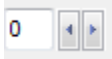|	
Automatic:	Network orientation is automatically calculated according to the orientation toolbar buttons.
Manual:	Network orientation can be manually set using the toolbar controls.
Median Node Position:	Only available when orientation is set to *Automatic*. Uses the median node position to calculate orientation on a shot-by-shot basis.
CMG:	Only available when orientation is set to *Automatic*. Uses the vessel course made good to calculate orientation on a shot-by-shot basis.

9.3.1.2   Toolbar

	Only available when orientation is set to *Automatic*. Network is oriented up when depressed.
	Only available when orientation is set to *Automatic*. Network is oriented right when depressed.
	Only available when orientation is set to *Manual*. Enter the desired orientation in degrees or use the scroll buttons.

Ellipse Toolbar:	Click on the ellipse colours to change the colour.

9.3.2   Creating Networks

A sub-network can be defined by one of the following methods:

- Clicking the *Select Nodes* button then using the mouse to select nodes.by drawing a rectangle around the nodes.
- Clicking the *Node List* button and selecting nodes in the list.

Use the *Invert Selection* button in the *Node* List window to invert the selected nodes if it is required to exclude the selection.

Use the appropriate arrow buttons in the *Node List* window to change the network configuration. Nodes in the *Nodes Available* list will not be included in the network configuration. Nodes in the *Nodes Used* list will be included in the configuration. The display is automatically updated each time the nodes in the *Nodes Used* list change. Click on *OK* to implement the configuration, or *Cancel* to revert to the previously displayed network.
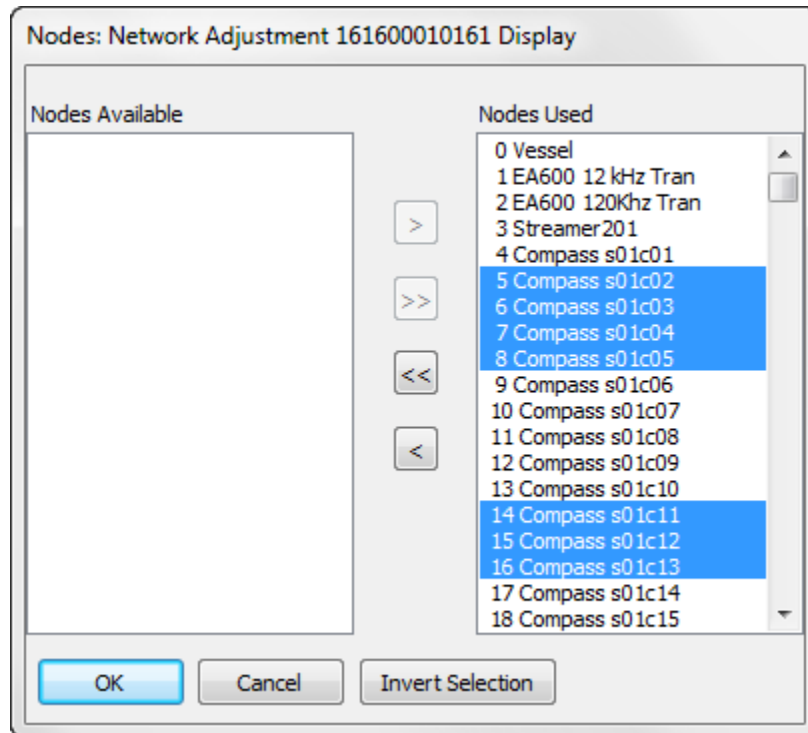
Figure 9-2: Network Adjustment – Editing Network

Note: *Nodes not included in the network will not have coordinates output. Nodes for which coordinates are required for output to P1, e.g. echosounder, must be included in the network even if they are not required for a successful adjustment.*

Once a network has been defined save it by selecting *Network | Save Network* from the control panel menu, and enter an appropriate name.

9.3.3 Redundant Nodes

Networks, defined initially by the P2 header, often comprise nodes which are superfluous to requirements, i.e. nodes which are located in the same horizontal position as another node (co-located node). These are known as redundant nodes. The presence of redundant nodes unnecessarily increases the computational burden during adjustment, sometimes significantly. The time taken to adjust one shot is exponentially proportional to the number of nodes in the network.

A redundant node may be manually dispensed with by re-referencing any observations to or from it to its co-located node, and then excluding it from the network.

This can be automatically achieved by checking the *Exclude Co-located Nodes* checkbox in the *Network* page of the control panel.

Redundant nodes' coordinates and QC statistics will be inherited from their co-located node which is included in the network.

A list of redundant nodes and the resultant referenced observations are written to the log.

9.3.4   Vessel-only Networks

The situation sometimes arises when a full network has already been computed and changes are subsequently made to the absolute positioning. Such changes may include:

- Re-processing of DGPS or radio-navigation data
- Excluding or including individual systems
- Excluding or including radio-navigation ranges
- Small changes to the datum and/or projection data (see warning below)

Because all computed nodes positions in the network are vessel-relative it is necessary only to re-adjust the vessel and DGPS and/or radio-navigation nodes.

When this is done, in order to preserve the whole network statistics (unit variance, degrees of freedom and number of iterations), the *Output | Adjustment Statistics* checkbox should be unchecked.

Warning: *If significant changes are made to the datum or projection e.g. change of datum and/or projection, then a full re-adjustment is required because of potential significant changes to the grid scale factor and convergence.*

9.3.5   OBS Acoustic Networks

When adjusting the network to compute acoustic pinger positions the network will be automatically configured if the project acquisition system is set to one of the OBS RECEIVER types. The resultant network contains only the nodes necessary to compute the pinger position.

9.3.6   ROV Networks

When adjusting the network to compute ROV arm positions the network will be automatically configured if the project acquisition system is set to GATOR ROV.

To automatically configure the ROV network too use only the USBL solution, select from the menu Network | ROV | USB Only.

To automatically configure the ROV network too use only the Inertial Navigation System (INS) solution, select from the menu Network | ROV | INS Only.

To use both USBL and INS solutions ensure that both these options are unchecked.

9.4   **Streamer Rotation and Stretch**

SeisPos provides the option to compute rotation and stretch for each streamer. By default the option is switched on. The computed values are the least squares estimates.

In order to be able to compute streamer rotation for a streamer the following conditions must be satisfied for each shotpoint:

1. For each streamer the streamer reference node, type STREAMER, must be included in the network.
2. At least one node of type _TAILBUOY_ must exist in the network.
3. The tailbuoy must have observations available to position it independently from the streamer, i.e. GPS, RGPS or radio-navigation.
4. At least one observation tying the streamer to the tailbuoy must exist. The observation(s) do not have to be directly from the streamer to the tailbuoy but can be indirect e.g. if streamer 1 has no tailbuoy an acoustic range from streamer 1 to streamer 2 and then from streamer 2 to tailbuoy 2 will suffice to enable streamer 1 rotation to be uniquely computed.
5. At least one observation of type _MAGNETIC BEARING_ must exist on the streamer.

In order to be able to compute streamer stretch for a streamer the above conditions 1 to 4 must be satisfied.

The computed values for rotation will depend, amongst other factors, on the value(s) for magnetic variation used. A mean value significantly different from 0 is usually indicative of incorrect magnetic variation which should then be corrected in the database prior to re-adjusting the network by adding the mean streamer rotation value to the magnetic variation in the database.

The computed values for stretch will depend, amongst other factors, on the defined offsets of the tailbuoy nodes and acoustic nodes on the streamer. If the latter have already been adjusted to account for stretch then it is possible for stretch to be computed as a negative value.

Two stretch models are supported:

Linear – all parts of the streamer are considered to stretch by the same amount.

Inverse square – the amount by which the streamer stretches is considered to decrease with distance from the front of the streamer and is in proportion to the inverse square of the distance from the front of the streamer.

9.5   Magnetic Variation

9.5.1   Using Database Values

Magnetic variation is taken from the value(s) stored in the database. If more than one magnetic variation station has been defined then the value for magnetic variation at each vessel position is computed from all stations using the inverse square method.

9.5.2   Using a Magnetic Model

The *Options* page of the control panel provides the option to compute magnetic variation on a shot-by-shot basis using a choice of IGRF or WMM model. Before this option can be used the magnetic model database must be downloaded and installed, and the path to the installed files set in *SeisPos Main Menu | Tools | Options*.

9.6   Streamers without Compasses

If the streamers do not have compasses, which may be the case where a full lattice of acoustic observations are defined along the full length of the streamers, then only those streamer nodes to/from which observations are defined may be included in the network.

The *Solve Rotation* and *Solve Stretch* checkboxes should be unchecked.

A Compass-less solution may also be achieved by removing all streamer compass nodes from the network.

9.7   Streamer Shaping

If streamer compasses are present then these are used to define a series of circular arcs along each streamer. These arcs are then used in the P1 output stage to compute the receiver group positions.

If no streamer compasses are present then each streamer will be modelled using a polynomial. The polynomial coefficients will be used in the P1 output stage to compute the receiver group positions. Refer to section 11.4.2.

9.8   Running the Network Adjustment

Optionally select the network node configuration as described above. Optionally change the options, described below. The default values should be applicable to most networks of average data quality.

Start the adjustment by clicking on either the *Start* button or the *Step* button. Using the *Step* button will compute the adjustment for one shotpoint only and the process will be paused until the *Start* button or *Step* button is clicked. If stepping through the adjustment clicking on the *Resume* button will resume continuous execution.

To pause the adjustment click on the *Pause* button. The current shot will be

computed after which execution will be suspended until the *Resume* button or *Step* button is clicked.

To stop the adjustment click on the *Stop* button. The process will continue until the current shot has computed. If this is taking a long time e.g. due to a large divergent network or excessive rejections, then clicking the *Stop* button a second time will cause the adjustment to stop immediately.

As each shotpoint is computed, all the adjustment output data is immediately written to file. The data files are overwritten only for the shotpoints computed, with the result that any part of a line can be adjusted without affecting previously stored data for the other parts of the line. The adjustment can be stopped at any time without loss of data. Summary report files are written at the end of each adjustment using an incremental file naming system so that previous reports are not overwritten.

Whilst the adjustment is running, the current shotpoint and the estimated time of completion are shown in the control panel toolbar.

9.8.1   Batch Processing

Multiple lines may be selected for adjustment. From the menu select *File | Select Lines.*

When Batch Processing is implemented, the first and last shotpoints for each line is automatically set as the first and last good shotpoints as specified in the Project.

To stop Batch Processing, from the menu select *File | Stop Batch Adjustment.*

When Batch Processing completes, a summary is displayed providing the first and last shotpoints successfully adjusted, and the adjustment status: *Complete* or *Incomplete.*

9.8.2   Log

Each time an adjustment is started a new Log window will open in the SeisPos main window. A sample log is shown in Figure 9-3. The same information is appended to the Log file for the line.
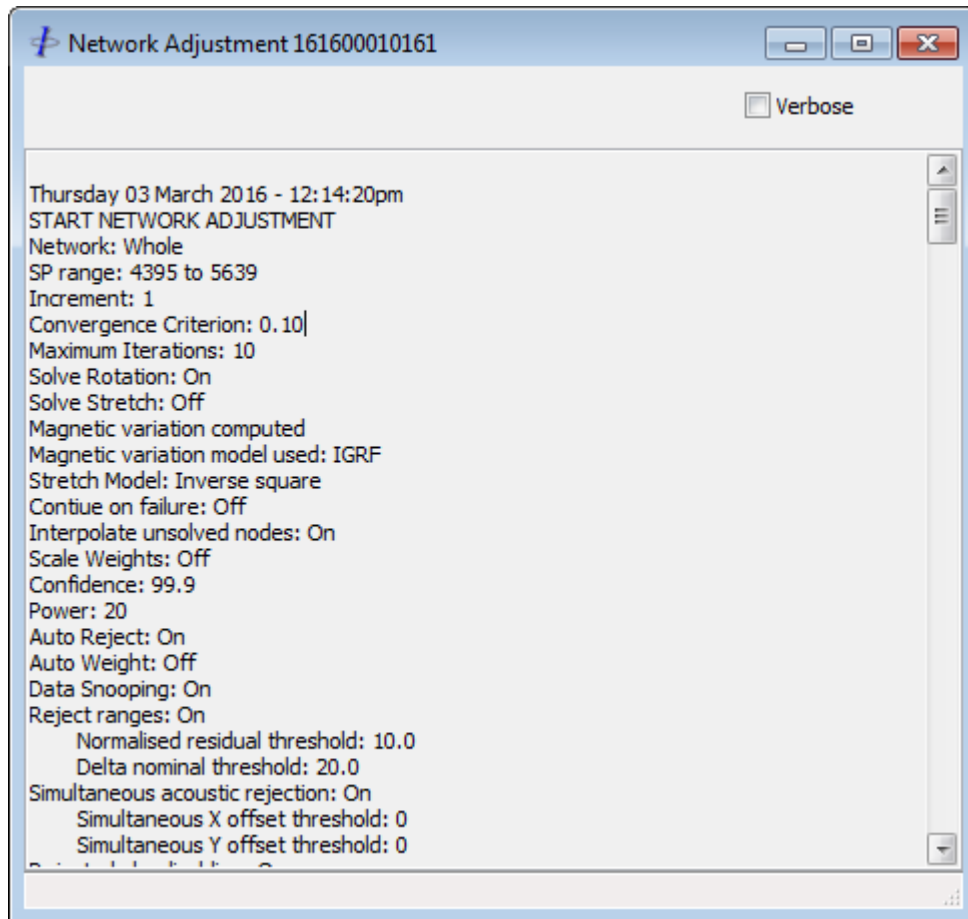
Figure 9-3: Network Adjustment – Log

Most of the information written to the log is self-explanatory; the following are explained for clarity:

REJ:	If Auto-Reject is switched on, the number and name of an observation which has been rejected, followed by its normalised residual.
Max dX:	The maximum movement of any node from the previous iteration. The value is followed by the name of the node to which it applies.
MaxW:	The maximum normalised residual from all observations used. The value is followed by the number and name of the observation to which it applies.
Max error ellipse:	The semi-major axis of the 95% probability error ellipse for the least precise node in the network.

Magnetic Variation: If more than one magnetic variation station has been defined
then the computed value for each vessel position will be
logged.

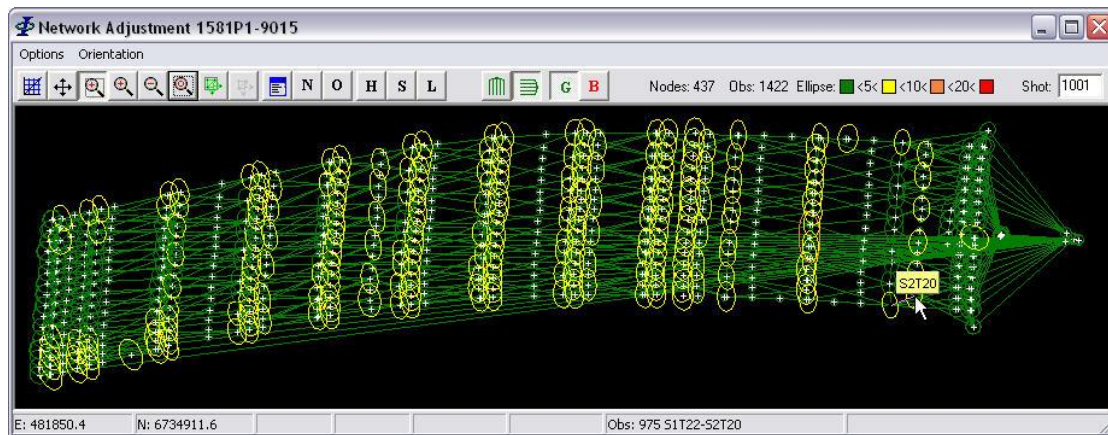### 9.8.3 Network Display

Figure 9-4: Network Adjustment – Network Display

The network updates after each shotpoint has been computed. The content of the
display depends on the Plotting Options selected (see below).

Error ellipses, if enabled, are displayed for each network node and are for the 95%
probability level. The ellipses are colour coded according to the value of the semi-
major axis. The colours can be changed by clicking on the relevant colour code in the
key in the Network display toolbar.

Observations used are shown in green, and those auto-rejected, or with missing data
in red. Observations not used, or manually rejected are not shown.

Node positions are displayed true to scale which depends on the aspect ratio of the
Network display window.

The Easting and Northing of the mouse cursor in metres position is displayed in the
status bar below the network display.

All other common Network display functions are described in section 6. Network
display.

9.8.3.1 Orientation

Two orientation options are selectable form the menu:

Automatic: Toggle the orientation buttons in the toolbar to orient up or right.
Manual: Enter the orientation rotation field in the toolbar, or hold down the left or

right arrow key until the desired orientation is obtained.

9.8.3.2 Display Node or Observation Statistics

If the *Node Stats* or *Obs Stats* page, or the *Time Series* page is open then clicking on a node or observation in the Network display will display the statistics for that node or observation. Repeated clicks will scroll through nodes or observations that are close together.

9.9 **Parameters**

This section describes the adjustment parameters available and also the node and observation statistical displays. The internally specified default values apply when the Network Adjustment module is used for the first time in a project and should be applicable for most situations.

To save the parameters and the current node configuration file if one has been saved, select *File | Save Parameter Set* from the menu. Subsequent adjustments will then default to these parameters and the current network configuration. The *Output* parameters are not saved and all outputs are enabled by default.

Note: *If Automatic Processing is to be carried out on subsequent lines save the node configuration by selecting Network | Save Network from the menu and then save the parameters. The saved network configuration and adjustment parameters will then be used for automatic processing.*
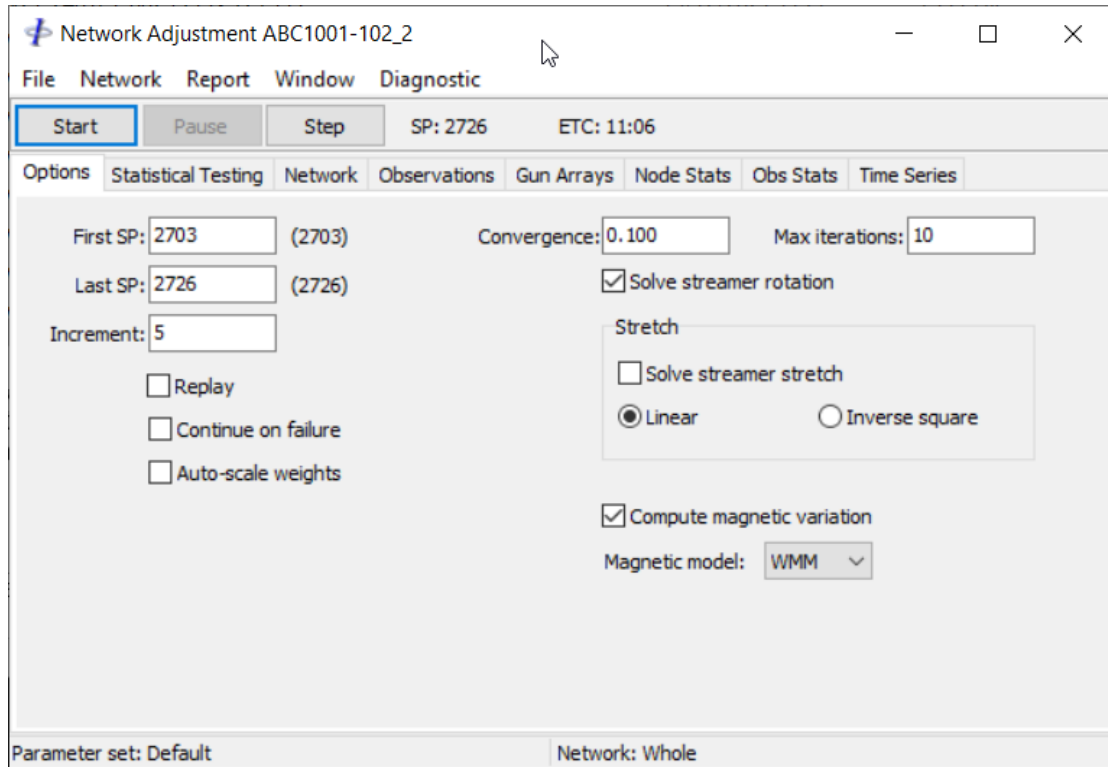
9.9.1   Options

Figure 9-5: Network Adjustment – General Options

First/Last SP: The shotpoint range for which adjustment is to be computed. The default range is that of the first and last good shotpoint shown in the project details for the line. If the first shotpoint specified is chronologically after the last shotpoint then the increment (see below) will be set negative and the line will be adjusted in reverse.

Increment: Optionally set the SP increment. Skipped shots will be interpolated. The default value is 1/-1.

Convergence: The maximum movement in the east or north directions, in metres, of all nodes between iterations below which convergence is deemed to have been achieved. The default value is 0.1m.

Max Iterations: The number of iterations for any one shotpoint beyond which the adjustment will be aborted. The default value is 10.

Replay: Replays the network adjustment for the shot range specified, displaying the network and all selected time series plots.

Continue on failure: When checked, if a node cannot be solved, the adjustment will be recomputed without that node, for up to 10 node failures. If the shot still cannot be solved then the adjustment will continue from next shot on failure, and an unsolved shot report, including unsolved nodes, will appear on completion of the adjustment.

Auto-Scale Weights: If checked, all observation standard deviations will be scaled in order to achieve a variance factor close to unity. The default is off.

Solve Streamer Rotation: If checked, rotation will be solved by method of least squares for each streamer providing the necessary observations exist.

Solve Streamer Stretch: If checked, stretch will be solved by method of least squares for each streamer providing the necessary observations exist.

Linear: Stretch is distributed equally along the streamer.

Inverse square: Stretch is distributed as a function of the inverse of the square of the distance of the node from the streamer reference point (centre near group). I.e. stretch is assumed to be greater towards the front of the streamer.

Compute Magnetic Variation: If checked, magnetic variation corresponding to the vessel position will be computed and applied from the specified magnetic model. The database values for magnetic variation are not used.

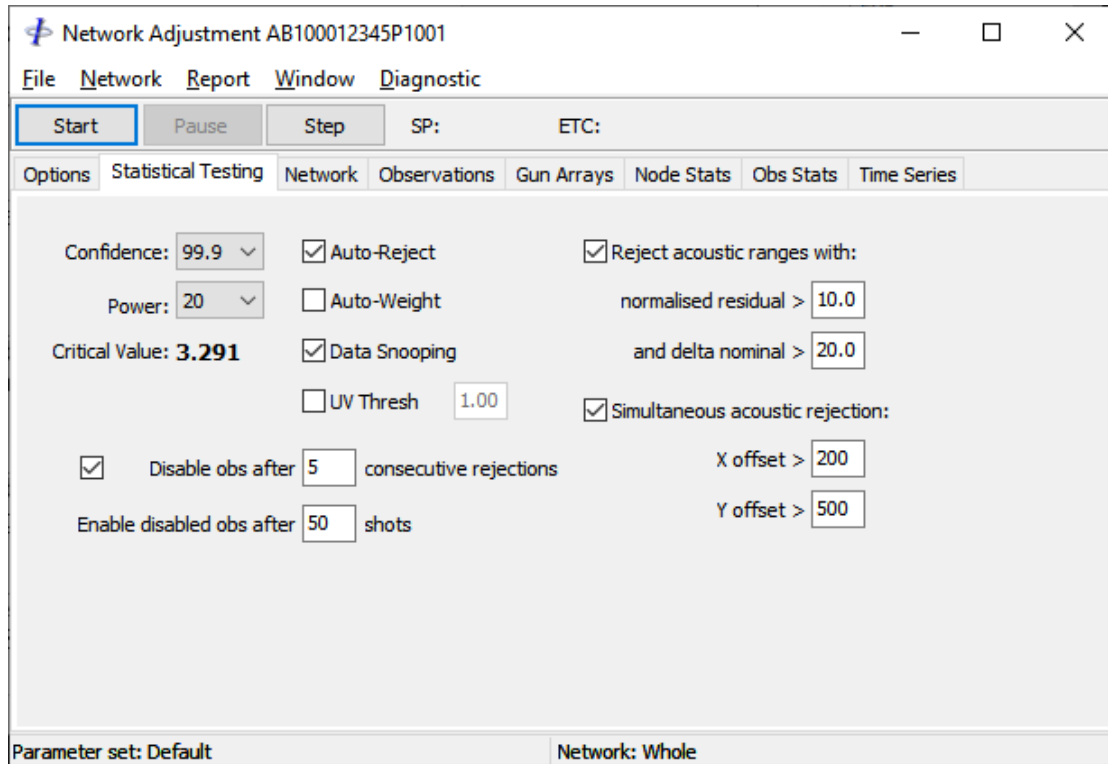*Magnetic Model:*   Select from IGRF or WMM.

9.9.2 Statistical Testing

Figure 9-6: Network Adjustment – Statistical Testing Options

Confidence: $100 - \alpha$ where α is the percentage probability of rejecting a good observation. The default value is 99.9.

Power: The percentage probability that errors the size of the reported marginally detectable errors will be accepted. The default value is 20.

Critical Value: A function of confidence, the normalised residual above which an observation will be rejected or down weighted if auto-rejection or auto-weighting is implemented.

Auto-Reject: If checked, auto-rejection will be implemented and auto-weighting turned off. The default is on. Setting an observation's SD to fixed will prevent it from being rejected.

Auto-Weight: If checked, auto-weighting will be implemented and auto-rejection turned off. Setting an observation's SD to fixed will prevent it from being down weighted.

Data Snooping: If unchecked, auto-rejection or auto-weighting will be applied to all observations whose normalised residual exceeds the critical value. If checked, the Baarda method is implemented – observations will be rejected/down weighted one by one until there are none whose normalised residual exceed the critical value. The default is on.

UV: If checked, rejection/down weighting will be applied only if the unit variance exceeds the specified *threshold*.

Threshold: See above.

Disable obs: If checked, the number of consecutive auto-rejections after which an observation will be disabled.

Enable obs: The number of shots after which a disabled observation will be re-enabled.

Reject acoustic ranges: Allows for simultaneous rejection of acoustic ranges which pass the specified criteria. This is a time saving measure for use with very large datasets.

Simultaneous acoustic. rejection: Allows for simultaneous rejection of acoustic ranges which are not correlated i.e. are far apart in the network. The values specified are the minimum inline and crossline distance between the centres of the ranges before they can be simultaneously rejected. This is a time saving measure for use with very large datasets.
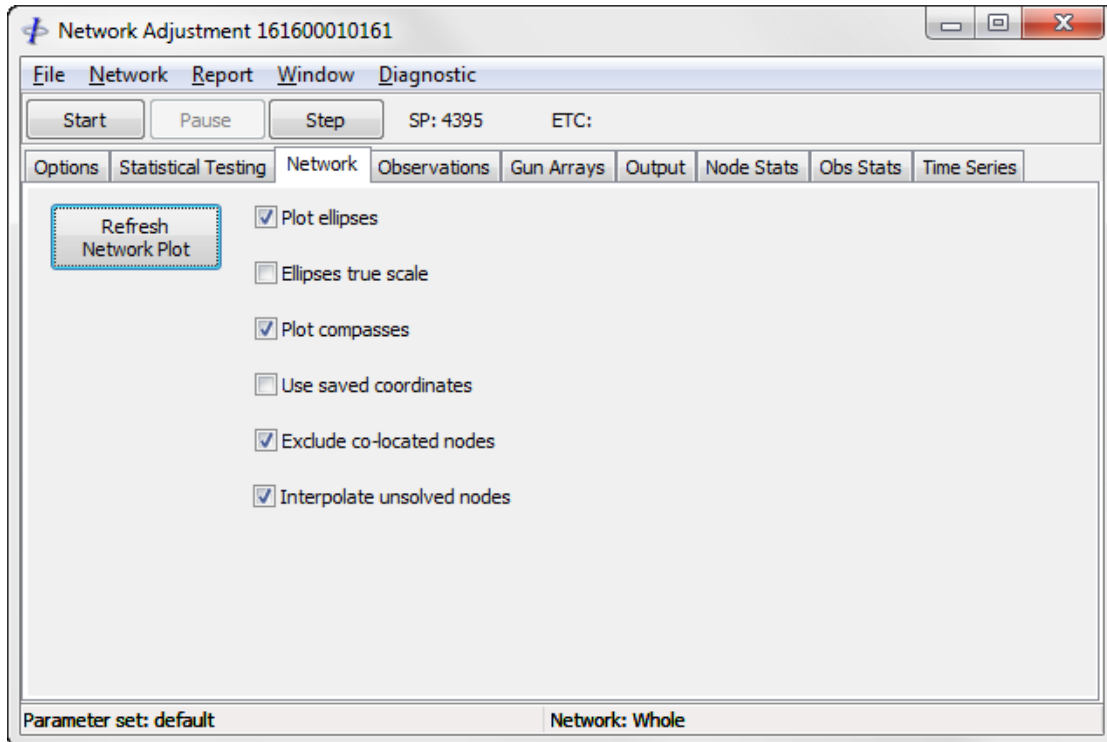
9.9.3 Network

Figure 9-7: Network Adjustment – Network Options

Refresh Network Plot:	Re-draws the network display.
Plot Ellipses:	If checked, error ellipses will be displayed on the network display. The default is on.
Ellipses True Scale:	When checked error ellipses will be plotted true to scale. The default is off.
Plot Compasses:	If checked, streamer compasses will be displayed on the network display. The default is on.
Use Saved Coordinates:	If checked the adjustment uses for the initial estimate node coordinates computed in a previous adjustment.
Exclude Co-located Nodes:	Removes redundant nodes from the network (see section 9.3.3).

Interpolate   Node which cannot be solved are interpolated for up to a
Unsolved   maximum of 10 consecutive shotpoints. A maximum of five
Nodes: nodes can be interpolated at any time.
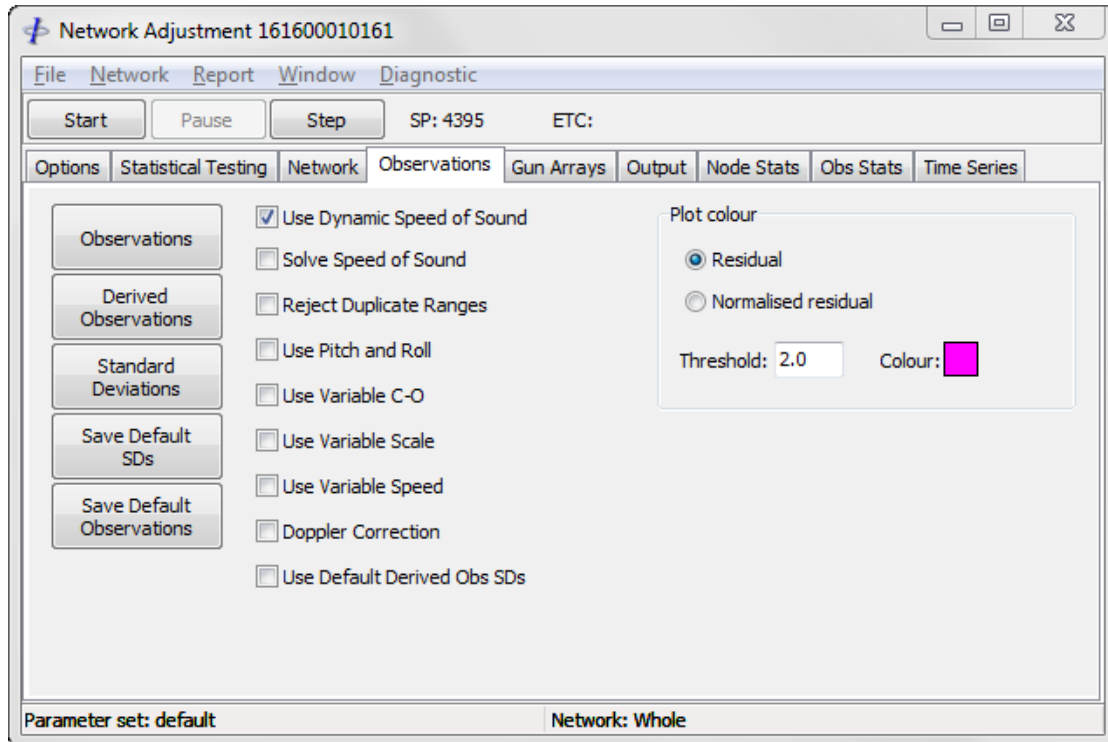
9.9.4   Observations

Figure 9-8: Network Adjustment – Observation Options

9.9.4.1   Defined Observations

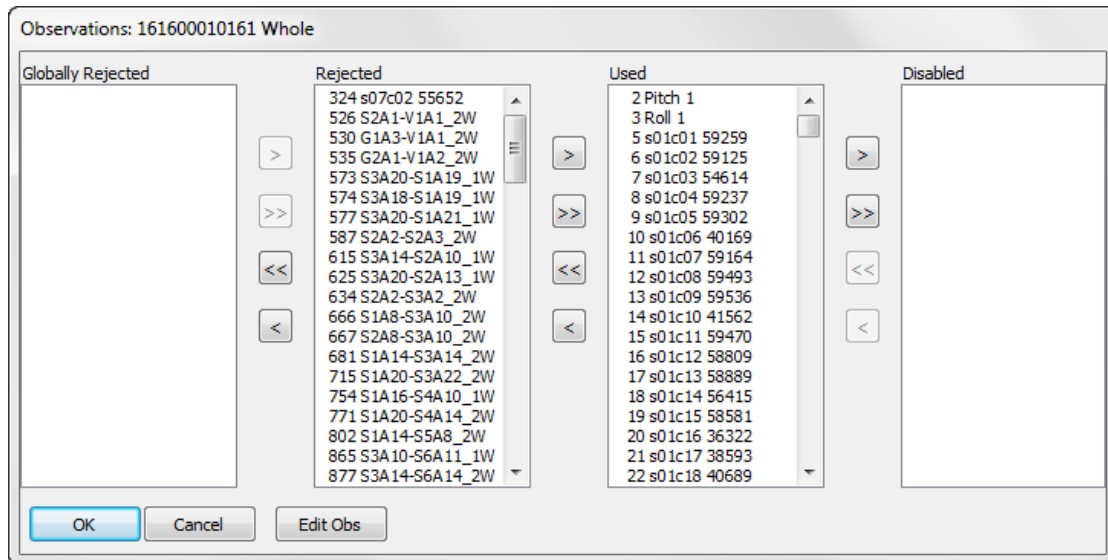Click on the *Observations* button to display the list of observations defied in the database as shown in Figure 9-9.

Figure 9-9: Network Adjustment – Observation List

Only the observations whose nodes are included in the current network appear in the lists. The *Used* and *Disabled* lists contain all observations which have not been manually rejected in any other SeisPos module.

To include observations which have been previously rejected, move them to the *Used* list.

To reject observations for the current line only move them to the *Rejected* list.

To reject observations for all lines subsequently input into the project, move them to the *Globally Rejected* list.

The *Disabled* list contains observations which have been temporarily disabled during the adjustment (see section 9.9.2). This list is updated each time the *Observations* button is clicked.

When moving observations from one list to another these observations remain highlighted so that they can be moved again without having to be re-selected.

By clicking on the *OK* button the use status is applied to the adjustment and saved to the database. Clicking the *Cancel* button will close the window without making any changes. Observations' use status can be set with or without the adjustment in progress and are effective from the next shotpoint to be computed.

9.9.4.2   Observation Dialog

Click the *Edit Obs* button to display the Observation Dialog as shown in Figure 9-10.

Changes made to the observation attributes will be saved to the database when the *Save Button* is clicked.

Figure 9-10: Network Adjustment – Observation Dialog

9.9.4.3   Manual Observations from Compass

If manual observations sourced from recorded streamer compass observations are present, and there is no data from the source, then the manual observation will automatically switch to using the next or previous compass observation on the same streamer, and a warning will be logged.

9.9.4.4   Derived Observations

Click on the *Derived Observations* button to display the derived observation list as shown in Figure 9-11.

Right click on this window to display a popup menu for options to copy all to the clipboard, and to search the table.

Derived observations are automatically created. Apart from this, they are used in the same way in the adjustment as defined observations, with the exception that they cannot be rejected.

The values and standard deviations of derived observations are automatically assigned. To change a value enter the new value and click on the *OK* button. Changing the standard deviation of an observation also disables auto-weighting of that observation if auto-weighting is implemented.

When the *OK* button is clicked, changes to derived observation SDs are saved to the database for that line only, and will automatically be applied for subsequent adjustments of that line.

When the *Save Default* button is clicked the changes will be saved and applied to all future network adjustments of any line in the database when the *Use Default Derived Obs SDs* checkbox is checked.

Obs No.	Type	At node	To node	Value (m/°)	SD (m/°)	Streamer
125	Y	545 TB7	746 S7A15	6.80	0.07	
126	X	546 TB8	770 tb8	0.00	0.10	
127	Y	546 TB8	770 tb8	0.00	0.10	
128	X	546 TB8	771 TB8R1	0.00	0.10	
129	Y	546 TB8	771 TB8R1	0.00	0.10	
130	X	546 TB8	772 TB8R2	0.00	0.10	
131	Y	546 TB8	772 TB8R2	0.00	0.10	
132	X	546 TB8	773 S8A23	0.00	0.68	
133	Y	546 TB8	773 S8A23	6.80	0.07	
134	RANGE	3 Streamer201	590 S1	0.01	0.01	1
135	MAG BEARING	3 Streamer201	590 S1	0.00	0.00	1
136	RANGE	590 S1	591 S1A1	17.20	0.41	1
137	MAG BEARING	590 S1	591 S1A1	0.00	0.00	1
138	RANGE	591 S1A1	592 S1A2	150.00	1.22	1
139	MAG BEARING	591 S1A1	592 S1A2	0.00	0.00	1
140	RANGE	592 S1A2	556 S1WS1	100.20	1.00	1
141	MAG BEARING	592 S1A2	556 S1WS1	0.00	0.00	1

OK   Cancel   Save Default

Figure 9-11: Network Adjustment – Derived Observations

There are 4 types of derived observations:
X: Distance, computed from nominal offsets, along the X-axis of the local coordinate frame from the *At Node* to the *To Node* located on the same vessel, buoy or gun array. The observation values are constant.

Y: Distance, computed from nominal offsets, along the Y-axis of the local coordinate frame from the *At Node* to the *To Node* located on the same vessel, buoy or gun array. The observation values are constant.

RANGE: Chord distance, computed from nominal offsets, from the *At Node* to the *To Node*. The observation values vary as a function of streamer shape. The standard deviations are proportional to the observation values.

MAG BEARING: Magnetic bearing, computed from streamer compass data shot-by-shot, from the *At Node* to the *To Node*. The standard deviations are computed from the individual compass standard deviations.

X/Y observations and *RANGE/MAG BEARING* observations are always in pairs between the same pair of nodes.

X/Y observations will be created between all pairs of nodes which have a *FIXED* relation.

RANGE/MAG BEARING observations will be created between adjacent nodes on the same streamer which are of type *STREAMER*, *NETWORK* or *BUOY* and have a relation *STREAMER*.

In the case of streamers without compasses, MAG BEARING observations will not be created.

9.9.4.5   A Priori Standard Deviations

Click on the *Standard Deviations* button to display the standard deviations list as shown in Figure 9-12.

Figure 9-12: Network Adjustment – A Priori Standard Deviations

The units of standard deviation for angles and bearings can be displayed in radians or degrees. The units for all other types of observations are displayed in the same units as the observation. To change the standard deviation of observations, select the observations in the list, type in the new value in the *SD* edit box, and click on *Apply* or press *<Enter>*.

The *SD* field supports single operation basic arithmetic functions. For example, to calculate the SD of a tailbuoy bearing for a range of 5000m and a standard error of 2m, set the units to radians and enter *2/5000*.

To disable or enable auto-rejections or auto-weighting of observations, select the observations in the list and click on the *Fixed* (disable) or *Variable* (enable) button.

The use status of observations can be changed by selecting the observations and clicking the *Use*, *Reject* or *Global Reject* button.

The list may be sorted according to any of the attributes shown by clicking on the column header. This is useful when wanting to apply the same SD to all observations in a group.

Click on the *OK* button to submit all changes and close the window, or the *Cancel* button to close the window without any changes. Changes can be made with or without the adjustment in progress and are effective immediately. However, if changes are made to the observation use status then it is advised to pause the adjustment and wait until the current shot has finished being computed before

clicking the *OK* button.

To save the current standard deviations to the default observation file click on the *Save Default SDs* button. If the default file does not exist it will be created with the current observation attributes. Refer to section 5.5.4 for details of default observations.

9.9.4.6 Speed of Sound for Acoustic Observations

Data from velocimeters can be recorded in user defined records in the P2/9x raw data file. SeisPos attempts to recognise this data based on the observation name. If found, the observation is designated type SPEED OF SOUND with units METRES/SEC.

If the *Dynamic Speed of Sound* checkbox is checked then the nearest SPEED OF SOUND observation will be used to apply to observations of type RANGE and units MILLISECONDS. If dynamic speed of sound data is absent or gated for a shotpoint then the observation speed as defined in the database for each observation will be used.

As an alternative, the speed of sound for acoustics can be computed in the least squares process by checking the *Solve Speed of* Sound checkbox. This is only advisable for fully braced acoustic networks, and is recommended for Q Marine datasets for which, at the tie of writing, no velocimeter data is usually present. When this option is used, the computed speed of sound is logged and its time series plot can be viewed in the *QC* module and the network adjustment time series.

9.9.4.7 Duplicate Ranges

By checking the checkbox *Reject Duplicate Ranges,* for each shotpoint all RANGE type observations are checked for duplicates and any duplicates found are not used for that shotpoint.

A *duplicate range* is defined as a RANGE type observation for which a *previous* RANGE type observation between the same two nodes has been found, is flagged for use and has "good" data i.e. valid data output by the Precondition module.

The first range between any two nodes is never rejected as a duplicate. Therefore, in the case of acoustic networks when 2-way observations are defined before their corresponding 1-way observations, the 1-way observations will only be used in the absence of a 2-way observation with "good" data.

Note: *The software does not detect 2-way or 1-way acoustic observations. It is the operator's responsibility to verify that the 2-way observations are defined before 1-way observations in the configuration.*

When a range for which duplicates exist is auto-rejected during the adjustment, *all* duplicate ranges for that range are enabled for the next iteration. These are then treated in the usual manner, i.e. it is possible that some or all of these may also be

subsequently auto-rejected.

9.9.4.8 Pitch and Roll

If pitch and roll observations are present then checking the *Use Pitch and Roll* checkbox will enable the pitch and roll measurements to be applied to all GPS antennas, i.e. nodes of type SATELLITE, which are located on the same vessel as the pitch and roll observations. If more than one pitch or roll observation is available for a particular vessel then the average value is used.

9.9.4.9 Variable C-O, Scale and Speed

The checkboxes corresponding to variable C-O, scale and speed refers to data which has been recorded in the E54 and T54 records (P2/9x) or T2,5,4,1 records (P2/11). Leave the respective checkboxes unchecked to prevent the data from being used.

9.9.4.10 Doppler Correction

When checked, acoustic ranges will be corrected for Doppler according to the direction of travel of the transmitted signal, its speed of propagation and the speed of the vessel computed from the last two shots (or the first two in the case of the first shotpoint).

9.9.4.11 Observation Highlighting

Observations in the network display during the adjustment can be highlighted according to their residual or normalised residual by specifying the appropriate settings under the *Plot Colour* group.
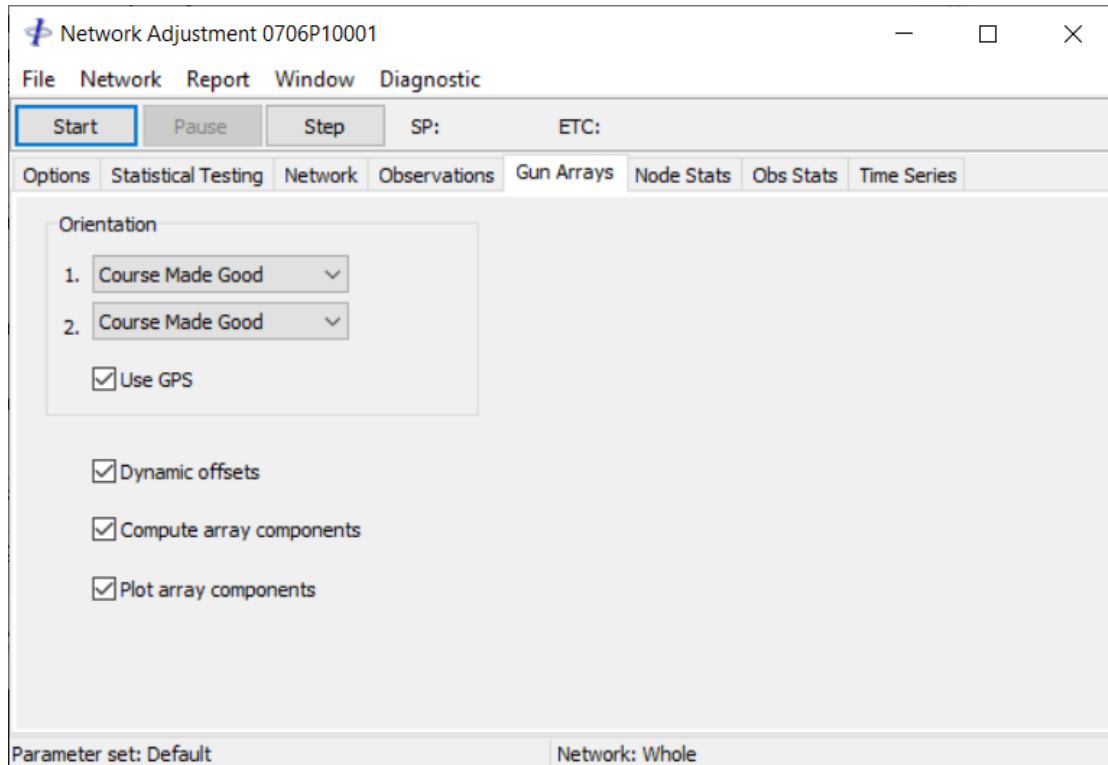
9.9.5   Gun Arrays

Figure 9-13: Network Adjustment - Gun Array Options

The *Orientation* group is used to specify the CRS orientation used to rotate the *X* and *Y* derived observations from sensors on the gun floats to the source centre. Two different observations may be selected from the following, and the average of the two is used. The default when streamers are present is *Mean Near* Compass and when no streamers are present is *Course Made Good*. RGPS may be used in place of this selection.

Course Made Good:	The course made good of the *VESSEL* node computed for the last shot.
Mean Gyro:	The mean of all gyrocompasses enabled.
Mean Near Compass:	The mean of the nearest good compass on each streamer.
Use RGPS:	If checked then any gun float with two or more RGPS targets at least 3m apart will result in the computed azimuth between the RGPS targets being used for that gun-array's orientation. This overrides the above selection. If there are insufficient RGPS data for any shotpoint then the orientation will revert to the above selection for that shotpoint.

9.9.5.1   Dynamic Offsets

Nodes which are referenced to the gun-array node have X and Y derived observations to tie them to the gun-array node. When the *Dynamic Offsets* checkbox is not checked then the value of these observations are the offset values.

When *Dynamic Offsets* is checked, then if RGPS observations are available on the gun floats the values of these derived observations are re-computed according to the node positions of the RGPS nodes *initially* computed directly from the RGPS observations. Note that these RGPS node positions are not a part of the least squares adjustment and therefore are sensitive to errors in the RGPS data. This option should therefore not be used if gun-array RGPS data is very noisy or suspect. Once the new derived observations' values have been computed in the manner the adjustment proceeds in the normal way.

The advantage of using this option is that when individual gun floats are towing very dynamically or non-symmetrically with the result that their nominal offsets are significantly different from their true offsets, then the gun-array position is more accurately computed. A result of this is that the residuals of the derived observations are negligible, and if a network comprised only of vessel and gun-array(s) is being adjusted the unit variance is likely to be much lower than usual.

Warning: Only use this option with good RGPS data on the gun-arrays.

9.9.5.2   Aray Components

Check the *Compute array components* checkbox to compute the coordinates of the individual guns, Near Field Hydrophones and gun depth sensors. These nodes do not need to be selected in the network node list.

Gun, NFH and depth sensor coordinates are computed relative to the sub-array, using their offsets from the sub-array, and the sub-array azimuth.

Check the *Plot array components* checkbox to display the individual array components on the network display.

9.9.5.3   Sub-array Azimuths

Sub-array azimuth will only be computed if the sub-array has at least two GPS observations separated by at least 3m.

9.9.5.4   Sub-array Separations

Sub-array separation will only be computed if either of the following are true:

- Sub-array separation nodes and observations have been created (see section 5.1.4.).
- Dynamic Offsets are used (see section 9.9.5.1)
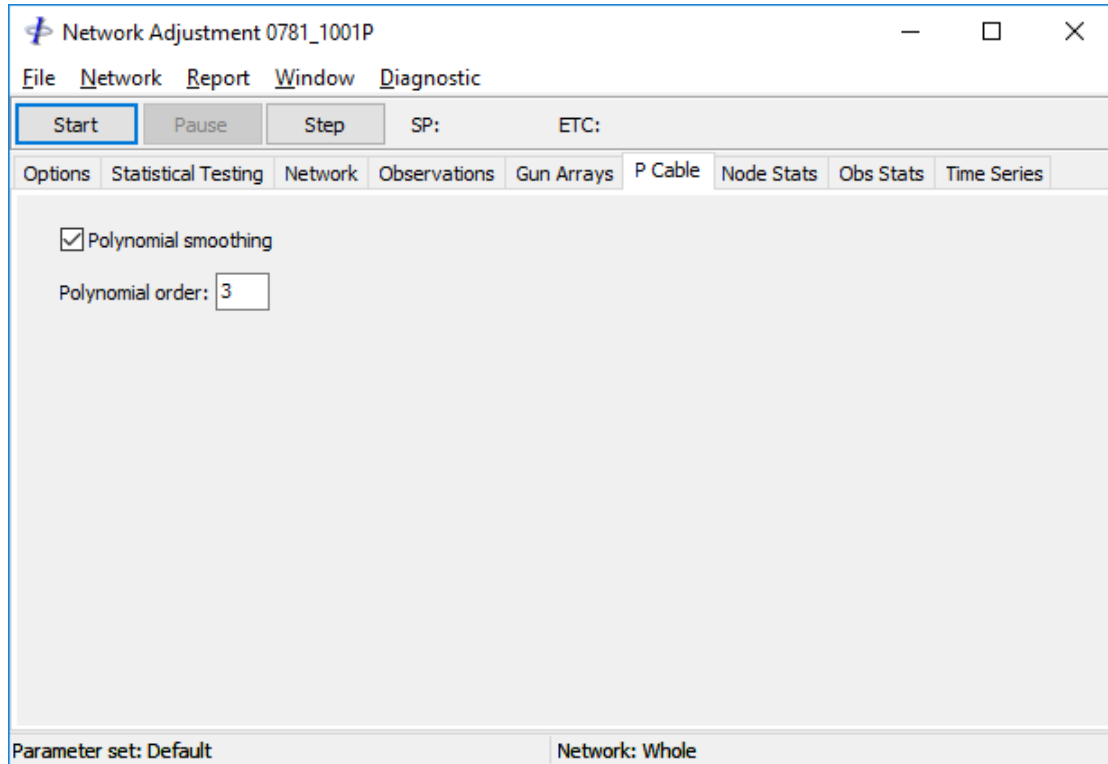
9.9.6 P Cable Compass

Figure 9-14: Network Adjustment - P Cable Compass Options

Optionally implement polynomial smoothing for P Cable compasses. The recommended order is 3.

9.9.7 P Cable Catenary

These parameters are applicable to the Triggerfish P Cable catenary implementation.
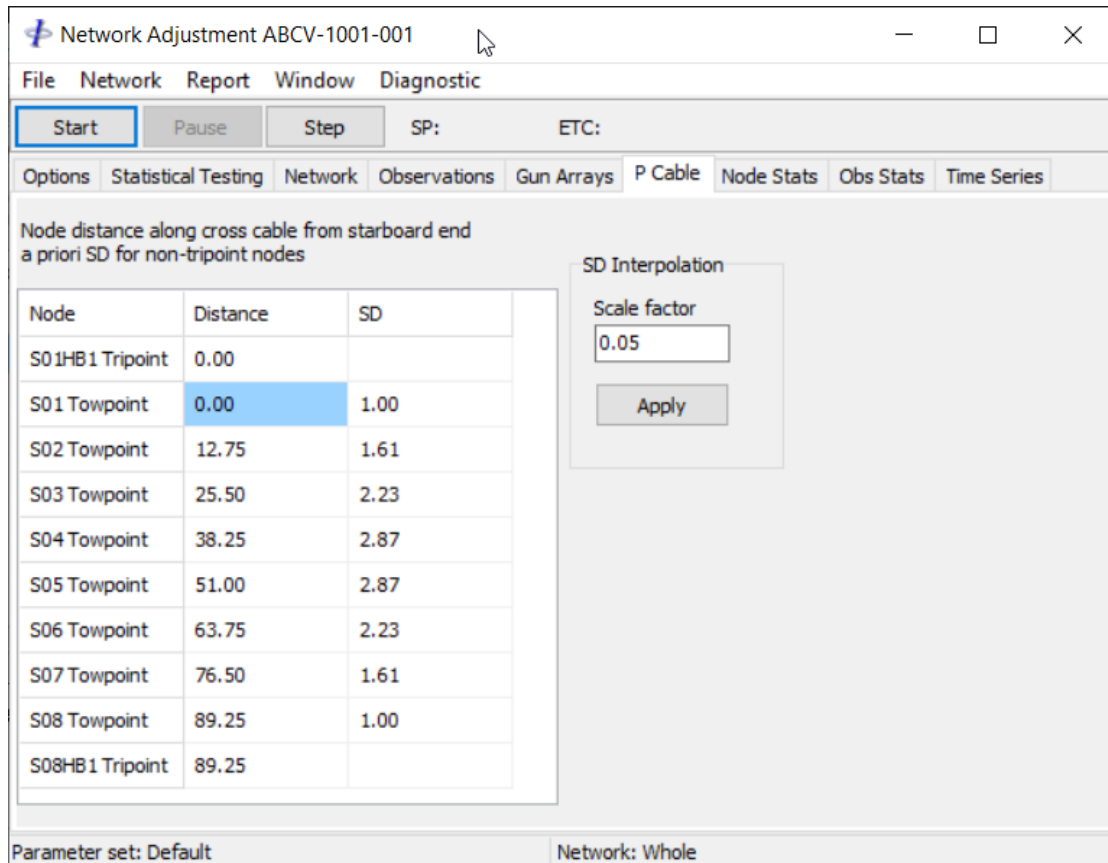
a

Figure 9-15: Network Adjustment - P Cable Compass Options

9.9.7.1 Offsets

The catenary model requires the distance *along the cross cable* of each cross cable node from the starboard end of the cross cable. These distances are initially calculated from their defined X, Y offsets from the starboard tripoint as per the Triggerfish convention. Their actual distances are by convention recorded in a comment record in the P2 header and may be used to manually check and if necessary, manually correct the node distances. The first node is the starboard tripoint and its distance. 0.0, cannot be changed.

9.9.7.2 A Priori Standard Deviations

The a priori SDs for the E, N type derived observation pairs associated with the cross cable nodes are initially interpolated from the SDs of the GPS observations associated with the tripoints. They are weighted according to their distance from either end of the cross cable. These SDs can be manually changed by editing their values. They may also be automatically re-calculated by changing the scale factor which is used to determine their weighting.

9.9.8 Node Statistics

Node statistics are updated after each shotpoint is computed and displayed in the *Node Statistics* page. The node for which statistics are displayed can be changed by clicking on the node in the Network display, or selecting from the dropdown list.
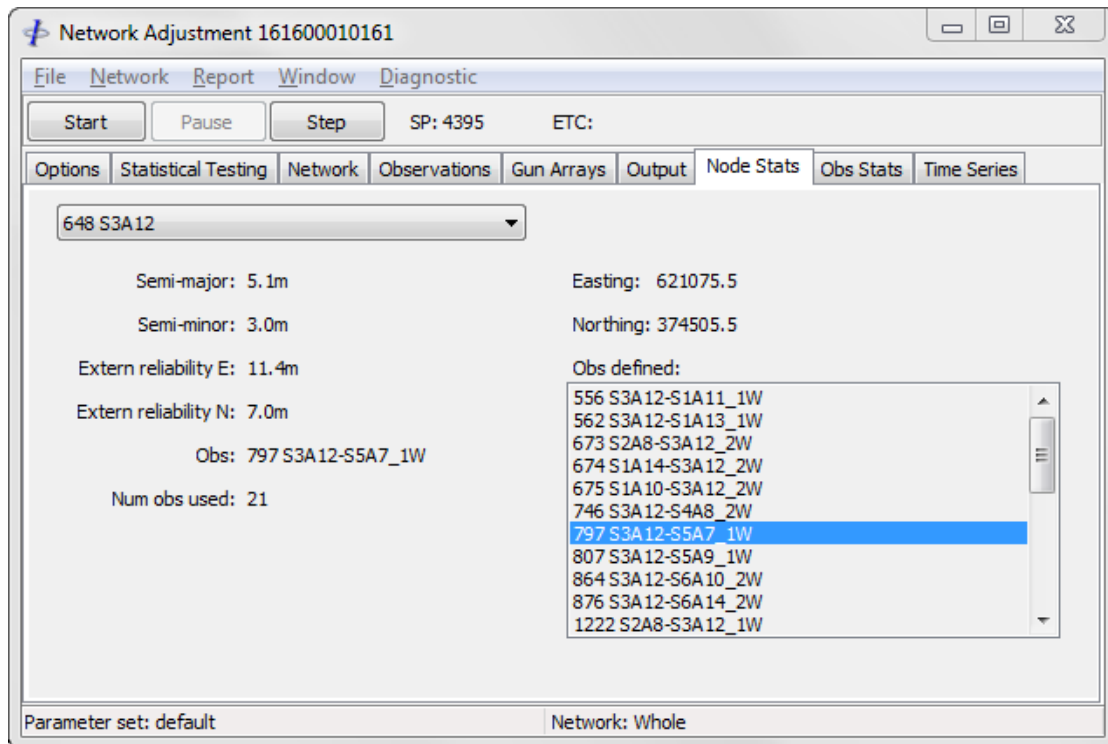

Figure 9-16: Network Adjustment – Node Statistics

The following information is displayed:

- Node number and name.
- Semi-major axis of the 95% probability error ellipse.
- Semi-minor axis of the 95% probability error ellipse.
- Grid Easting in metres.
- Grid Northing in metres.
- External reliability of Easting and Northing.
- The observation number and name from which the highest external reliability is derived.
- Number of observations.
- The list of observations connected to this node. Double clicking on an observation in this list will display the statistics for this observation in the *Observation Statistics* page which will be displayed.

9.9.9 Observation Statistics

Observation statistics are updated after each shotpoint is computed and displayed in the *Observation Statistics* page. The observation for which statistics are displayed

can be changed by clicking on an observation in the *Node Statistics* page, by clicking on one of its nodes in the Network display, or selecting from the dropdown list.
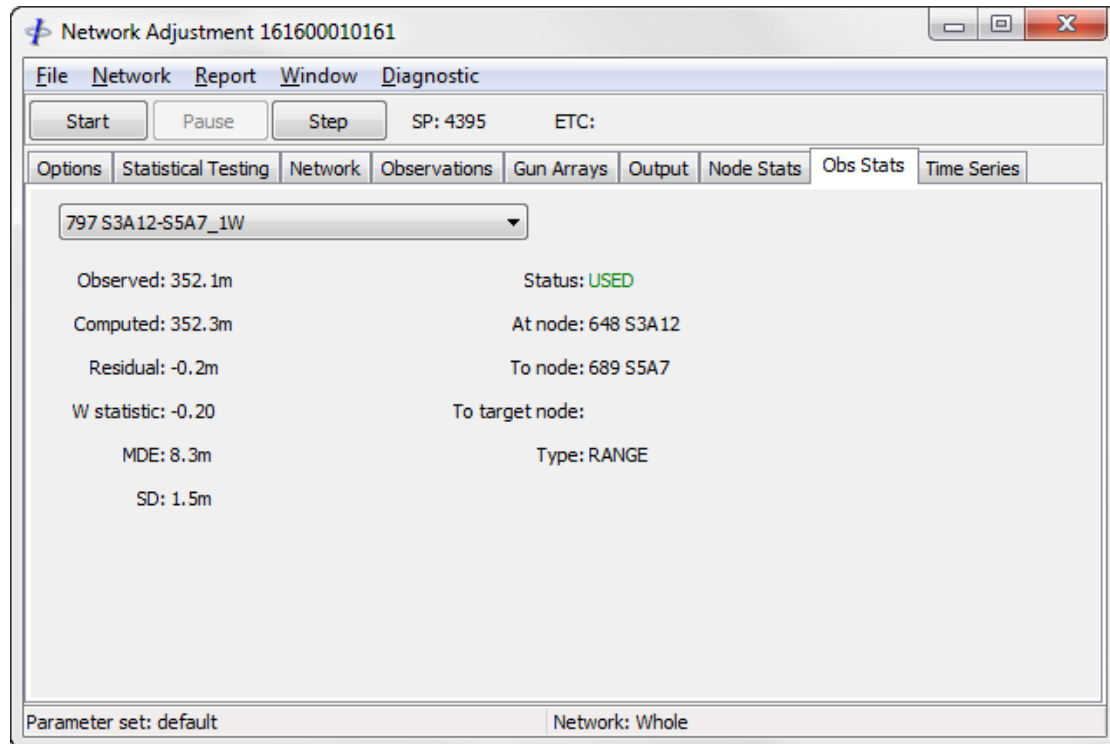

Figure 9-17: Network Adjustment – Observation Statistics

The following information is displayed:

- Observation number and name.
- Observed value in metres or degrees.
- Computed value in metres or degrees.
- Residual in metres or degrees.
- Normalised residual.
- Marginally detectable error.
- A priori standard deviation.
- Use status.
- At node.
- To node.
- To target node (angle type observations).
- Observation type.

9.9.10 Time Series Plots

Adjustment, Streamer, Node and Observation attributes can be displayed as time series plots, updated as the adjustment progresses. Only one plot from each of these four categories can be displayed at one time.
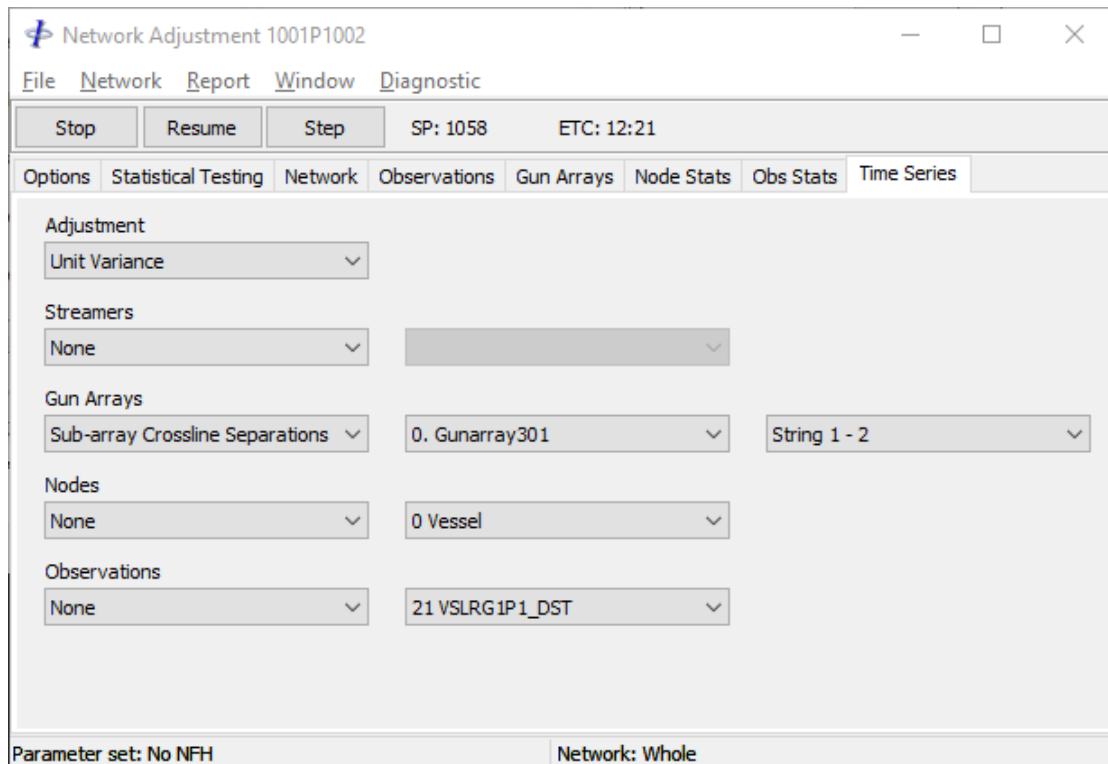

Figure 9-18: Network Adjustment – Time Series Plots

For each category select the attribute to plot. The plot window, as shown in Figure 9-19, will appear at the bottom left of the screen. For node and observation attribute plots select the node or observation from the dropdown lists, or click on a node in the Network Display. Each time a node is clicked on the observation displayed is scrolled to the next observation to or from that node.

The following attributes are available:

Adjustment: Unit variance.
                    Degrees of freedom.
                    Number of iterations.
                    Speed of sound, if computed.
                    Magnetic variation, if computed

Streamers: Rotation, if computed.
                    Stretch, if computed.
                    Feather

Gun-arrays: Array azimuth.

Sub-array azimuth. This is only available if the sub-array has RGPS nodes from which its unique azimuth is calculated.

Sub-array crossline separation, based on array azimuth.

Sub-array alongline separations, based on array azimuth.

Nodes: Semi-major axis of the 95% confidence error ellipse.

External reliability, $\sqrt{\left(\delta E^2 + \delta N^2\right)}$, where δE and δN are the respective East and North components of maximum external reliability.

Number of observations at and to the node.

Cross line distance of the node from the defined preplot.

Along line distance of the node from the last preplot waypoint.

Observations: Value.

Residual.

Normalised residual (W statistic).

Marginally detectable error.

A priori standard deviation.

Figure 9-19: Network Adjustment – Unit Variance Plot

The shotpoint number and data value at the vertical cursor position is displayed at the top of the plot.

The X-axis is scaled to the full range of shotpoints specified for the adjustment. The Y-axis is automatically scaled to the maximum and minimum data values.

To expand or contract the vertical and horizontal scales use the zoom buttons on the left of the toolbar, or the mouse wheel plus the *<Ctrl>* and/or *<Shift>* key(s).

To zoom in on an area of the plot use the left mouse button to draw a rectangle defining the required zoom area, use <Shift> and/or <Ctrl> keys with the mouse wheel. This will also disable automatic scaling.

To shift the plot vertically and horizontally use the single arrow buttons on the right of the toolbar.

Zooming or shifting vertically will disable automatic vertical scaling. Zooming or shifting horizontally will disable automatic horizontal scaling.

To zoom out, click on the *Zoom Original* button., or the mouse wheel.

Toggle the *Rate of Change* and *Delta* buttons to display the rate of change or the shot to shot difference respectively. To revert to the normal plot toggle either of these buttons off.

To close a plot select *None* in the plot category.

9.10 **Reports**

9.10.1 Tabulated Results

From the menu select *Report | Adjustment Results*.

No.	Name	SMA mean	SMA min	SMA max	Ext Rel mean	Ext Rel min	Ext Rel max
0	Seisquest	2.1	2.1	2.1	0.9	0.7	2.0
1	EA600 12 kHz Tran	2.1	2.1	2.1	0.9	0.7	2.0
2	EA600 120Khz Tran	2.1	2.1	2.1	0.9	0.7	2.0
3	Streamer201	2.7	2.6	2.8	1.9	0.9	8.0
57	Streamer202	2.7	2.6	2.8	2.2	1.1	10.0
111	Streamer203	2.7	2.7	3.0	2.1	1.1	7.0
165	Streamer204	2.9	2.7	4.1	2.9	1.3	18.6
219	Streamer205	2.7	2.7	2.8	1.2	0.9	4.7
273	Streamer206	2.7	2.6	2.8	1.2	0.9	5.3
327	Streamer207	2.7	2.6	2.8	1.2	0.9	2.4
381	Streamer208	2.7	2.6	2.8	1.7	1.4	3.0
435	Gunarray301	2.7	2.7	4.8	2.0	1.2	7.0
487	Gunarray302	2.7	2.7	2.8	1.6	1.1	4.5
539	TB1	3.1	3.1	3.7	3.5	2.5	3.6
540	TB2	3.2	3.1	3.7	3.6	2.5	3.9
541	TB3	3.1	3.1	3.3	3.3	3.3	3.6
542	TB4	3.1	3.1	3.7	3.3	3.2	3.5
543	TB5	3.1	3.1	3.2	3.3	3.2	4.9
544	TB6	3.1	3.1	3.2	3.3	3.2	3.5
545	TB7	3.1	3.1	3.2	3.3	3.3	3.5
546	TB8	3.2	3.2	5.3	4.0	3.1	8.9
553	V1	2.1	2.1	2.1	0.9	0.7	2.0
554	S4V1	5.7	5.7	5.7	1.5	0.9	2.7
555	S5V1	5.1	5.0	5.2	1.2	0.8	3.1

Figure 9-20: Network Adjustment – Adjustment Results

Right click on this window to display a popup menu for options to copy all to the clipboard, and to search the table.

The adjustment results are presented in tables for the following categories:

- Adjustment
- Nodes
- Observations
- Streamers

Note: Observation SDs are displayed in units of degrees or metres.

The default shotpoint range is that which appears in the adjustment control panel, Options page. When changing the shotpoint range the current table must then be refreshed by clicking the button in the toolbar.

Click the *Options* button to change highlighting thresholds (see section 9.10.3).

Tables may be sorted incrementally or decrementally for each attribute by clicking on the appropriate column header.

9.10.2 Text Reports

Each time the adjustment is stopped a new set of text reports is generated, with an incremental name. In the example shown in Figure 9-21 the report is the 67th.

The reports are accessible from the *Report* menu. The latest report is displayed.

The observation residual and normalised residual reports support the additional feature, accessible from the popup menu, of allowing the observation at the cursor to be edited in the precondition module. Any edits or changes in precondition parameters are applied to the database immediately. These is no need to exit either the Precondition or the Network Adjustment module in order for the changes to be applied.

Figure 9-21: Network Adjustment – Reports

9.10.3 Options

The *Options* item in the *Report* menu is used to specify thresholds for highlighting items in the report.
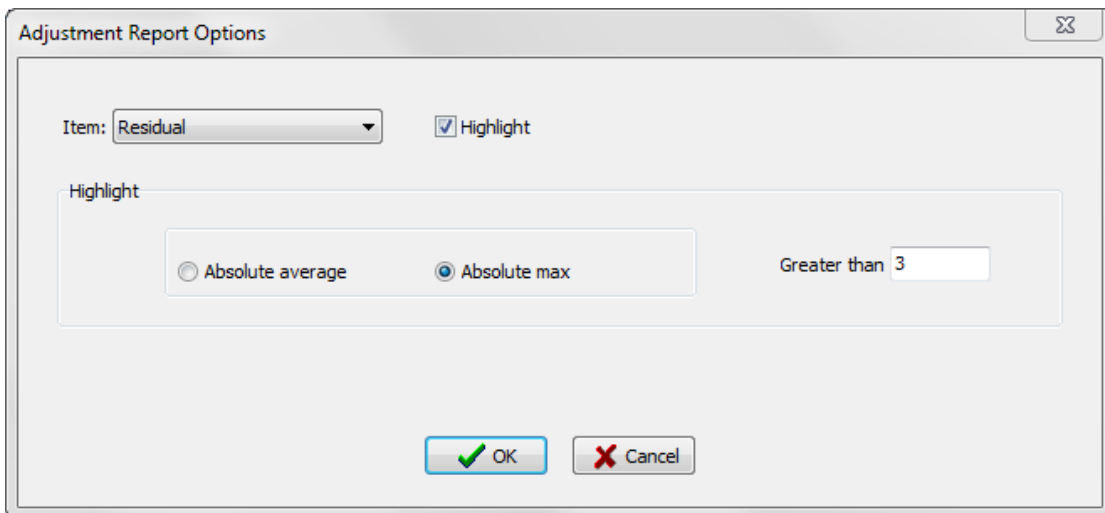
Figure 9-22: Network Adjustment – Highlighting Options

To specify highlighting, select the report item from the *Item* list. Check the *Highlight* checkbox to enable highlighting for the selected item.

For all items except *No. Observations per Node* values greater than the specified threshold will be highlighted in red. For *No. Observations per Node* values less than the specified threshold will be highlighted in red.

All negative values, for example as may occur in residuals, are converted to a positive value.

The highlight settings can also be changed from the *Options* menu in the *Adjustment*

Results table form.

10 QUALITY CONTROL

To start the Quality Control click on the *Quality Control* button in the main toolbar.

The QC module allows interactive browsing of time series plots of QC data. With the exception of shot time interval which is available immediately after the input of P2 data, the data for these plots is a product of the network adjustment.
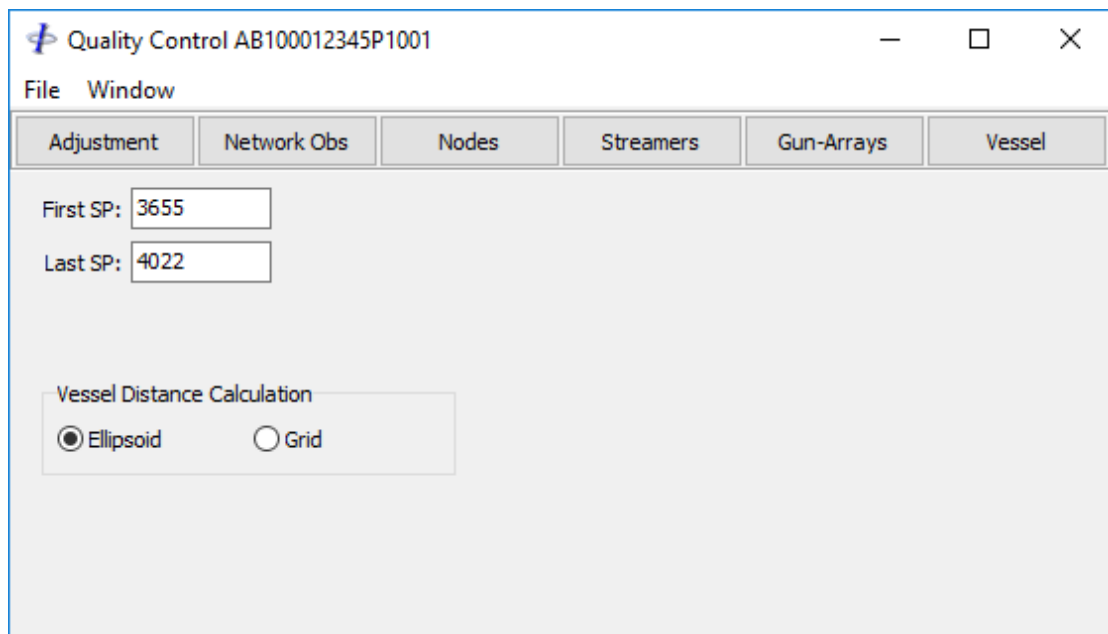

Figure 10-1: Quality Control Module

10.1 Options

10.1.1 Vessel Distance Calculation

Check either *Ellipsoid* or *Grid* to specify the mode for distance calculations applied to the *Vessel* plots.

Note: *Distances for Node plots are always calculated on the ellipsoid.*

10.2   **Available plots**

Adjustment:

- Number of iterations
- Degrees of freedom
- Unit variance
- Speed of sound for acoustics (if computed)
- Magnetic variation (if used)

Network Observations:

- Value – inclusive of fixed and variable C-O, scale, propagation speed and grid convergence or scale factor.
- Residual
- Normalised residual (W statistic)
- Marginally detectable error
- A priori standard deviation

Nodes:

- Cross line distance from pre-plot survey line
- Along line distance from pre-plot start of survey line
- Easting
- Northing
- Semi-major axis of the 95% probability error ellipse
- External reliability, $\sqrt{\left(\delta E^{2} + \delta N^{2}\right)}$, where δE and δN are the respective East and North components of maximum external reliability. This quantity is exclusive of vessel positioning observations.
- Number of observations to/from a node, including derived observations

Streamers:

- Rotation
- Stretch
- Feather relative to pre-plot survey line

Gun-arrays:

- Array azimuth
- Array depth
- Sub-array azimuth, only available if sub-array has at least two GPS pods.
- Sub-array crossline separation, based on array azimuth.
- Sub-array alongline separation, based on array azimuth.

Vessel:

- Shot time interval, available immediately after input of P2 data.
- Inter shot distance
- Speed in knots
- Course made good

Any number of these plots may be viewed simultaneously.

Referring to Figure 10.1, the shotpoint range in the main QC window defaults to the first and last good shotpoints as shown in the Project details for the line. To view any of the plots with a different shotpoint range enter the required shotpoint range prior to clicking on the appropriate data type button.

10.3   Plot Data

The data from which these plots are taken is overwritten each time a network adjustment, or partial network adjustment is carried out, if the relevant outputs are enabled (refer to section 9). These plots therefore represent the most recent network adjustment of every part of the line. For example if an adjustment for shotpoints 100 to 1000 is computed, followed by a re-computation of the adjustment for shotpoints 500 to 1000 then the plots will show data from the first adjustment for shotpoints 100 to 499, and from the second adjustment for shotpoints 500 to 1000.

For parts of the line where no data has been output, e.g. auto-rejection of observations, the plot will appear blank.

10.3.1   Network Observations

In the case of Network Observations, the only series available for streamer compasses and gyro compasses is the value as these observations are not directly used in the least squares process.

The data for derived observations pertains to the most recent adjustment configuration. All data for derived observations will be overwritten if the network configuration in the network adjustment module is changed and adjusted.

10.3.2   Nodes

Coordinates for nodes computed by SeisPos are always in metres even if the P2 format specifies a non-metric unit.

For streamer compasses, the semi-major axis and external reliability is not available as these nodes are not solved as part of the least squares process.

If field derived positioning data has been recorded in the P2 in E12 records then these nodes will also appear in the node list. The naming convention adopted is:

> * FPD ##

where:
*	=	node name as appears in the database node table
##	=	sequence as defined in the P2 format

10.3.3 Plotting Functions

Refer to the *MultiPlot manual* for detailed descriptions of the plotting functions and statistics.

When viewing the observation plots an additional function is provided to view the

network display, accessible from the   button.

11   OUTPUT

To output processed data to file, click on the *Output* button on the main toolbar.

Output file formats supported are:
- OGP (ex UKOOA) P1/90
- OGP P1/11
- SPS format revision 1.0
- SPS format revision 2.1

The default location of the output file is that specified in the Project setup.

11.1 Parameter Sets
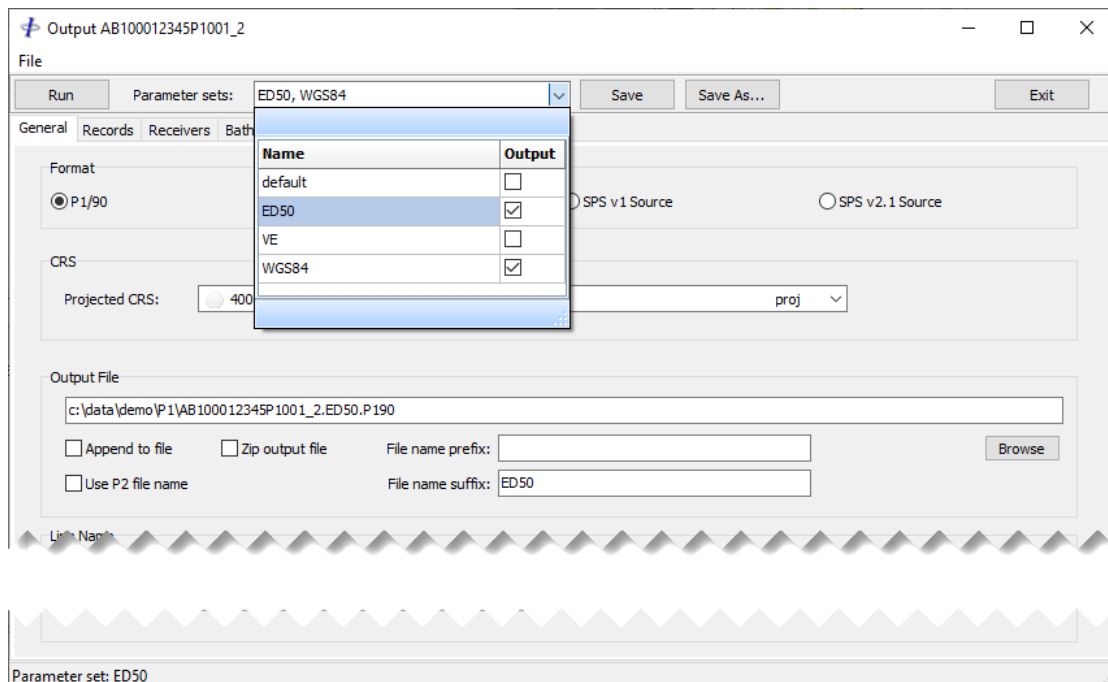
Figure 11-1: Output – Parameter sets

When the Output module is used for the first time in a project a default parameter set is created, named *Default*.

To create a new parameter set click the *Save As* button and enter the new parameter set name.

To load a parameter set into the User Interface (UI), click on the parameter set in the dropdown list. The currently loaded parameter set name is displayed in the status bar at the bottom of the UI.

Lines selected for output can be output to multiple files using different parameter sets. A typical use would be to output using different CRSs. When outputting to different files use the file name prefix or suffix to differentiate the file name.

When the *Run* button is clicked, each selected line will be output using each parameter set that is checked (see Figure 11-1), as well as the parameter set that is currently loaded into the UI. To avoid using an unwanted parameter set click on one of the checked parameter sets to load it into the UI.
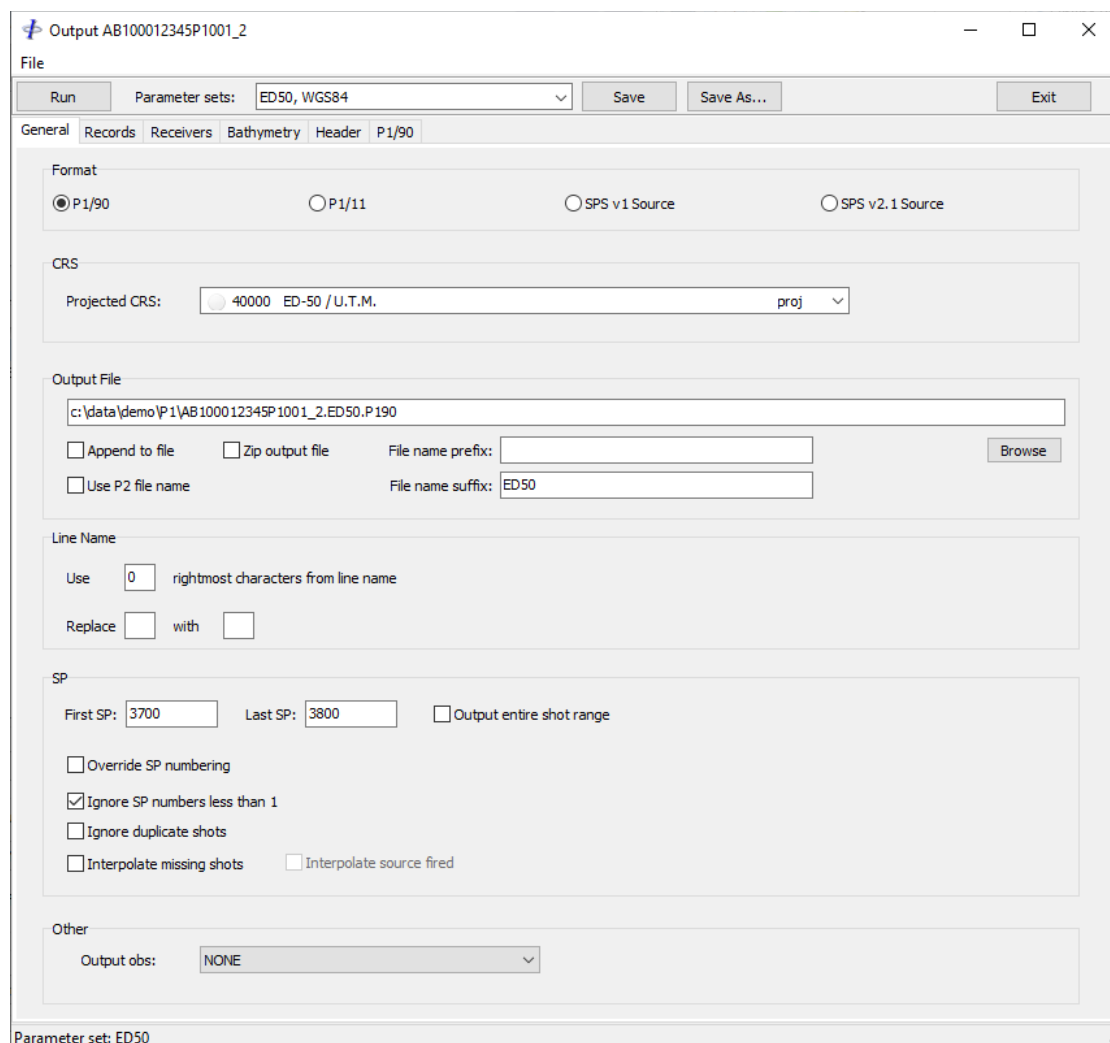
11.2 General

Figure 11-2: Output – General

Format: The output file format.

CRS:	Select the projected Coordinate Reference System to be used from the list. If the selected CRS is not the CRS in which the network adjustment has been calculated then all coordinates will be converted to the selected CRS during output.
Output file:	The full path and name of the output file. The default is the output path as specified in the Project Dialog, and the line name as defined in the P2 file.
Append to file:	If checked, the output file will be appended to. If not checked the output file will be overwritten. Default is unchecked.
Zip Output File:	Archive the output file using .zip compression.
Use P2 file name:	When checked, the output file root name will be the same as the P2 file root name.
File name prefix:	Inserts text before the beginning of the file name.
File name suffix:	Inserts text immediately before the filename extension.
Use chars from line name:	Uses the specified number of non-blank characters from the right of the line name as appears in the general parameters in the database. A maximum of 12 characters will be used. If blank or 0 then up to12 of the rightmost non-blank characters will be used. Note: if the value is non-zero then the line name option in the *Project* dialog will be overridden. See section 2.2.
Replace … with …:	Optionally used to replace characters in the line name.
First/Last SP:	The shotpoint range for which the output file is to be written. The default range is that of the first and last good shotpoint shown in the Project Dialog.
Output entire shot range:	Output all shots.
Override SP numbering:	When checked allows specification of FSP number and SP number increment.

Ignore SP numbers less than 1	When checked SPs whose number is < 1 will not be output.
Ignore duplicate shots:	When checked SPs which have duplicate numbers will not be output.
Interpolate missing shots:	If checked, single or blocks of missing shots will be linearly interpolated and output. Warnings will be logged and the number of interpolations will be written to the log. Default is off. This option will not interpolate source records.
Interpolate source fired:	If checked, when missing shots are interpolated a source record will be interpolated. Warnings will be logged. Default is off. This option will not force output of a source record for a misfire i.e. the source ID for the shot does not correspond to an actual source ID e.g.: valid source IDs are 301, 302 and shot source ID is 300.
Output obs:	Select an observation from the dropdown list. The observation name and data will be written to an "F" record. See section 11.2.1 for description of F record. Default is NONE.

11.2.1 F Record

This option is only available for P1/90 output.

If an observation is selected for output it will be written to an F record of the following format:

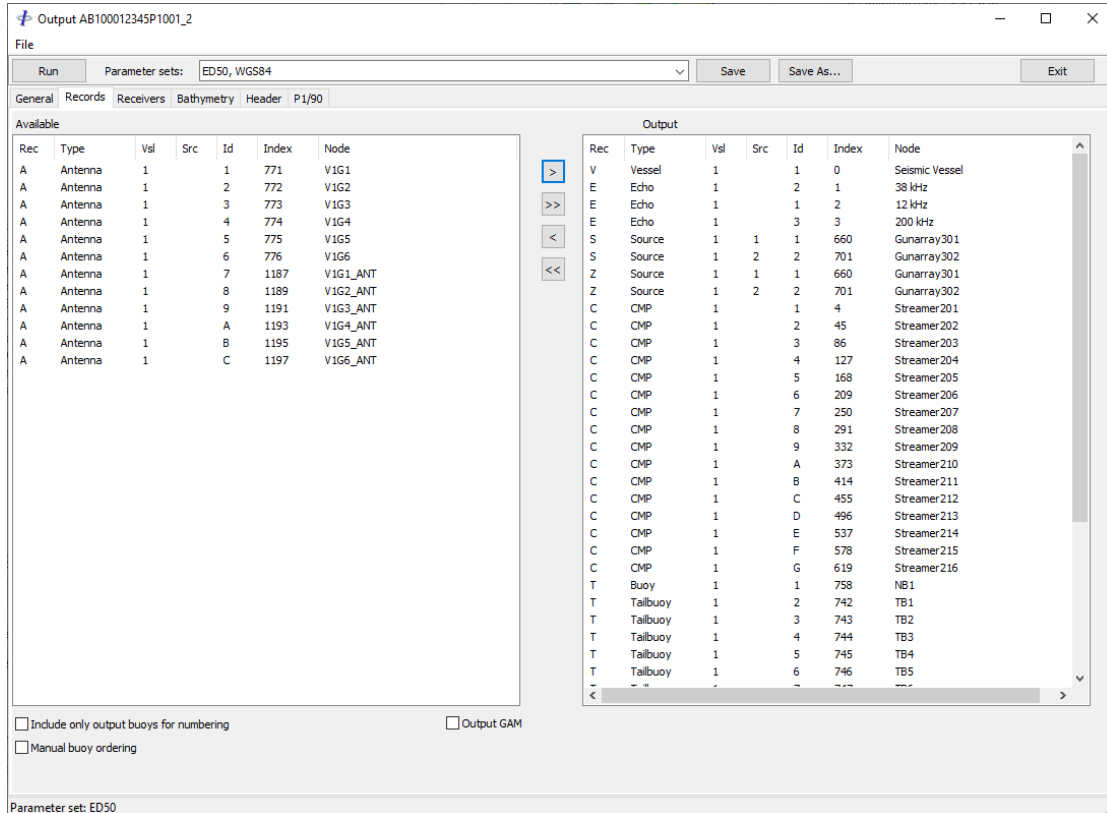| Description	P1/90 Columns	Format
"F"	01-01	A1
Line name (left justified)	02-13	A12
Blank	14-19	A6
Shotpoint number (right justified)	20-25	A6
Blank	26-26	A1
Observation name (left justified)	27-43	A17
Blank	44-46	A3
Observation value	47-56	F10.2
Blank	57-70	A14
Julian Day of year	71-73	I3
Time (hhmmss)	74-79	3I3
Blank	80-80	A1

11.3 Records

11.3.1 P1/90

Figure 11-3: Output – P1/90 Records

The following records are available for output to P1/90 and automatically assigned internally:

Record Identifier	SeisPos Node Type	Description
V	*VESSEL*	Vessel reference point
E	*ECHO*	Echosounder
A	*SATELLITE*	GNSS antenna
S	*GUN ARRAY*	Source fired only

Z	*GUN ARRAY*	All sources
	GUN	Individual gun
	NEAR FIELD HYDROPHONE	Near field hydrophone
	GUN DEPTH SENSOR	Gun depth sensor
C		midpoint between firing source and near receiver group
T	*TAILBUOY*	Tailbuoy
	BUOY	Other buoy

Each item in the list comprises, in the order indicated:

Item	P1/90 column
Record identifier	1
Record type	
Vessel number	17
Source number	18
ID number	19
Node index	
Node name	

By default, all available records appear in the *Output* list. To change the output configuration, use the appropriate arrow buttons.

11.3.1.1 Gun Array Components

For gun array components of type GUN, NEAR FIELD HYDROPHONE and DEPTHSENSOR, the following P1/90 column assignments are made:

P1/90 Columns	Description	Format
1	'Z'	A1
14	Component type: 1=Gun; 2=NFH; 3=Gun Depth Sensor	I1
15 - 16	Component ID	A2
	Taken from the trailing digits or the specified characters of the node name – see section 11.7.1.	
17	Vessel ID	I1

18	Source ID	I1
19	Component ID in alphanumeric format: 1…9, A…Z, a...z	A1
	Optional	
65 - 70	Gun and NFH: water depth	F6
	Gun Depth Sensor: sensor depth	

11.3.1.2 Buoy Numbering

By default, all buoys and tailbuoys are numbered according to the UKOOA P1/90 convention:

"From Starboard, Top, Back through Front, Bottom, Port"

This numbering can be modified in two ways:

1. *Include only output buoys for numbering:*

   When checked the numbering will be calculated based only on the buoys selected for output in the *Output* list.

2. *Manual buoy ordering:*

   Click the *Order Buoys* button to display the buoy ordering dialog as shown in Figure 11-4.

   The order in which the buoys will appear can be changed by dragging and dropping the list items. The buoy numbering can be changed by entering the number of the first buoy in the list. The remaining buoys will be numbered incrementally from the first buoy number.

   By using a combination of these actions all buoys can be numbered manually but the numbers will be incremental i.e. without gaps in the numbering.
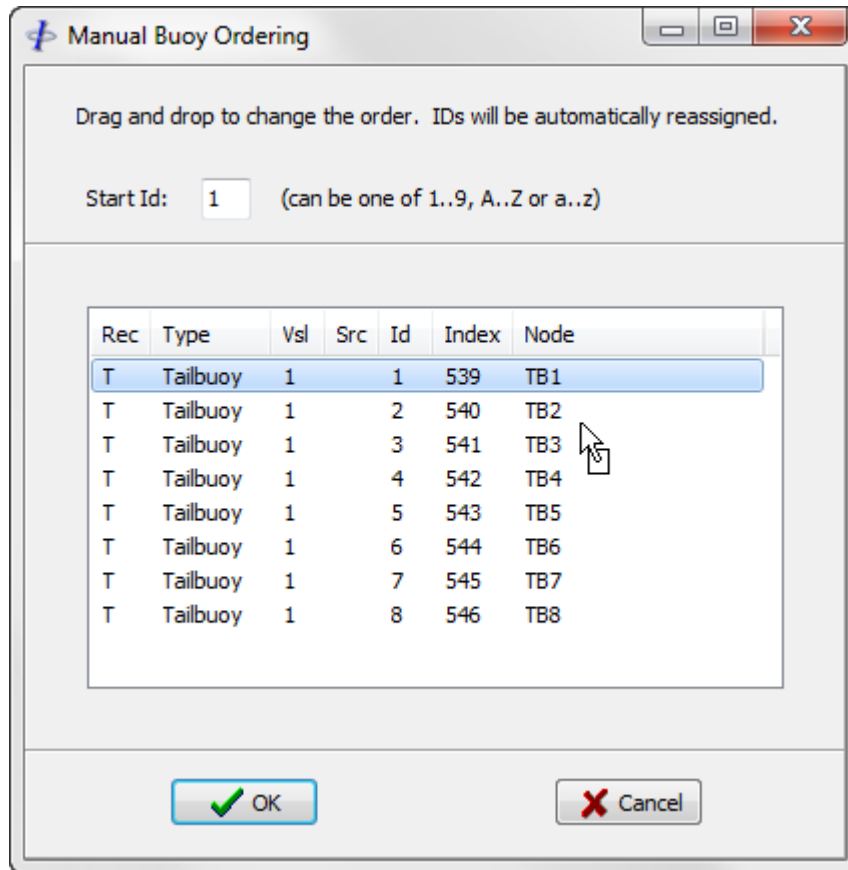
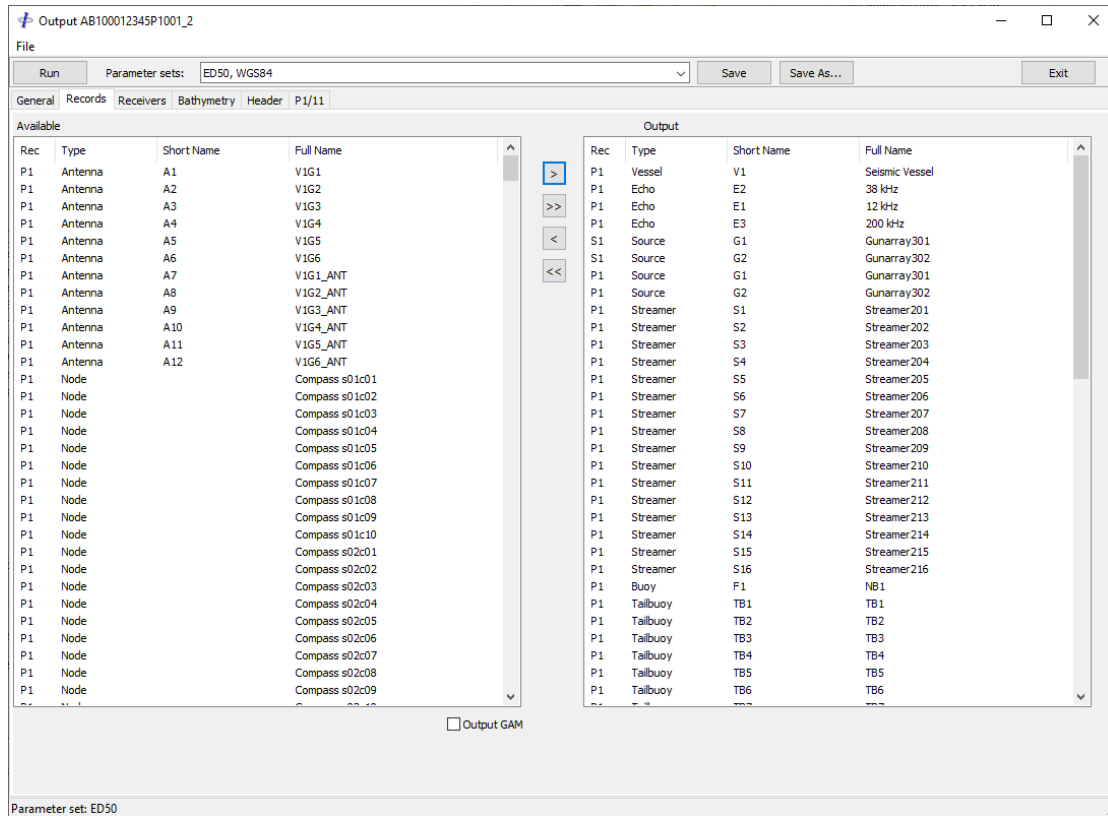**Figure 11-4: Output – Manual Buoy Ordering**

11.3.2 P1/11

Figure 11-5: Output – P1/11 Records

All nodes can be output to the P1/11 as P1 records. The fired source can be output to S1 records.
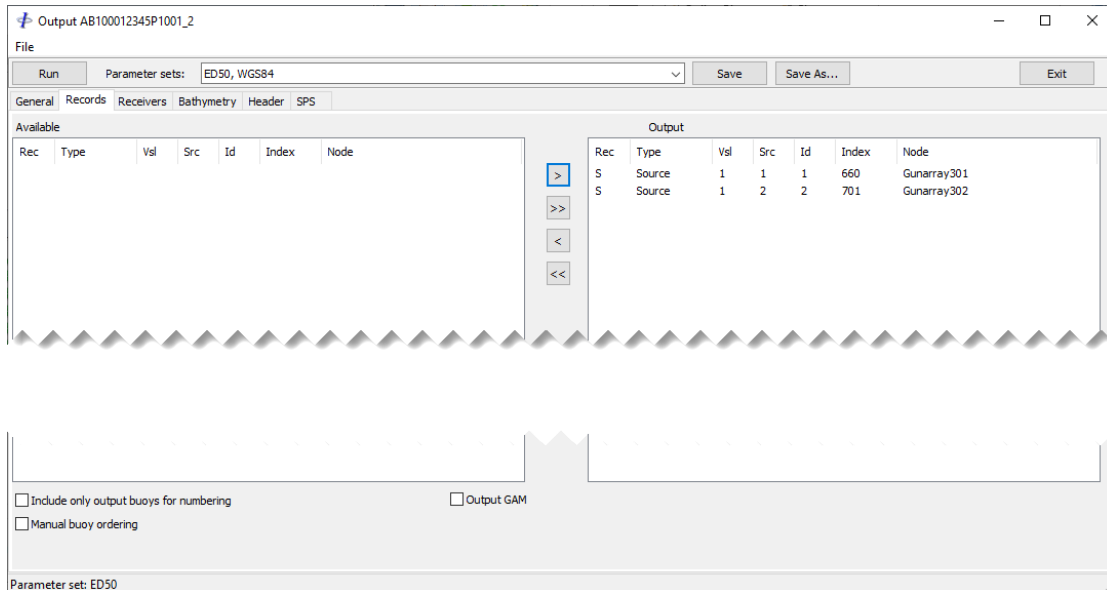
11.3.3 SPS

Figure 11-6: Output – SPS Records

Only gun-array, OBN receiver and echosounder records are available for output.
Echosounder records are not output but if water depth and tide is required to be
written to the SPS file then the echosounder from which depths are required must be
selected.

11.3.4 GAM (Gun Array Mean)

When *Output GAM* is checked then an additional record corresponding to the mean
of the firing and non-firing gun-arrays, with identifier as specified by *Record ID,* will
be output. This feature is used usually in OBC operations to support situations when
the mean of the two gun-arrays is required in order to assess offline comparison with
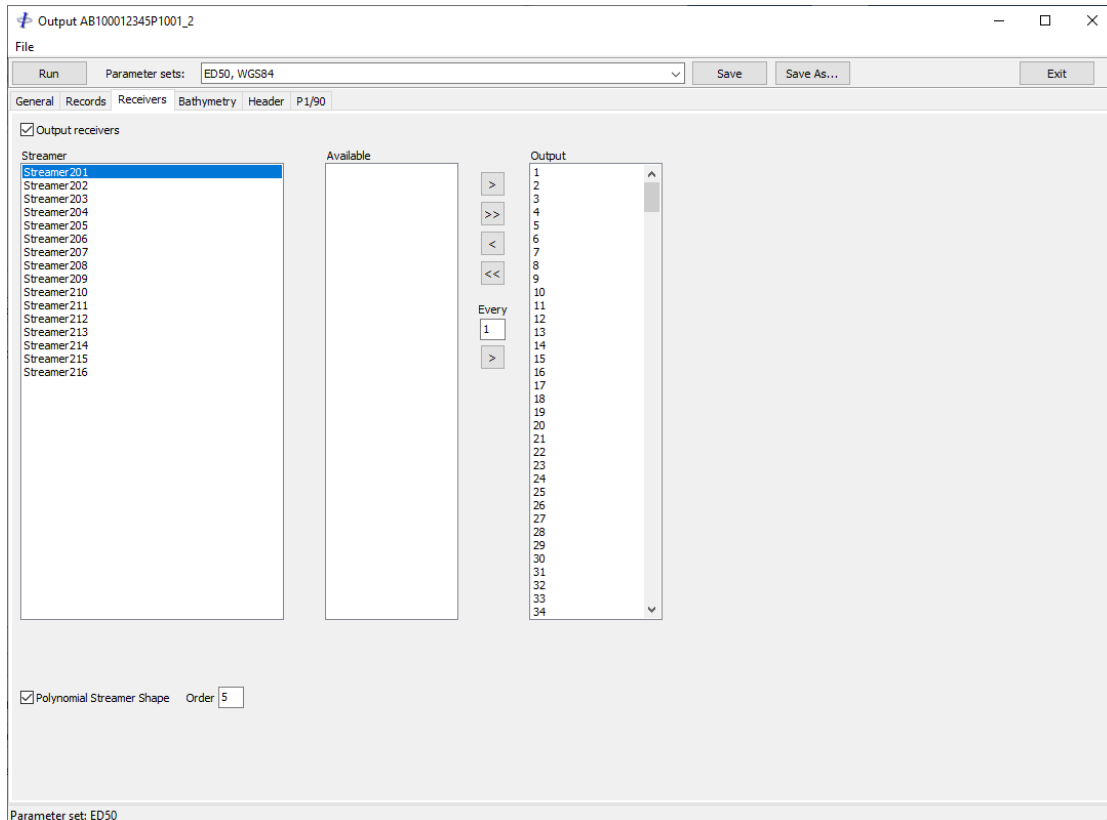the preplot.

11.4 Receivers

Figure 11-7: Output – Receivers

To enable/disable the output of receiver records check/uncheck the *Output receivers* checkbox.

For each streamer all receivers as defined in the database are available for output and by default appear in the *Output* list. The receivers appearing in the *Available* and *Output* lists are those belonging only to the streamer highlighted in the *Streamer* list. The receiver numbering is also defined in the database so any changes required must be made in the database prior to output.

To change the output configuration select the required items and use the appropriate arrow buttons.

To suppress output of a streamer highlight the required streamer in the *Streamer* list and click on the << button.

11.4.1 Decimation

To output a decimated P1, for each streamer for which decimation is required highlight the streamer in the *Streamer* list, enter the required receiver group interval in the *Every* field and click on the > button below this field

.

11.4.2 Streamer Shaping

The default method of streamer shaping when compasses are in use is the concatenated circular arc. With this method, the receiver positions are interpolated along circular arcs described by every consecutive pair of streamer compasses, using the nominal offsets of the compasses and the receivers.

Whether streamer compasses are present or not, the polynomial streamer shape option can be used. With this method, the receiver positions are interpolated based on their nominal offsets along a polynomial which is modelled from the streamer node positions and nominal offsets using a least squares fit of the specified order.
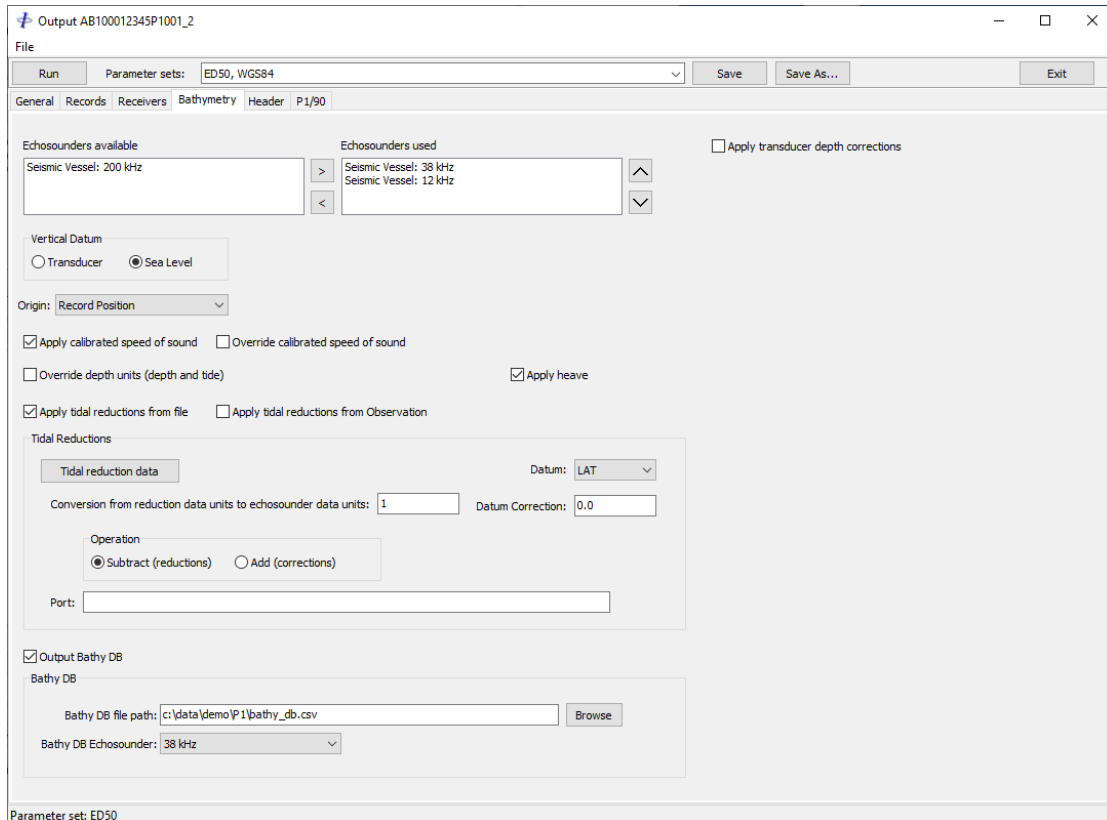
11.5 Bathymetry

Figure 11-8: Output – Bathymetry Options

11.5.1 Echosounder

To output bathymetric depths to non-echosounder records, at least one echosounder must be selected from the available echosounders. In the event of missing data, data will be used from the next echosounder in the list if echosounders used.

Depths written to echosounder records will be the depth for the echosounder to which that record belongs.

Note: for SPS, at least one echosounder record must be selected in order to output water depth and surface elevation.

11.5.2 Vertical Datum

Transducer: The depth data output is referenced to the echosounder transducer.

Sea Level: The depth data output is referenced to sea level. Tidal reductions may be applied (section 11.5.7)

The correction which is made for either of these depends on the echosounder setting which can be viewed in the *Database* module under *Header | Echosounders.*

11.5.3 Origin

Select from the dropdown list the node to whose horizontal position the depth data refers. Five options are provided:

Echosounder: Depth is at the echosounder position. This is the default setting.

Vessel: Depth is nearest the vessel position.

Centre of Source: Depth is nearest the centre of the active source position.

Near CMP: Depth is nearest the average common midpoint position between the active source and all streamer near receiver groups.

Record Position: Each record has the depth nearest to its own position.

In all cases when the origin is not the echosounder the software will use the depth value obtained nearest to the position corresponding to the origin.

Note: *If the origin is not set to Echosounder and there are insufficient shotpoint coordinates computed for the echosounder node prior to the first good shotpoint then the depth value for the first shotpoint for which the echosounder coordinates have been computed will be used.*

Note: *For P1/11, if the origin is set to anything other than "Record Position" then only nodes of the specified type will contain water depth.*

11.5.4 Transducer Depth Corrections

This option is only available when the Depth Reference is set to *Sea Level.* Check the *Apply transducer depth corrections* checkbox to enable the application of transducer depth corrections.

The values entered represent heights and should be in the same units as the echosounder data. E.g. if the transducer is 0.5m deeper than indicated by the echosounder Z coordinate then a value of –0.5 should be entered.

At least the first correction must be specified. If two corrections and corresponding dates are specified then the correction used is linearly interpolated from the corrections and dates. This may typically be used when applying corrections for the start and end of survey transducer depth which may vary.

Additional: The correction will be subtracted from the data.

Absolute: The depth data are corrected to transducer depth, if necessary, before
                the correction is subtracted from the depth data. I.e. the correction
                replaces the echosounder Z coordinate.

11.5.5 Speed of Sound

Check the *Apply calibrated speed of sound* checkbox to correct for the difference
between the speed of sound set in the instrument and the speed of sound actually
observed, e.g. by TS dip. These values can be seen in the *Database* module under
Header | Echosounders.

The *Override calibrated speed of sound* option is available if *Apply calibrated speed
of sound* is checked and the value entered will replace the calibrated speed.

11.5.6 Depth Units

Depth units can be overridden by specifying a scalar which recorded depths are
scaled by and stating the units name.

11.5.7 Heave

Check the *Apply heave* checkbox in order to apply heave is heave has been
recorded. The heave data will be subtracted from the observed depth after speed of
sound corrections, if specified, have been applied.

11.5.8 Tidal Reductions

Tidal reductions can be applied using values from either an external file or recorded
as an observation.

To apply tidal reductions from an observation, check the *Apply tidal reductions from
observation* checkbox and select the observation from the dropdown list.

To apply tidal reductions from file, check the *Apply tidal reductions from file*
checkbox, and click the *Tidal reduction data* button when setting up for first time use.
This option is covered in details in section 11.5.8.1.

The reductions will be subtracted from the water depth in the case of P1 format, or
added to the surface elevation in the case of SPS format.

Datum: Select *LAT* or *MSL* from the dropdown list.

This information is used only in the P1/90 header. For P1/11 the appropriate vertical CRS is created and recorded in the header.

Conversion from reduction data units to echosounder data units: Enter the value required to convert the tidal reduction data to the same units as the echosounder data. If both are in the same units then a value of 1.0 should be specified.

Datum Correction: The value entered will be subtracted from the water depth in the case of P1 format, or added to the surface elevation in the case of SPS format.

Operation: Select from:

Subtract: for P1 tide values will be subtracted from the measured water depth and for SPS added to the surface elevation field.

Add: for P1 tide values will be added to the measured water depth and for SSPS subtracted from the surface elevation field.

11.5.8.1 Tidal Reductions from File

Tidal reductions computed externally and supplied in a file can be used to reduce the depth data in the output file.

The data synchronisation can be based on time or SP number. Time based synchronisation is the more typical format, whereby usually a single file covering the entire survey period can be used for all lines acquired over the duration of a project.

The external data must conform to the following:
- The file must be in ASCII.
- The data field must be present.
- When synchronised on time, at least one time field must be present.
- When synchronised on SP number the SP number field must be present.
- Fields must be either of consistent fixed width or delimited with a character or string of less than 256 characters.
- Each record must end in a carriage return/line feed.

To use this data, check the *Apply tidal reductions from file* checkbox, then click on

the *Tidal reduction data* button to specify the data file and format.

11.5.8.2 Format Strings

The format string allows the following format specifiers which are case sensitive:

y   Year (4 or 2 digits) – optional, if not present the year of the first data record
        is assumed.

M   Month – optional.

D   Day – optional.
        If month is specified then this is the day of the month.
        If month is not specified then this is the day of the year (Julian day).

H   Hour – optional.

M   Minute – optional.

S   Second – optional.

P   shotpoint number – must be specified if date and time is not specified.

X   data value

Any other character = do not import

Delimited:

Each data field, regardless of length, is represented by a single format specifier.
Refer to Figure 11-9 below for an example. In this example year and Julian Day are
not present in the records.

The field delimiter used to separate the data fields must be specified.

If the file has time with colons, as in the example in Figure 11-9, then check the
checkbox *Treat colons as delimiters*.

To suppress import of a field, use any character not listed above e.g.:

```
DATA RECORD:    100,2001,49,12,02,20.9,$XYZ,4.56
FORMAT STRING:  #ydhms#x
```

In this example the 1st and 7th fields, 100 and $XYZ, will be ignored.
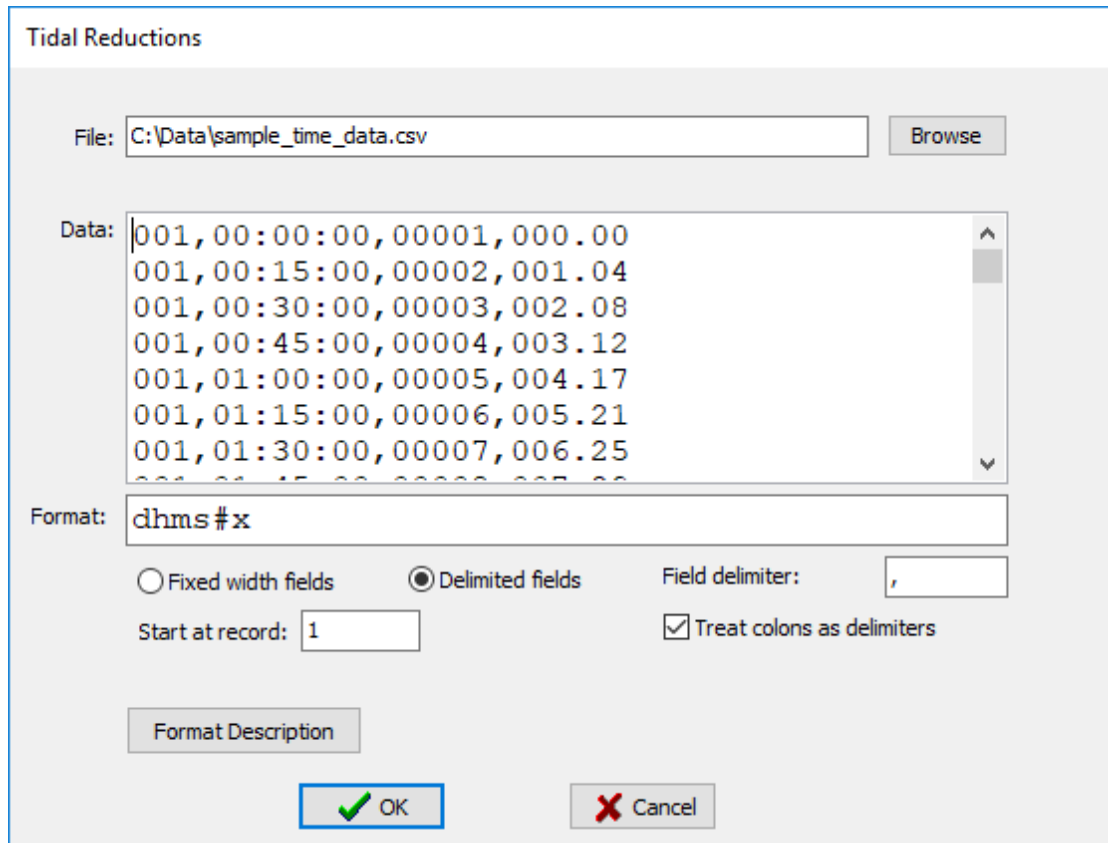
Figure 11-9: Output – Tidal reductions from file, delimited format

Fixed Width:

Each data field is represented by a group of the same format specifiers representing the exact position and width of the field. The field delimiter is not used. Refer to Figure 11-10 below for an example. In this example space characters have been used to indicate the positions in the data records to be ignored.
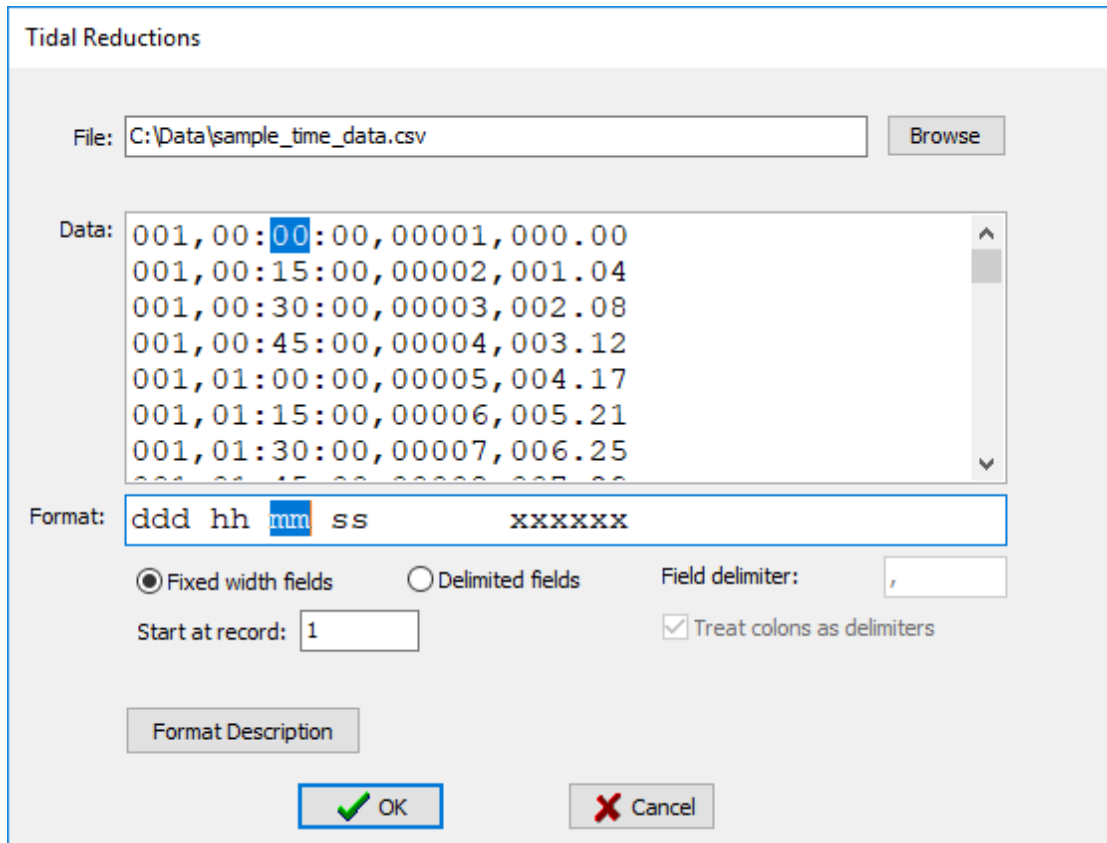
Tidal Reductions

File: `C:\Data\sample_time_data.csv` [Browse]

Data:
```
001,00:00:00,00001,000.00
001,00:15:00,00002,001.04
001,00:30:00,00003,002.08
001,00:45:00,00004,003.12
001,01:00:00,00005,004.17
001,01:15:00,00006,005.21
001,01:30:00,00007,006.25
```

Format: `ddd hh mm ss        xxxxxx`

(•) Fixed width fields   (○) Delimited fields   Field delimiter: `,`

Start at record: `1`   ☑ Treat colons as delimiters

[Format Description]

[✔ OK]   [✘ Cancel]

Figure 11-10: Output – Tidal reductions from file, fixed width format

11.5.9 P1/11

Tide value is written to user defined record extension No. 100 for echosounder records.

11.5.10 Bathymetry Database

A bathymetry database stored in a .csv file may be optionally output by checking the *Output Bathy DB* checkbox. Specify the name of the file, and select the echosounder to use.

The bathymetry DB file format is:

easting, northing, water depth, tidal reduction, year, JD, hour, minute, second

Each time a line is output the bathy DB is updated with the new data. If a line is re-output then the any changes to the water depths or tidal reductions are updated in existing records.

11.6 **Header**

11.6.1 Source

The header for P1/11 is always generated automatically. For other formats the following options are available:

None: Only data records are output. This option does not apply to P1/11 output.

From File: Header from an external text file is used. Enter the name of the header file in the *Header File* field. This option does not apply to P1/11 output.

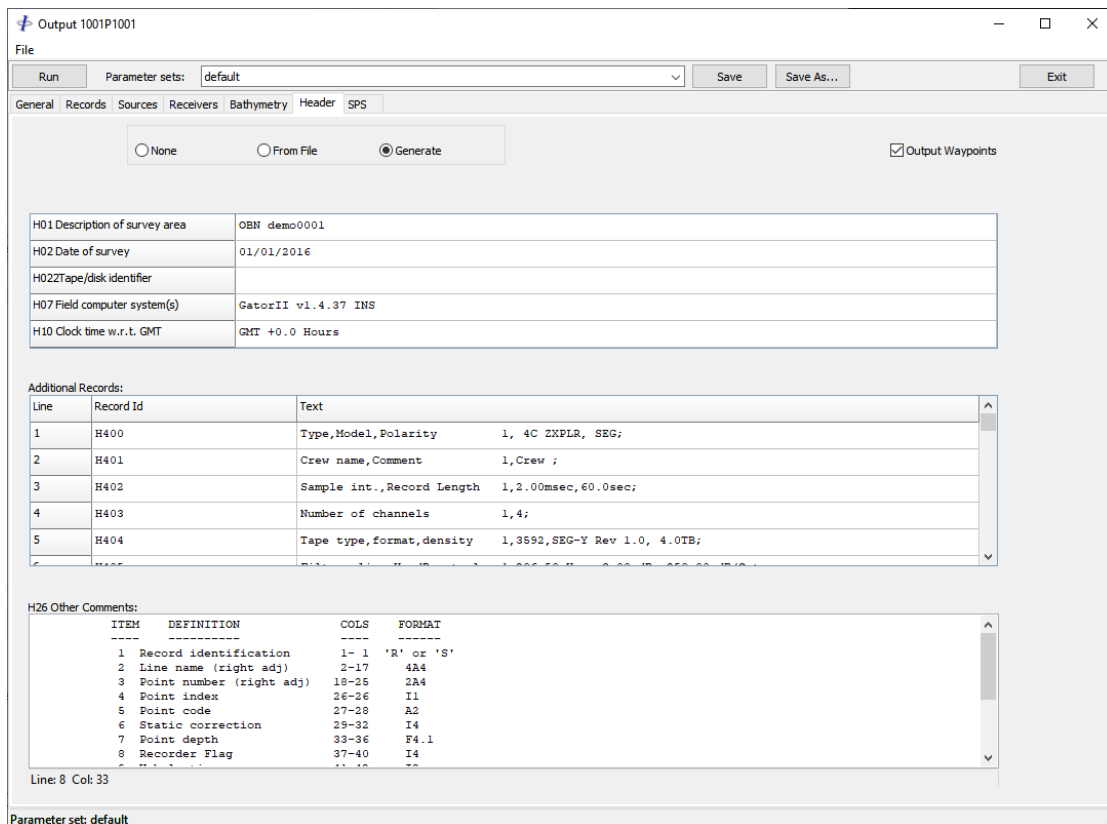*Generate:*   Header is automatically generated. This is the default setting.

Figure 11-11: Output – Header

11.6.1.1 Generate Header

If the *Generate* option is selected the header details shown in Figure 11-11 should be supplied (P1/90 option is shown, these details slightly differ when outputting P1/11 or SPS files). All other information in the header will be automatically generated from the information in the database.

11.6.1.2 Header from File

When selecting the *From File* option, checking the *Copy Header Verbatim* will not perform any checks on record lengths, otherwise records will be truncated or padded to 80 characters.

11.6.2 Output Waypoints

When the *Output Waypoints* option is used, waypoints read from the P2 will be output to comment records in a format:

P1/90:
Cols 01-21:   "H2600 WAYPOINT (E, N)"

SPS:
Cols 01-21:   "H26 WAYPOINT (E, N)"

P1/90 and SPS:
Cols 46-55   Grid easting of waypoint
Cols 56-65   Grid northing of waypoint

This option does not apply to P1/11 for which waypoints are automatically written to the N1 records.

11.6.3 Additional Records

Optionally enter additional records. These should be formatted correctly according to the format specification. Optionally use the popup menu to paste from the clipboard. When pasting, the record ID and record contents will be automatically parsed. These records will appear before the user defined comment records.

This option is not available for P1/11.

11.6.4 Comments

The information entered in the comments box (H2600, H26 or CC) may be entered without regard to record length as this is handled automatically.

For P1/90 and SPS files comment records containing waypoint coordinates referenced to the projected CRS are written. This information is optionally used in FGPS P1Tools program for calculating the along line and cross line node positions and for displaying the survey line in the replay module. Waypoints are defined in the format for P1/11.

11.6.5 P1/90 Line Name Prefix

A user specified prefix will override an automatically generated prefix, if any.

If the line name prefix specified in the H0203 record exists in the first part of the line name then it will be automatically be excluded from the line name in the data records.

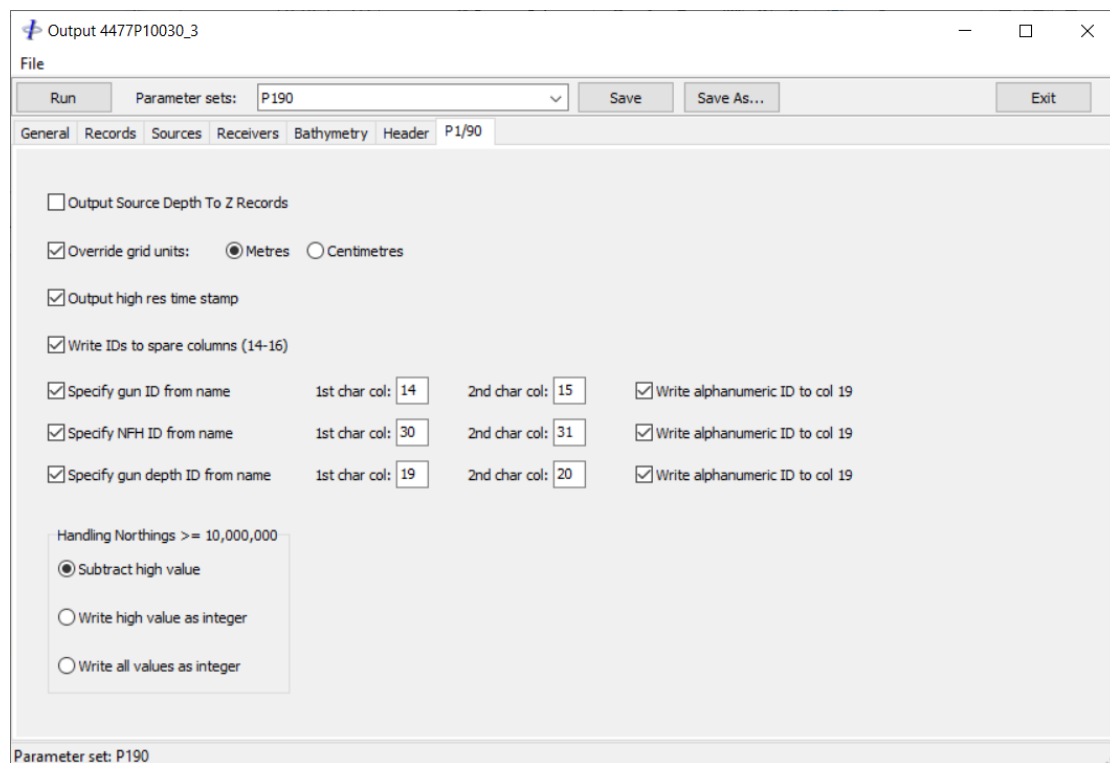## 11.7 Format Specific Options

11.7.1 P1/90

Figure 11-12: Output – P1/90 options

The following options are available in the *P1/90* options page when the output format in the General options page is set to P1/90.

Output source depth to Z records:	When this option is checked, source depth instead of water depth will be written to the Z records in the depth field (cols 65-70). Z records must be selected for output in the *Records* page.
Override grid units:	When checked, the option is provided to convert grid coordinates to metres or centimetres. If centimetres are specified then the coordinates will be written as integers.

|	
Output high res time stamp:	When checked, outputs shot times to microsecond precision.
	If the input file is P2/11 then the time stamp will be taken directly from the Source Fired Event data, otherwise the time stamp will be taken from the defined observation. See section 5.5.2.
Write IDs to spare columns:	Write buoy and gun-array component integer IDs to P1/90 spare columns 14 – 16.
	See section 11.3.1.1
Specify ID from name:	Specify the two characters to use from the relevant node name. These are combined to create the ID written col columns 15-16 in the P1/90.
	A value of 0 entered will result in the corresponding column in the P1/90 to be blank.
	Applies to gun, near field hydrophone and depth sensor.
Handle Northings >= 10 000 000	
Subtract high value:	Subtracts 10 000 000 from the northing. Applies only to the affected shots.
Write high value as integer:	Rounds the value to integer and does not write the decimal. Applies only to the affected shots.
Write all values as integer:	Rounds the value to integer and does not write the decimal. Applies to all shots regardless of the northing value.

11.7.2 SPS
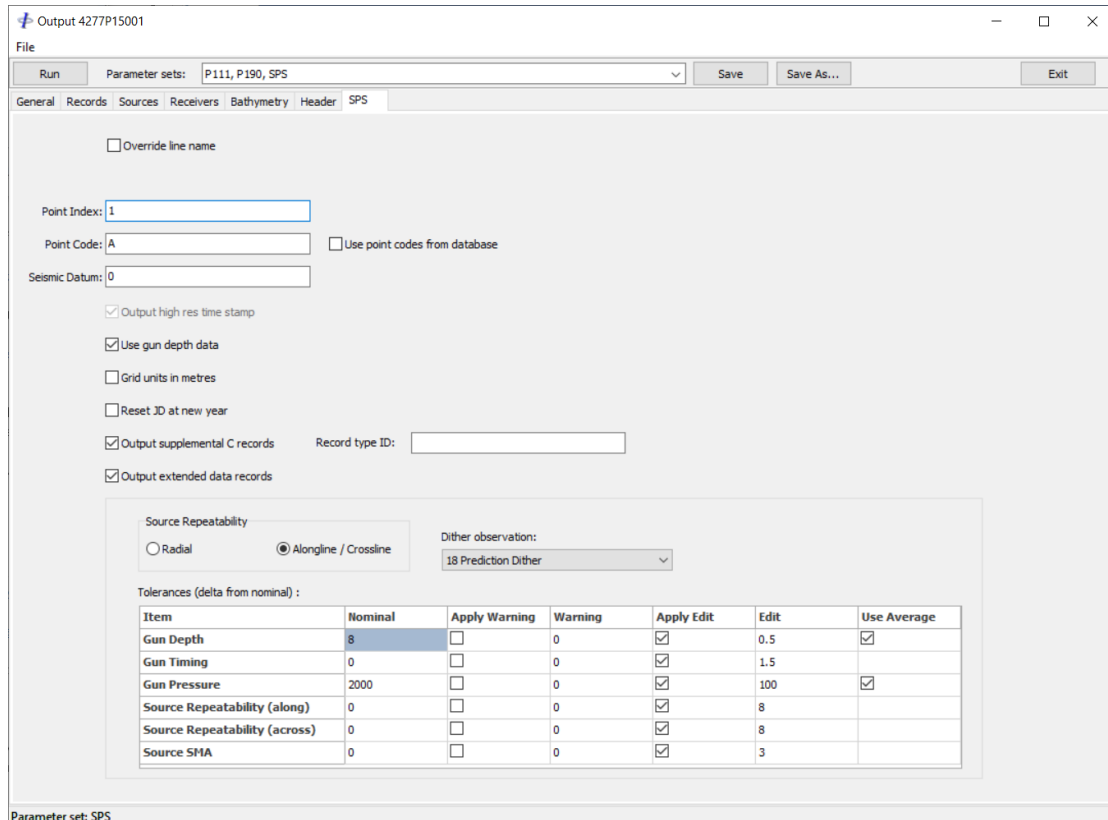
Figure 11-13: Output – SPS Options

The following options are available in the *SPS options* page when the output format in the General options page is set to one of the SPS Source options.

Override line name:	When checked, the line name will be written as specified in the *Line Name* field.
	Note: this option only applies to single line output.
Point Index:	Specify the point index to be written to all records. Valid entries are in the range 1-9. The default setting is '1'.

Point Code:	Specify the point code, maximum 2 alphanumeric characters. The default setting is 'A'.
	When one character is specified, the point code will be written as this character followed by the soured number. If two characters are specified then the source number will not be written.
Use point codes from database:	When checked, the point codes in the *Source Fired Event* table will be used. For shots with no point code specified in the *Source Fired Event* table the default point code (see *Point Code* above) will be used.
Seismic Datum:	Optionally enter an integer up to four characters long.
Output high res time stamp:	When checked, outputs shot times to microsecond precision.
	If the input file is P2/11 then the time stamp will be taken directly from the Source Fired Event data, otherwise the time stamp will be taken from the defined observation. See section 5.5.2.
Use gun depth data:	When checked, the average gun depth from all *good* gun depth sensors on the gun-array will be written instead of the nominal gun depth. This option is enabled by default.
Grid units in metres:	If checked, grid coordinates and depths will be output in metres, otherwise grid coordinates and depths will be output in the units defined by the metric conversion factor in the projection parameters.
Reset JD at new year:	When checked, the Julian day will be reset at 1 on the 1st January.
	When not checked (default), the Julian day will continue to increment from the last day in the year defined by the start of survey date as recorded. This date can be edited in the Database | Header | General table.
Output supplemental C records:	Output C records for each shot – see section 11.7.2.1
Record type ID:	Enter the record type ID.
Output extended data records:	Output additional QC data - see section 11.7.2.2

11.7.2.1 Supplemental C Records

For each shot a C record is recorded immediately after the S record in the following format:

Definition of field	Columns	Format	Value(s), min to max	Default	Justification
Comment Record ID	1-1	A1	"C"	"C"	
Record Type ID	2-8	A7	"GTR0401"	""	Left
Point Number (same as S/R record definition).	9-18	F10.2	-999999.99 to 9999999.99		Right
Unique ID (Node ID, Rx ID etc.). May be blank in S records.	19-34	A16	Alphanumeric Unique Identifier		Left
Date (yyyymmdd)	35-42	A8			Right
Time (hhmmss.ssssss)	43-55	A13			Right

11.7.2.2 Extended Data Records

High resolution shot times are set to enabled and additional QC data is output to the S records. These comprise:

SPS Column	Data
88 - 92	Line sequence number.
93 – 95	Nominal sail line azimuth from first to last waypoints.
96 – 97	Year of shot.

Shot edit status flags:

98	Gun depth.
	Any individual instrument, or the average for the array if the checkbox is checked.

99	Gun delta time (from P2/11 only).

100	Gun pressure.
	Any individual instrument, or the average for the array if the checkbox is checked.

101	Source repeatability: difference from preplot waypoint. Select between:

- Radial
- Maximum of along line and across line.

Note: if there is no corresponding waypoint, e.g. during run-in and run-out, this field will be blank.

102	Source error ellipse (SMA 95%)

103 – 107	Shot dither time in milliseconds. This is initialised from the user defined observation whose name contains the string *dither*. Select the required observation from the dropdown list if the default observation is not the required one.

Note: observation time must match source fired event time to within 1s.

For each shot edit status item enter the nominal value and the warning tolerance and edit tolerance.

Check the *Apply Warning* and *Apply Edit* checkboxes to enable/disable testing for the selected items. If both options are disabled then the resultant column in the SPS file will be blank.

If the absolute data value exceeds the nominal ± either of the specified tolerances then the flag will be set as follows:

0 = no issues

1 = warning tolerance exceeded
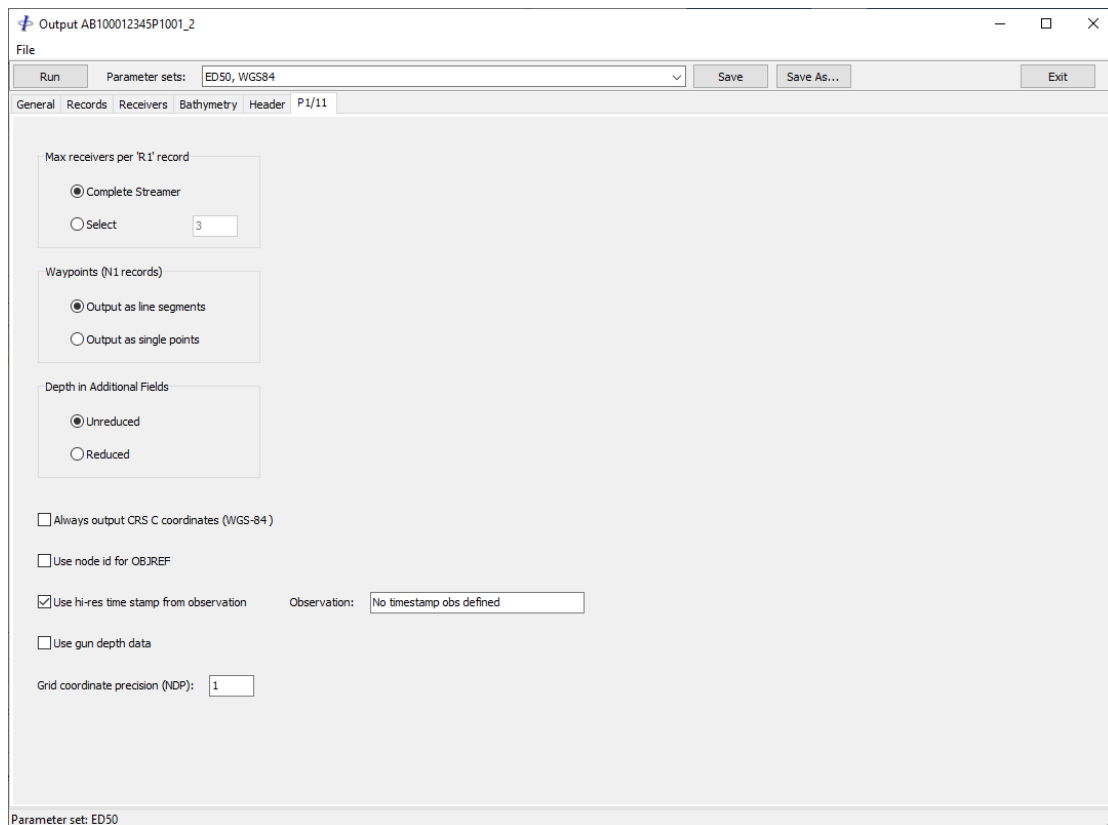
2 = edit tolerance exceeded

11.7.3 P1/11

Figure 11-14: Output – P1/11 Options

The following options are available in the *P1/11* options page when the output format in the General options page is set to P1/11.

Max receivers per R1 record

    Complete Streamer: All receivers on a streamer will be written to a single record.

    Select: Specify the maximum number of receivers to be written to a single record.

Waypoints

Output as line segments:	The preplot waypoints are written in pairs to straight line segment records (N1.2 records). This is the default setting.
Output as single points:	Each preplot waypoint is written to a single position record (N1,1 record).
Depth in additional fields	
Unreduced:	Water depths written to additional fields is not reduced.
Reduced:	Water depth written to additional fields is reduced.
Always output CRS C coordinates:	When the survey CRS's base geographic CRS is WGS-84 then, in order to avoid duplication so as to reduce file size, CRS C coordinates will only be output when this option is checked.
Use node ID for OBJREF	Object reference numbers in the P1/11 will be taken from the node IDs as seen in the database. For positioning objects defined in the P2/11 HC,2,3,0 records. Other nodes' reference numbers will be assigned by SeisPos.
Use high res time stamp from observation:	When checked, outputs shot times to microsecond precision using the defined observation. See section 5.5.2. This only applies when the input format is P2/94 because the P2/11 format has no restrictions on time precision.
Use gun depth data:	When checked, the average gun depth from all *good* gun depth sensors on the gun-array will be written instead of the nominal gun depth. This option is enabled by default.
Grid coordinate precision:	Enter the number of decimal places, from 0 to 3, required for projected CRS coordinates in P1, S1 and R1 records.

11.8 **Parameters**

To save all *Output* parameters select *File | Save Parameters* from the menu and enter a filename, or select from existing files.

To load a previously saved parameter set select *File | Load Parameters* from the menu and enter a filename, or select from existing files.

Each time the Output module is started the default parameter set loaded is the last saved or loaded. If no parameters have been previously saved then an internal default set will be applied.

The name of the current parameter set is displayed in the status bar at the bottom of the Output dialog window.

Note: *If it is intended to perform Automatic Processing on subsequent lines then the parameter set must be saved. The default set, including the record and receiver configuration will apply to Automatic Processing. If the number of records or receivers has changed a message will be displayed and Automatic Processing will not continue.*

11.9 Running

Optionally change the output settings as described in the previous sections, then click on the *Run* button. The output dialogue window closes and the log window opens in the SeisPos main window.

The output process runs in the background and the progress and any warnings appear in the log window. This same information is appended to the line log. Warnings are given for missing or interpolated shots. If invalid coordinate data is encountered, typically if a shot has not been solved, an error message will be written to the log and the shot will be skipped.

Click on the log with the right mouse button to display a popup menu giving file and text processing functions.

Click on *Stop* to abort output. The program will write the current shotpoint data and stop.

Click on the *Pause* button to pause output so that the log may be browsed. The *Pause* button changes to a *Resume* button which when clicked will resume output.

After output has completed the log window will remain visible until the *Close* button is clicked.

If the storage medium reaches capacity during output, a message will be displayed and the process suspended. To continue output free up some disk space before clicking on the *OK* button, or click the *Cancel* button to abort output.

11.9.1 Multiple Line Output

To multiple lines, from the menu select *File | Select Lines* and select the lines from the list. Click on the *Run* button. The selected lines will be output consecutively, each to a its own separate file.

For each line, the same parameters will apply except for the shotpoint range, which will be selected from the default first and last good shotpoint for each line as given in the Project.

An output summary will be displayed after all lines have been processed.

12 REPORT

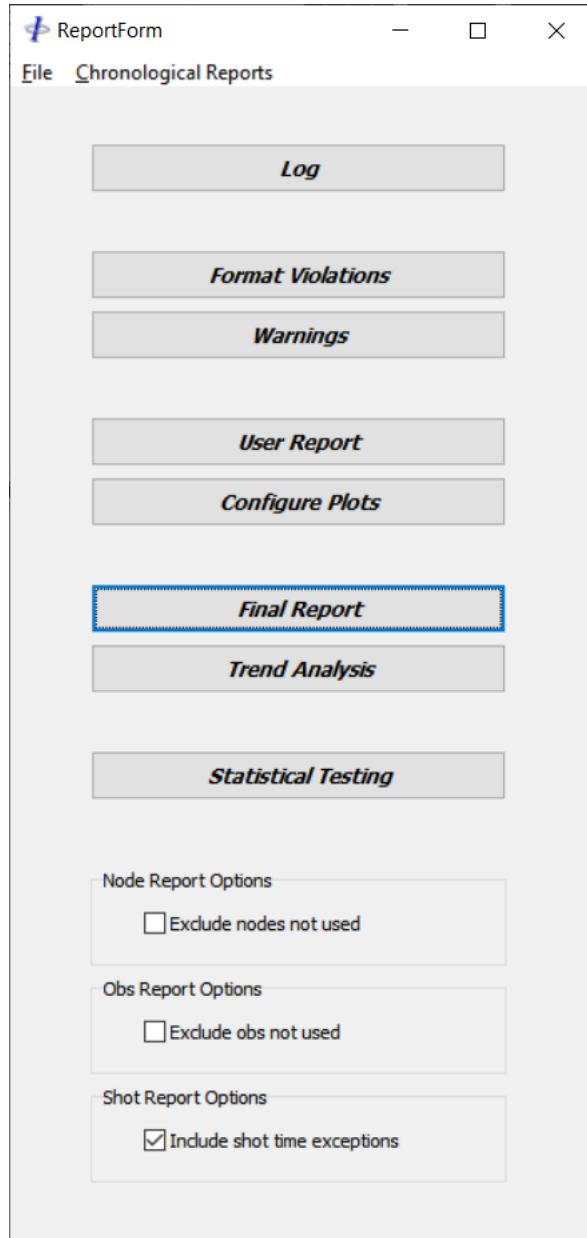To open the report module, click the *Report* button on the main toolbar.

Figure 12-1: Reports

The Report module includes features for viewing the line log, format violations, warnings and text reports, and for generating text reports, plots and trend analyses.

12.1 **Options**

Exclude nodes not used:	Nodes that have been excluded from the network adjustment will not be included in any report.
Exclude obs not used:	Observations that have been excluded from the network adjustment will not be included in any report.
Include shot time exceptions:	Shot time exceptions will be reported in the Shot Exception Report.

12.2 **Chronological Reports**

From the menu select *Chronological Reports*, followed by the report type and the line.

These are summary reports pertaining to various stages of processing of a line and are written to text files in the Report folder under the *<line_database_folder>*.

Each time a process is executed a new report file is written with the naming convention:

> *Process.#*.txt

Where *Process* is the type of report e.g. *precon*, *adjust* etc. and # is the number of the report and is incremented each time a new report is generated.

When a line is deleted from the database the report files are not deleted.

When reports are invoked from the menu the latest report, i.e. the one with the highest number, is opened. Other reports of the same type can be opened from the report window by clicking the right mouse button and selecting *Previous* or *Next* from the popup menu.

Reports applicable to the network adjustment can also be opened directly from the report menu in the Network Adjustment module.

The following reports are available:

Report Type	**Generated**
Shot Summary	Each time this report is run.
Shot Exceptions	Each time this report is run.
Node Report	Each time this report is run.

Precondition Parameters	Each time Precondition is run.
Precondition Summary	Each time Precondition is run.
Compass Biases	Each time the compass Bias Estimate is run.
Adjustment Summary	Each time the Network Adjustment is run.
Residuals	Each time the Network Adjustment is run.
Normalised Residuals	Each time the Network Adjustment is run.
Marginally Detectable Errors	Each time the Network Adjustment is run.
Semi-major Axis – 95%	Each time the Network Adjustment is run.
External Reliability	Each time the Network Adjustment is run.
Number of Observations per Node	Each time the Network Adjustment is run.
Unsolved Shots	Each time the Network Adjustment is run.
Output	Each time the line is output to file.

12.2.1 Shot Reports

The shot summary and shot exceptions reports are generated from the database in its current state, and reports the following:

- First shot
- Last shot
- Number of shots
- Shot number exceptions i.e. missing or extra shots
- Source ID exceptions: any change in the detected source firing sequence
- If enabled, shot time exceptions i.e. shot intervals outside the range:
  average interval ± half average interval

12.3 **Rejected Observation Report**

From the main menu select *Report | Rejected Observation Report.*

This report lists the number of lines in the project for which each observation is rejected. Observations which have no rejections are not included.

12.4 **Log**

Click the Log button to display the line log.

The line log for each line is created when a P2 is input. The log is located in the *<line_database_folder>*\Report folder. When a line is deleted from the project the log is not deleted. The log is of the naming convention:

> *Line_name.*LOG

Where *Line_name* is the name of the line as recorded in the P2.

Recorded in the log are all events and actions which occur during processing of the line, including warnings, format violations and comments recorded in the P2. When viewing warnings, format violations and comments only the relevant lines of the log are extracted and displayed. For this reason it is not advisable to edit the log file in any way.

The log windows which appear in the main SeisPos window when running the Input, Network Adjustment and Output modules contain the same information that is written to the log.

12.5 **Report Popup Menu**

Previous:	Open the previous report. Applies only to multiple reports with the naming convention file_*name.xx.txt* where xx is a sequential report number.
Next:	Open the next report. Applies only to multiple reports with the naming convention file_*name.xx.txt* where xx is a sequential report number.
Find:	Opens the *Find* dialog.
Replace:	Opens the *Replace* dialog.

Filter: Open the *Filter* dialog to enable filtering the contents of the window.

Select All: Selects all text.

Copy: Copies highlighted text to the clipboard.

Paste: Pastes contents of clipboard at current cursor position.

Print: Sends to the default printer.

Save As: Opens the *File Save* dialogue box, the default folder is the designated database folder.

Open: Opens the *File Open* dialogue box. When a new file is opened the contents of the report window are discarded without saving. The default folder is the designated database folder.

Close: Closes the report window.
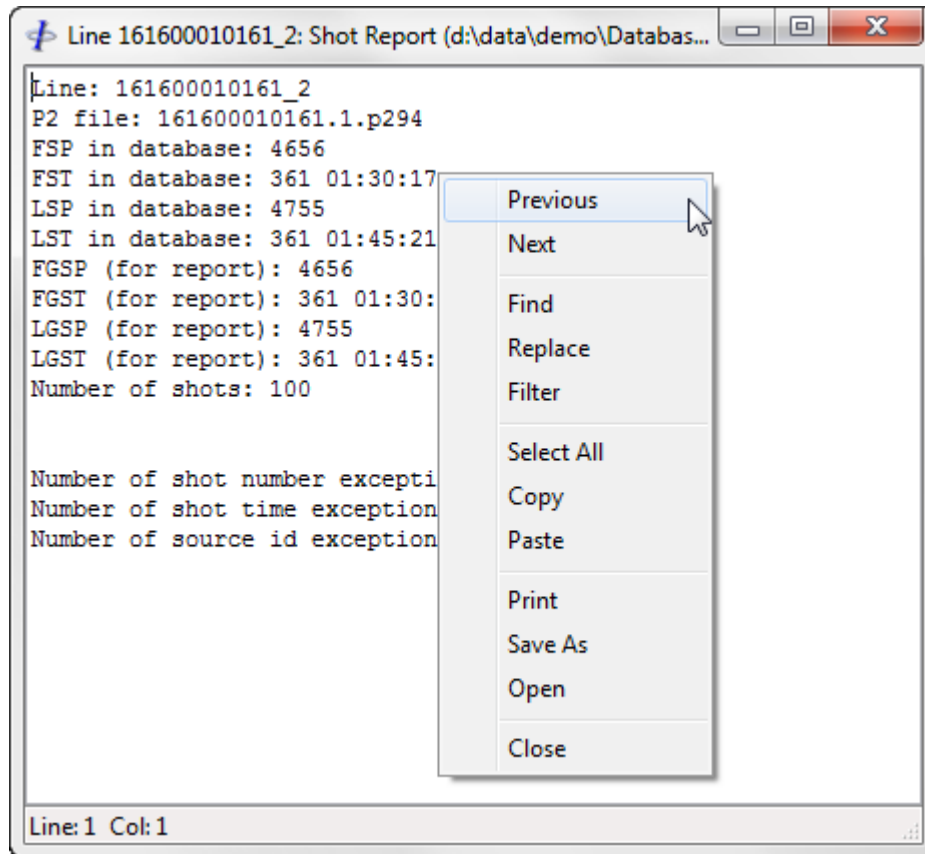
Figure 12-2: Report – Popup Menu

12.6 User Report

The *User Report* is a document for recording user comments. The report is saved in Rich Text format under the *<project_reports_folder>*, and is named according to the following convention:

*Line_name_*user.rtf

Note: *If the report file name is changed it will not be included in the final report.*

12.7 Plot Configuration

SeisPos supports saved configuration and automatic printing of all available plots which can be seen in the Precondition and Quality Control modules. From the Report module click *Configure Plots*.
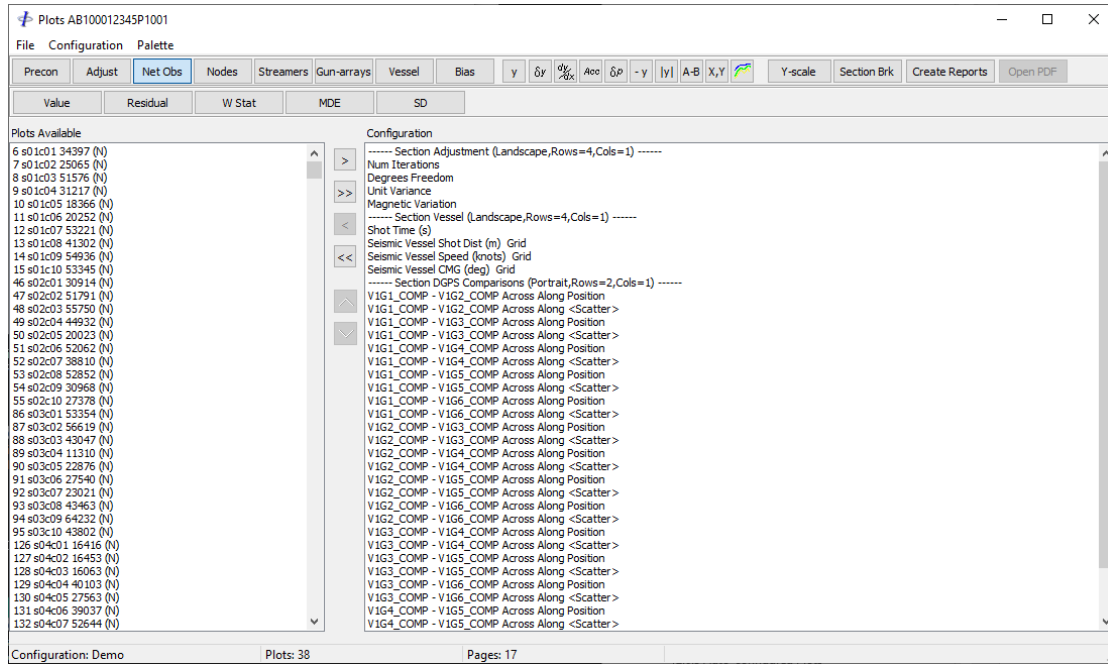
Figure 12-3: Report – Configure Plots

Plots are classified by *Group* and *Series*, and can be modified according to *Type*.

12.7.1 Groups and Series

Plot groups and the series available for each group are given in the table below:

Group	**Series**
Precon: *(Series can be overlaid)*	Raw (time domain) Processed (time domain) Processed minus Nominal Shot Event (shot domain). See section 12.7.2 below.
Adjustment:	Number of iterations Degrees of freedom Unit variance Speed of Sound Magnetic variation
Network Observations: *(Series can be overlaid)*	Value Residual W Statistic (normalised residual) MDE (marginally detectable error) SD (a priori standard deviation)

Nodes:	Across (distance across from pre-plot)
(Series can be overlaid)	Along (distance along from start of line)
	Easting
	Northing
	Position (only used for comparisons)
	SMA (semi-major axis 95% ellipse)
	External reliability
	Number of observations to/from a node
Streamers:	Rotation
(Series can be overlaid)	Stretch
	Feather
	Mean depth
	Min depth
	Max depth
Gun-Arrays:	Array azimuth
	Sub-array azimuths
	Sub-array crossline separations
	Sub-array alongline separations
	Sub-array radial separations
Vessel:	Shot time interval
	Inter-shot distance – grid or ellipsoid
	Speed – grid or ellipsoid
	CMG (course made good) – grid or ellipsoid
Bias:	Compass bias

12.7.2 Shot Event Data

Shot event data cannot be used with other series.

Shot Event data may be refined to contain only data pertaining to the active source by clicking the *Active Source* button. If the selected observations are directly or indirectly referenced to a gun-array then only data for shots for which that gun-array fires will be plotted. Clicking the button again will toggle off this option.

12.7.3 Creating/Modifying and Printing a Configuration

When any of the group buttons (see Figure 12-3) are clicked the series toolbar for that group appears, and the *Plots Available* list shows all plots that are available in that group.

The current configuration is shown in the *Configuration* list.

To add to the configuration:
1. Click on the required group button.

2. Select the required plots from the *Available* list. Multiple selections can be made by using the *Ctrl* and *Shift* keys in the usual manner.

3. Click on the > button to add the selected plots, or the >> button to add all plots in the group.

4. For all groups except *Adjustment* and *Vessel*, select the plots in the *Configuration* list and click on the required series button. The series name will be added to the plot name.

12.7.3.1 Series

Some plots can be configured to overlay multiple series (see section 12.7.1). Highlight the required plots in the *Configuration* list and click in turn on each of the required series. Each time a series button is clicked that series will be toggled on or off for all the selected plots for which those series apply. The plot name in the *Configuration* list will be modified accordingly.

12.7.3.2 Types

Each plot can be configured to plot one of the following plot *Types* as indicated in the *Type* toolbar in Figure 12-3:

y	Normal plot
δy	Delta plot – point to point difference
$\frac{dy}{dx}$	Rate of change plot
Acc	Acceleration plot
δp	Polynomial delta plot – difference from least squares polynomial of specifiable order from 1 to 25 fitted through all good points.
- y	Reverses the sign of the samples
|y|	Plot absolute values
A-B	Comparison plot
X,Y	Scatter plot – applies only to position comparison plots. Requires two series: across line and along line, or Easting and Northing.

Overlay plots. Up to 25 plots may be overlaid. To overlay plots:
1. Select the plot in the *Configuration* list for which overlays are required.
2. Click down the *Overlay* button.
3. Select the plots to overlay from the *Plots Available* list.
4. Unclick the *Overlay* button.

To list the overlays, right click on the plot and from the popup menu select *Overlays.*

To remove overlays click the [y] button.

Note: only one series can be plotted for overlaid plots.

To modify the plot *Type,* highlight the required plots in the *Configuration* list and click on the appropriate *Type* button. The plot name(s) will be modified accordingly.

To specify a plot's comparison plot, highlight the required plots in the *Configuration* list. Then with the *A-B* button depressed select the required comparison plot in the *Available* list. Both plots must be of the same *Group.* The plot name(s) will be modified accordingly.

Click on the *y* button to reset selected plots to normal and no comparison.

12.7.3.3 Y-Scale

Click on the *Y-scale* button to modify the Y-axis scaling for the highlighted plots in the configuration. Four options are available as shown in Figure 12-4:

Auto:	This is the default mode – plots will be scaled by the maximum and minimum data values.
Absolute Max/Min:	Enter the *maximum* and *minimum* values for the Y-axis.
Mean ± Value:	The Y-axis maximum and minimum values will be the mean data value plus and minus the entered *value.*
Nominal ± Value:	The Y-axis maximum and minimum values will be the entered *nominal* plus and minus the entered *value.* In the case of *Precondition* data, the *nominal* is taken from the observation database and any entered *nominal* will have no effect. The nominal value will be plotted in red.

Node Crossline Offset:	The entered value will be added to the data prior to plotting. This option is enabled only for data group *NODES*, series *Across*, plot type *Normal*.

If multiple plots are selected the dialog options and fields will be those of the *last* plot of the selection. On clicking *Ok* the scaling parameters will be applied to *all* plots in the selection.
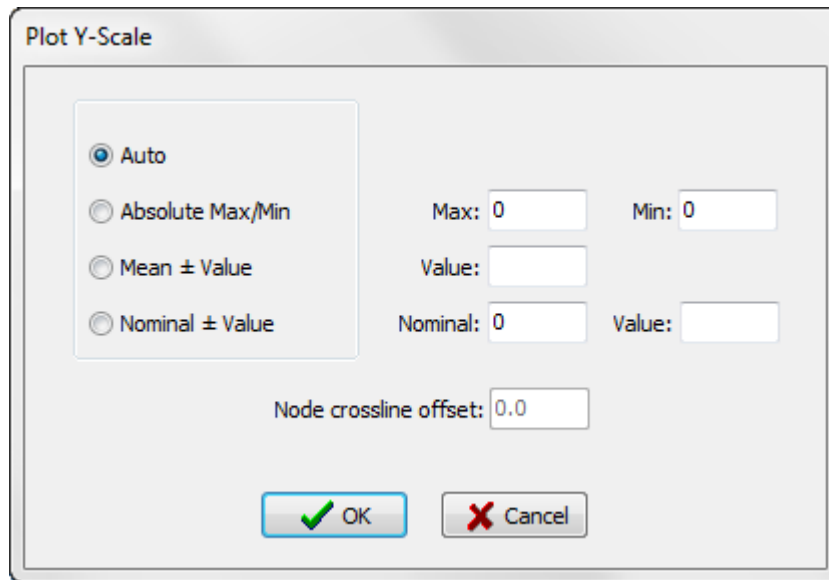

Figure 12-4: Report – Plot Scale

12.7.3.4 Section Breaks

A section break contains the title and formatting for the plots that follow it. A configuration must start with a section break.

To add a section break, highlight the first plot to be included in that section and click the *Section Break* button. Enter the title and formatting parameters as shown in Figure 12-5.

Section breaks can be moved and deleted in the same way as plots items in the list except for the first section break which cannot be deleted.

To edit a section break, double click on it, or right click and select *Edit* from the popup menu.
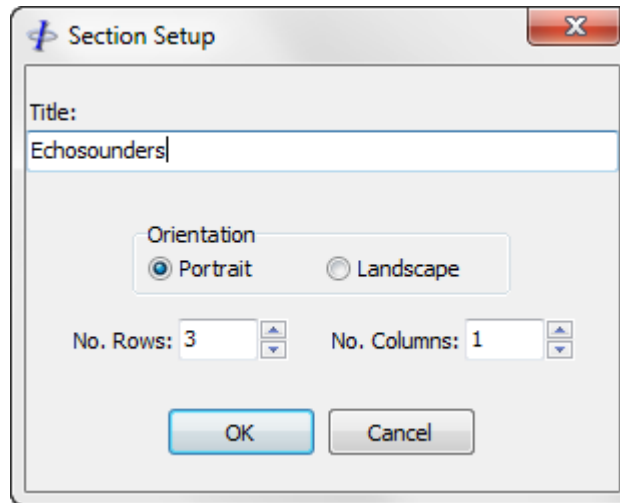
Figure 12-5: Report – Plot Section Break

12.7.3.5 Saving/Loading a Configuration

To save the current configuration as appears in the *Configuration* list, select
Configuration | Save from the menu to display the File Save dialog. Enter an
appropriate name and click on *Save*.

To load a previously saved configuration, select *Configuration | Load* from the menu
to display the File Open dialog and select the required configuration. If the current
configuration has not been saved a message box prompting to save will appear.

When loading a configuration when the existing configuration list contains items, a
prompt appears asking to replace the existing configuration. By clicking the *No*
button, the configuration being loaded will be appended to the existing configuration.
The configuration name will be replaced by that of the configuration being loaded.

When a configuration is saved or loaded, its name appears in the left of the status
bar at the bottom of the window.

12.7.3.6 Output

To send the current configuration as appears in the *Configuration* list to the printer for
the selected line select *Print* from the *File* menu.

To output the current configuration to PDF and/or CSV file, click the *Create PDF*
button. The file is named after the sequence number, line name and configuration
name, and is saved in the *<project_reports_folder>.*

Multiple lines may be output in one go by first selecting the required lines from the
File | Select Line menu option.

If only one line has been selected a dialog box as shown in Figure 12-6 will appear
prompting for the shotpoint range and title to appear at the top of the plot. The default

values for the shotpoint range are the first and last good shot point as given in the project details. The default plot title is made up from the line sequence and name and the configuration name.
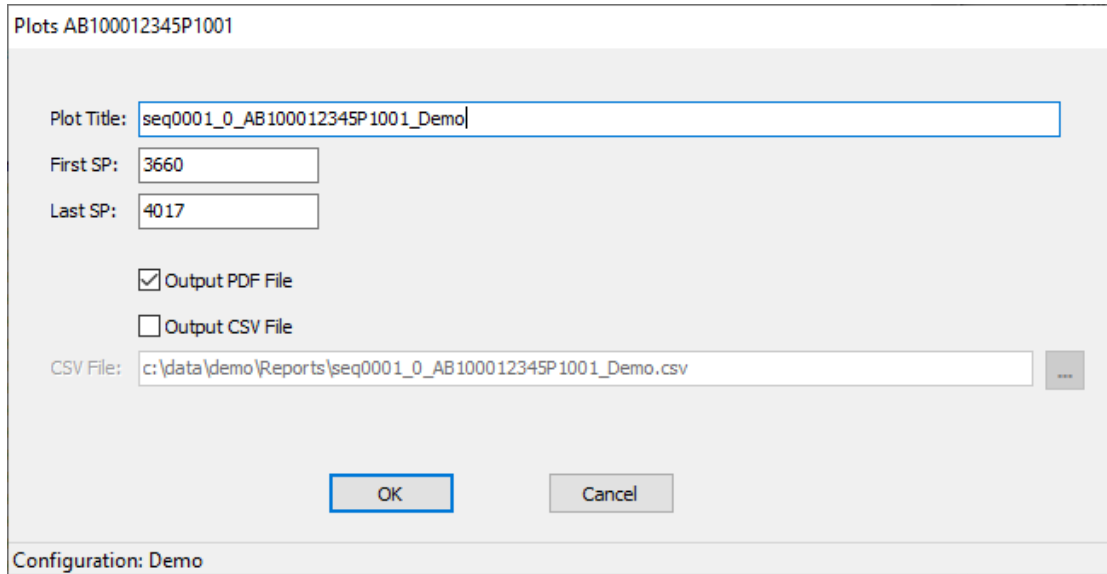

Figure 12-6: Report – Output Dialog

If multiple lines have been selected then this dialog will not appear and for each line the default first and last good shotpoint ranges and plot title will apply.

12.7.3.7 Output to CSV File

By checking the *Output CSV File* checkbox and entering a file name in the Print Dialog, shown in Figure 12-6, all data will be written to a comma separated value (CSV) file in addition to being plotted.

Each series will be written to file in a separate column.

The Raw and Processed series observation data in Precon cannot be written to CSV file because of the variable number of samples. To write Precon data select the Shot Event series.

Selecting an existing file will cause the new data columns to be appended alongside existing columns of data in the file.

When saving parameters for the Plot Configuration module the state of the *Output CSV File* checkbox will be saved.

12.7.4 Auto-configured Plots

The *Configuration | Auto-Configure* menu option provides options to automatically create the following plot configurations. Unless otherwise stated, all plots are in the shot domain. These configurations are saved in the *<project_database_folder>*.and

are available for use in the *Trend Analysis* and *Final Report* modules.

Adjustment:	Number of iterations
	Degrees of freedom
	Unit variance
	Speed of sound for acoustics (if computed)
	Magnetic variation (if used)

Vessels:	Shot time
	For each vessel:
	Shot distance
	Speed
	Course made good
	Crab

Node Movement: For nodes of type Vessel, Gun-array, Compass and Tailbuoy the delta values of the across line and along line node positions.

Note that any anomalies in the shot distance, e.g. a missing shot, will cause a spike to appear in the delta along line plots for all nodes. In this case it may be preferable to replace the delta with rate of change.

Streamers:	For each streamer:
	Rotation
	Stretch
	Feather
	Mean, minimum and maximum depth on active streamer

Compass Biases: Bias

Note that compasses are identified by their serial numbers. This enables tracking of individual compass biases in the Trend Analysis module (see section 12.9.2).

Echosounders:	For each echosounder:
	Raw and processed (time domain) in separate plots
	Comparison with all other echosounders

Gun Depths: Depth, scaled by its nominal value ± 0.5

DGPS Comparisons: DGPS comparison nodes must have been created in the database (see section 5.1.4). For each system:
    Across and along delta from each other system
    Scatter plot comparing with to each other system

Separations: Gun-array and streamer separations using radial distance between adjacent sources and streamers, starboard to port.

Gun-arrays:	Gun-array azimuths and sub-array azimuths; cross line, along line and radial separations based on array azimuth.
	If sub-array separation nodes have been created then these will be used.
	Gun-array depth.
Gyro comparisons:	For each gyro:
	Comparison of its shot event data with all other gyros
	Comparison of its network observation with all other gyros
	Note that the network observation takes into account scale, C-O and grid convergence.

12.7.5 Palette

To change the plotting colours, select *Palette | Edit | Series* # from the menu where # is the series number from 1 to 6. The palette dialog defaults to the current colour for the selected series.

To save the current palette select *Palette | Save* from the menu. To load a previously saved palette, select *Palette | Load* from the menu. The palette files are compatible with those used in the Precondition and QC modules.

12.7.6 Parameters

To save the current window settings and plot configuration select *File | Save Parameters*. Each time the module is subsequently started these parameters will be automatically applied.

12.8 Final Report

The Final Report module provides the functionality to combine selected text reports and plot configurations into a single report in PDF format, and text reports in plain text format.

Unlike the *Chronological Reports* the *Final Report* re-computes the statistics from the database so that the report reflects the actual, *final*, state of the process for the line. Assume for example that a line has been adjusted in several parts, none of which included the entire shot range. Then each of the chronological adjustment reports will reflect only the portion of the line adjusted. When generating the final report however, all data is re-read from the database so that the statistics reported are an accurate reflection of the whole line. The only exceptions to this are for the Shot, Compass Bias the Output reports, for which the latest chronological reports are used.

The Final Report is compiled from the individual reports and plots selected from the list on the left and dragged using the mouse to the right-hand list.

To reorder the items in the report drag them to a new position using the mouse.

To remove an item from the report, click on it and press the *<Del>* key.

To save or load a configuration select the appropriate *File* menu options,

To generate the report, select the formats by checking the *PDF* and/or *Text* checkboxes, then click the *Create Report* button. Note that plots are not output to text reports.

To generate multiple line reports, first select from the menu *File | Select Lines.* Each report is saved to a separate file.

When *Automatic* processing is carried out (see section 4.4) the final report, if configured, will be produced.

The report files are saved in the *<project_reports_folder>* and are named according to the following convention:

Seq*<sequence>*_0_*<line_database_name>*_proc_report.xx

Where xx is a number starting at 0 and incremented each time the report is produced.

NOTE: Nodes not solved in the last network adjustment are excluded from all node related text reports.
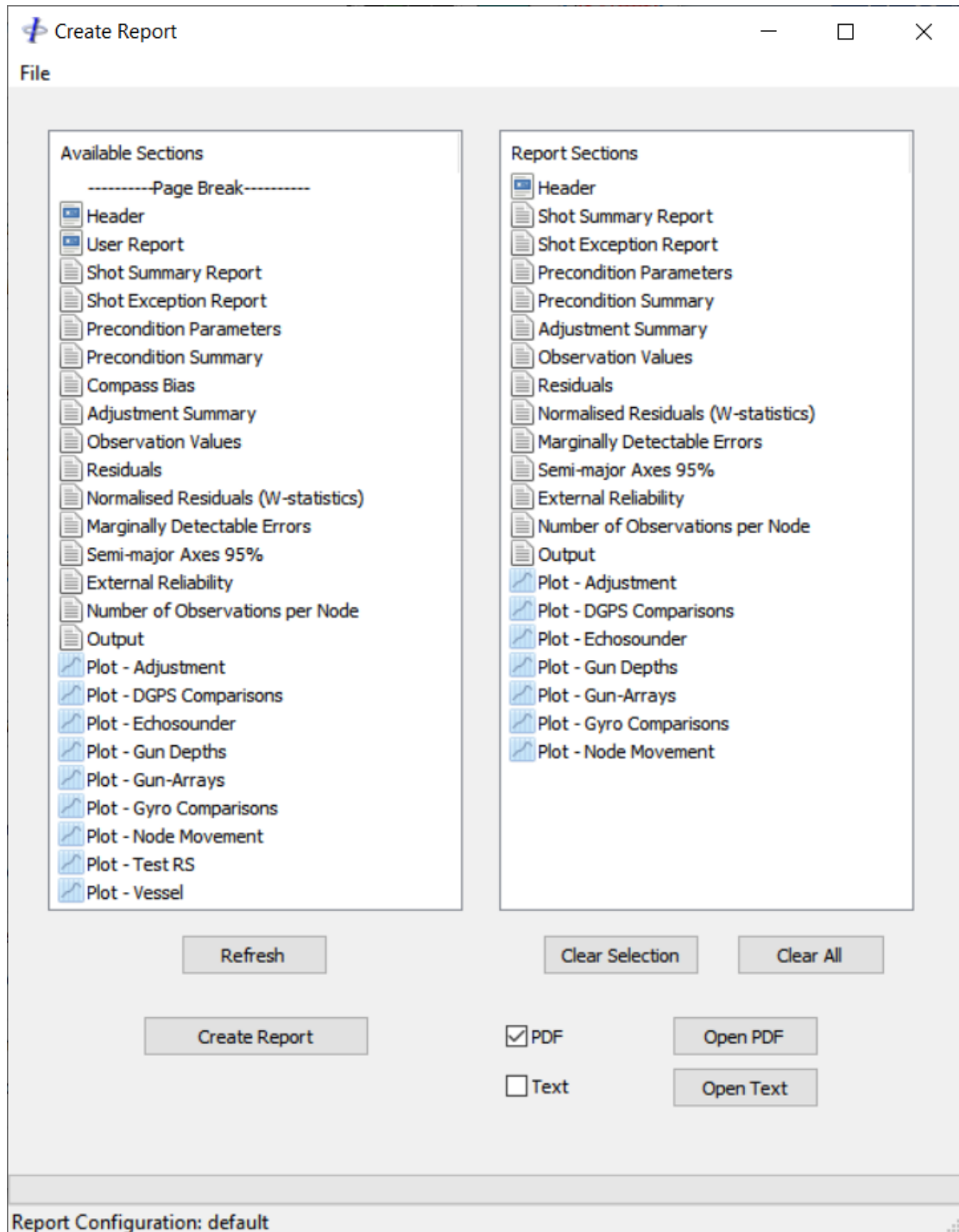
Figure 12-7: Report – Final Report

The shotpoint range used for all reports and plots is the FGSP – LGSP as appears in the Project window.

12.9 Trend Analysis

The Trend Analysis module is used to track statistics for all available data items throughout the project. For each line in the project the Mean, Maximum, Minimum and Standard Deviation of the selected data item is plotted.

From the main menu select *Execute | Trend Analysis*.
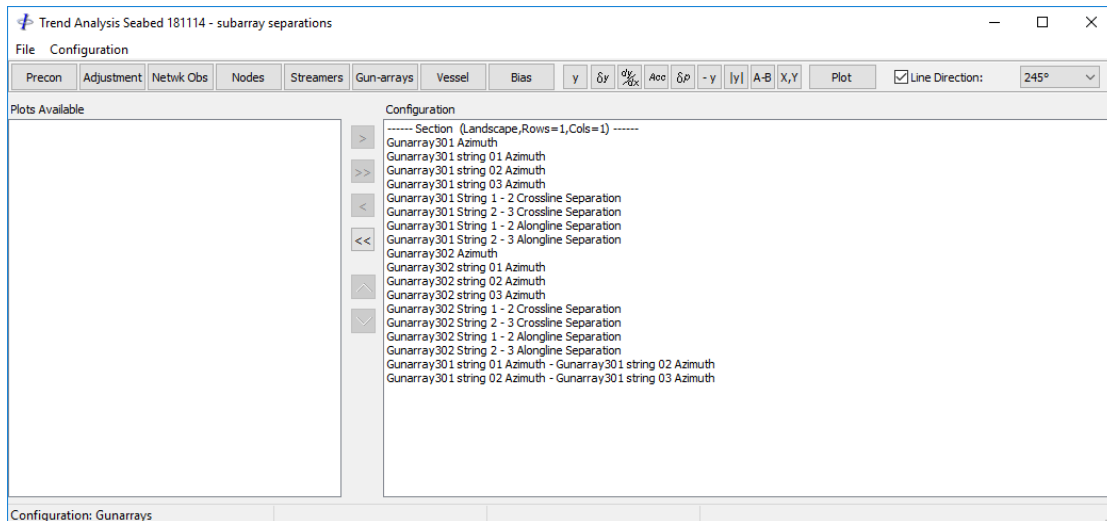
Figure 12-8: Report – Trend Analysis

The general behaviour of the *Trend Analysis* module is identical to that of the *Configure Plots* module. Behaviour unique to the *Trend Analysis* module is described below.

12.9.1 Groups and Series

The plot groups and series are identical to those in the *Configure Plots* module with the exception of the *Compass Bias* series which is added to the *Streamer* group (see section 12.9.2).

12.9.2 Compass Biases

Plot option 1:

The *Bias* group displays the mean, minimum and maximum value for each selected compass, by serial number, based on its *shot-by-shot* computed bias. The *mean* series is indicative of the actual compass bias. The *maximum* and *minimum* series may be useful as part of an analysis of streamer dynamics, or indicative of compasses which provide grossly inaccurate data over a part of the line.

The data for these plots is stored in *.bias* files in the *<line_database_folder>* for each line*.*

Note: This plot configuration is designed to track compass performance based on

actual serial number as opposed to compass number.

Plot option 2:

The *Streamers* group contains a series for *Compass Bias* which displays, for each selected streamer, the mean, minimum and maximum of the (mean of all shots) bias of all compasses on that streamer. This plot therefore indicates the value of the most biased compass on that streamer (minimum or maximum), and the mean bias for all compasses, which should approximate zero.

12.9.3 Creating/Modifying a Configuration

Creation of plot configurations is identical to that described in section 12.7.2 under Plot Configuration.

Configurations created in the Trend Analysis *and Configure Plots* modules are interchangeable, with the exception that the *Trend Analysis* module does not support section breaks.

The *Trend Analysis* module does not support the *Auto-Configure* menu options.

12.9.4 Line Direction

For some plots, e.g. Vessel Course Made Good, Compass Biases, it is often more useful to group data by a common line heading. In this case check the *Line Direction* checkbox and select the line direction from the dropdown list. Directions are based on the line direction as specified in the Database *General* table, rounded to the nearest whole degree. Only lines whose direction is specified will appear in the line selection dialog.

12.9.5 Plotting

To send the current configuration as appears in the *Configuration* list to the interactive Multiplot module click the *Plot* button.

The line selection dialog appears, sorted by sequence, with all lines selected. At least three lines must be selected.

Note: *When trend analysis computed for the first time the operation can take several minutes as the relevant database tables are read, depending on how many plots are in the configuration and how many lines have been selected. The trend analysis results for each plot and line are then saved in a summary file (*.sum) in the <line_database_folder> for each line. On subsequent computations, if the particular database table is unchanged and the FGSP-LGSP are unchanged then the summary file is read resulting in a significant time saving.*

The interactive *Multiplot* display is shown for the selected lines. The line sequence number is plotted along the X-axis. Each data item appears in a separate plot with its

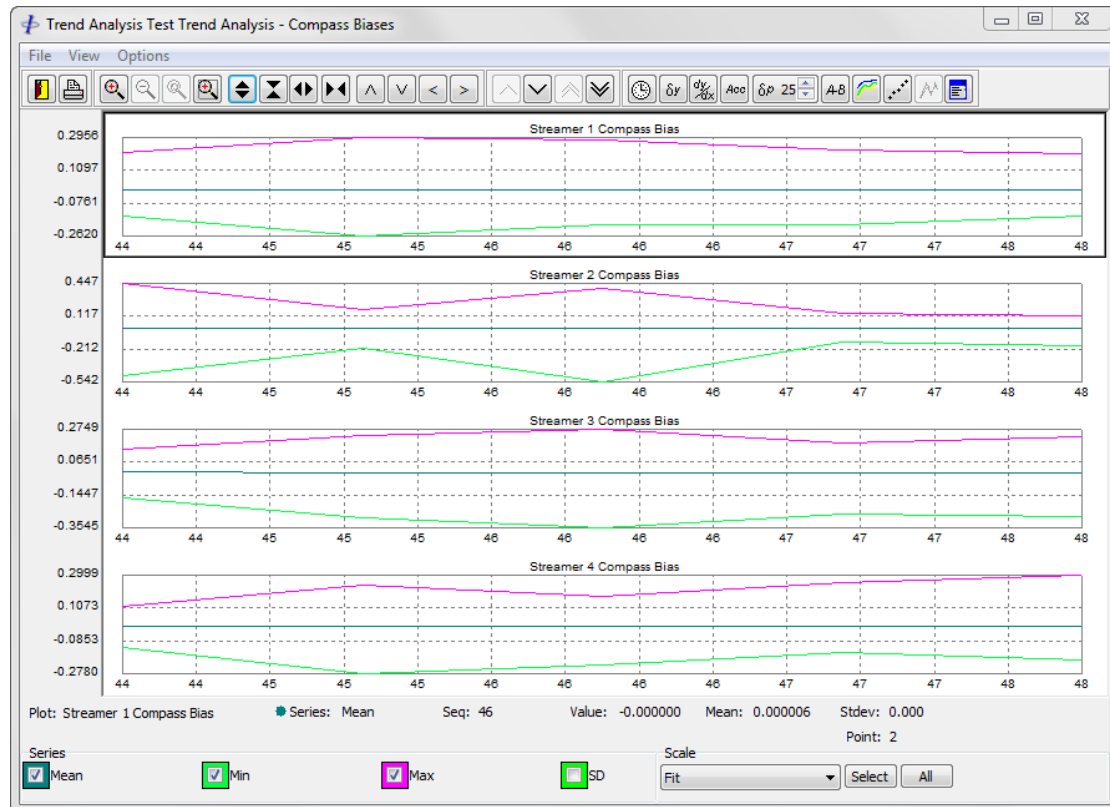series overlaid. Refer to the *MultiPlot manual* for a description of the *Multiplot* module.

Figure 12-9: Report – Trend Analysis, plots

12.9.6 Output to CSV File

The *Output CSV Dialog* appears after the line selection has been made.

By checking the *Output CSV File* checkbox and entering a file name in, shown in Figure 12-6, all data will be written to a comma separated value (CSV) file in addition to being plotted.
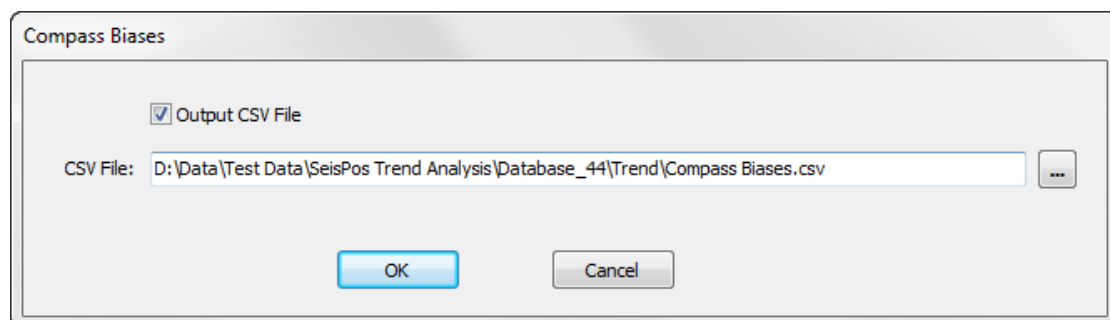

Figure 12-10: Report – Trend Analysis, CSV file

Each series will be written to file in a separate column in the file.

Warning: Selecting an existing file will overwrite the contents of that file.

12.10 Statistical Testing

The *Statistical Testing* module provides the functionality to perform tests on data from configured plots based on user specified criteria. The plots need to first be configured as described in section 12.7 above.
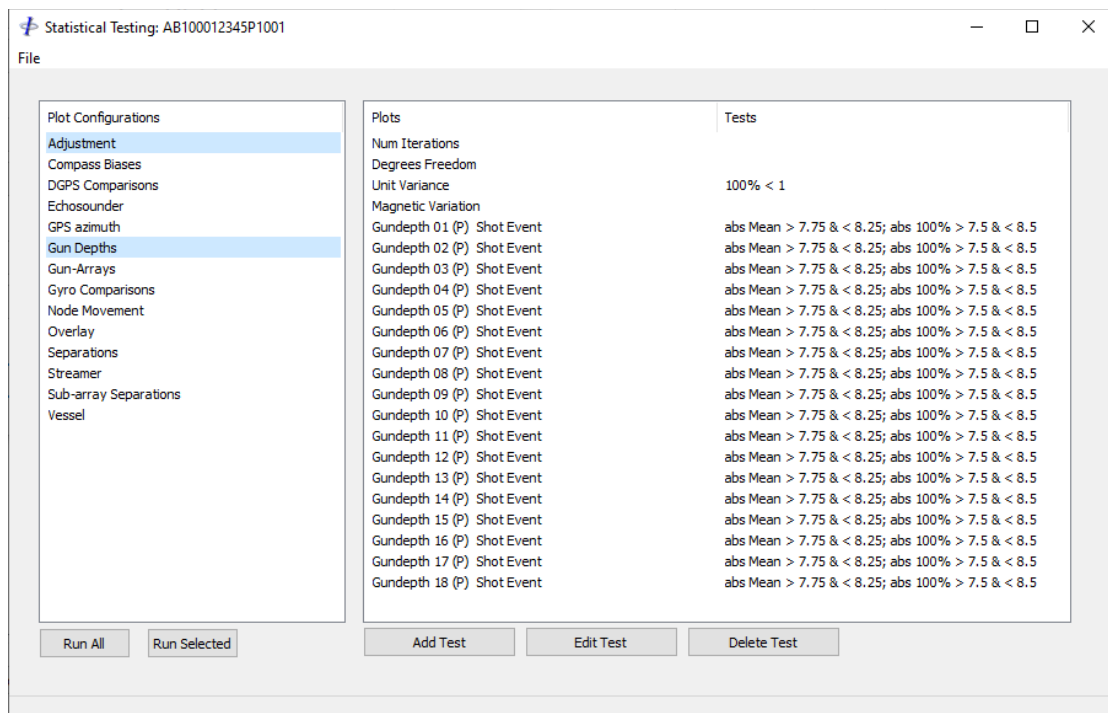
Figure 12-11: Report - Statistical Testing

12.10.1   Defining Test Criteria

To add test criteria first select the plots for which the tests are to be defined, then click *Add Test* button.
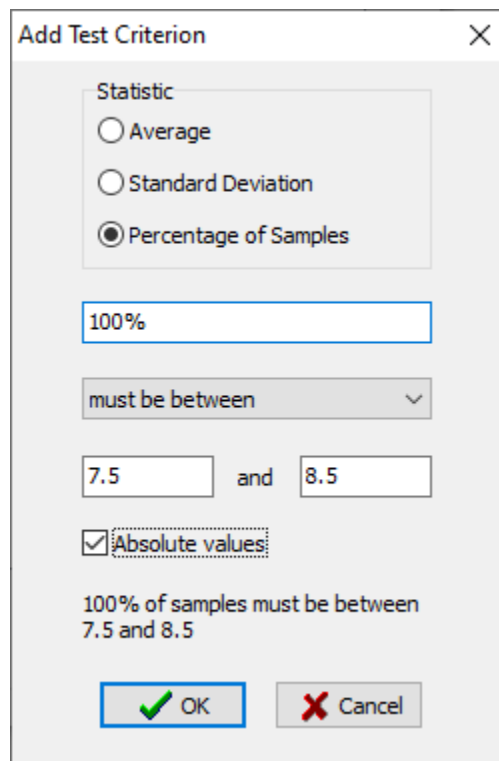
Figure 12-12: Report - Add Statistical Test

A criterion is formed by specifying the *Statistic*, the *Operator*, and the *Value*. The resultant criterion is displayed textually below the value field.

Clicking the *OK* button adds the specified criterion to the selected plots.

Multiple tests can be defined for the same plot(s).

12.10.2   *Editing Test Criteria*

To edit a test first select the plots for which the test is defined, then click the *Edit Test* button. If more than one test has been defined for the selected plots then select the test to edit from the list which appears.

12.10.3   *Deleting Test Criteria*

To delete a test first select the plots for which the test is defined, then click the *Delete Test* button. If more than one test has been defined for the selected plots then select the test to delete from the list which appears.

12.10.4   *Series*

At present only the first series of a plot will be available for testing.

12.10.5   Running the Tests

Optionally select multiple lines using the *File | Select Lines* menu item.

Click the *Run All* button to run the tests for all plot configurations.

Click the *Run Selected* button to run the tests for the selected plot configurations.

For each plot configuration, all tests that have been defined will be run.

12.10.6   Test Reports

A test report text file will be saved for each line in the *<project_reports_folder>*.

Note: existing report files will be overwritten. It is advised to run all tests in order to preserve or update existing test results.

In addition, all test reports are concatenated into a report window which appears on completion of the test, and for which an example appears in Figure 12-13 below.

For each test, only failures are reported in the following columns:
- Plot name
- Test criterion
- The value, or maximum or minimum value, which has caused the failure.

This report can optionally be saved by right clicking on the window to select *Save As* from the popup menu.

Figure 12-13: Report - Statistical Test Report

13   AUTOMATIC PROCESSING

SeisPos supports Automatic Processing whereby it is possible to process a line from input of P2 data file to output of P1 or SPS file without manual intervention.

To specify automatic processing select the Automatic option in the Input dialog when inputting one or more lines. It is also strongly recommended to enter the first and last good shotpoints to prevent the possibility of the network adjustment failing because of lack of good data at the start and end of line.
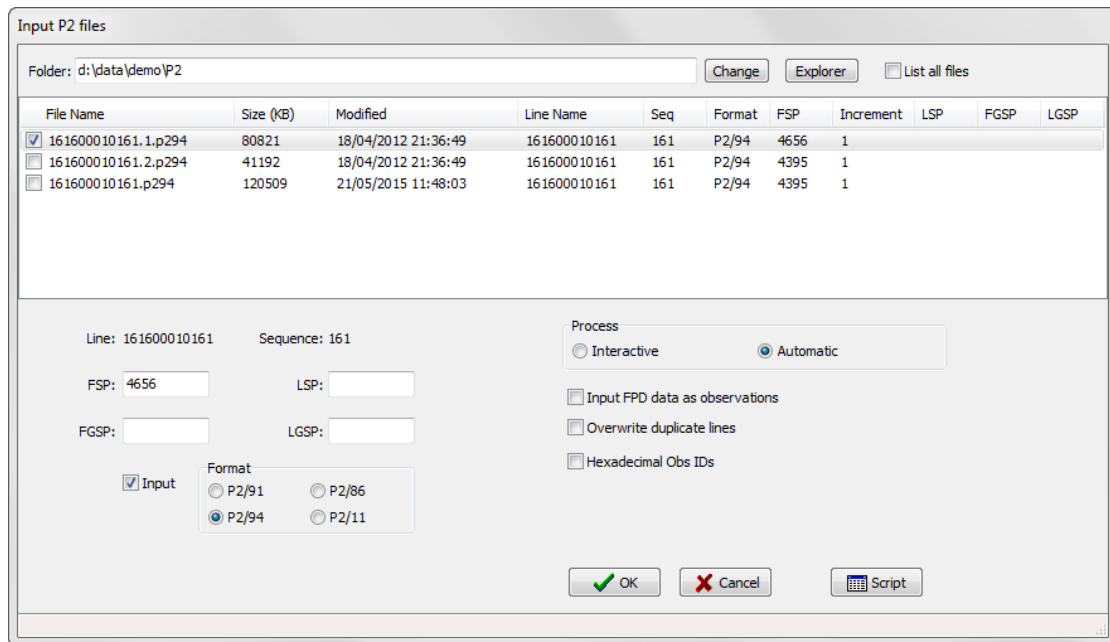

Figure 13-1: Automatic Processing

13.1   Parameter Setup

It is not necessary to establish any parameters in the various modules prior to automatic processing. However, if this is done then the parameters last saved in each module will be used. It is recommended that parameters be established and saved in the various individual modules during interactive processing of the first line, in particular the following:

Database:	Make any changes required to optimise the network node and observation configuration then create default nodes and observations. Such changes may be the result of the creation of nodes and/or observations.
Precondition:	Precondition one line, selecting optimal processing parameters. Save these as defaults when prompted.
Compass Bias Estimate:	Configure the parameters as required then save the default parameters (*File | Save Parameters*). It is

recommended that auto-reject be enabled.

Network Adjustment: Save the network configuration if the default network (*whole.net*) is not to be used (*Network | Save Network*), set all the adjustment parameters as required, then save the default parameters (*File | Save Parameter Set*).

Set the a priori standard deviations as required and save these to defaults.

Output: Configure the output parameters as required, including records and header, then save the default parameters (*File | Save Parameters*).

13.2 Processing Flow

The automatic processing flow is as follows:

1. The line is input for the specified shotpoint range or for all shots if none are specified.

2. The first and last good shotpoint, if specified, are recorded with the line attributes and are shown in the project details.

3. All default database tables that have been previously created are loaded.

4. The whole line is preconditioned using the saved default parameters

5. Compass bias estimation is performed using the default or saved parameters.

6. The line is adjusted for the first to last good shotpoint range. The network configuration used is that which was in use when the adjustment parameters were saved. The adjustment parameters used, except for output, are those in use when the adjustment parameters were last saved. For output, all options are enabled.

7. The line is output using the output parameters and record and receiver configurations in use when the parameters were last saved.

If the processing flow is interrupted any time with a dialog requiring user input then processing may be stopped depending on the response. Most likely reasons would be errors in the P2 file or incompatible nodes or observations with those configured.

If the network adjustment does not run to completion then the P190 output will not be performed.

14 UTILITIES

The following utilities are accessed from *main menu | Utilities.*

14.1 Extract P2

This module enables the extraction of the header and a specified range of shotpoints from a UKOOA P2 file.
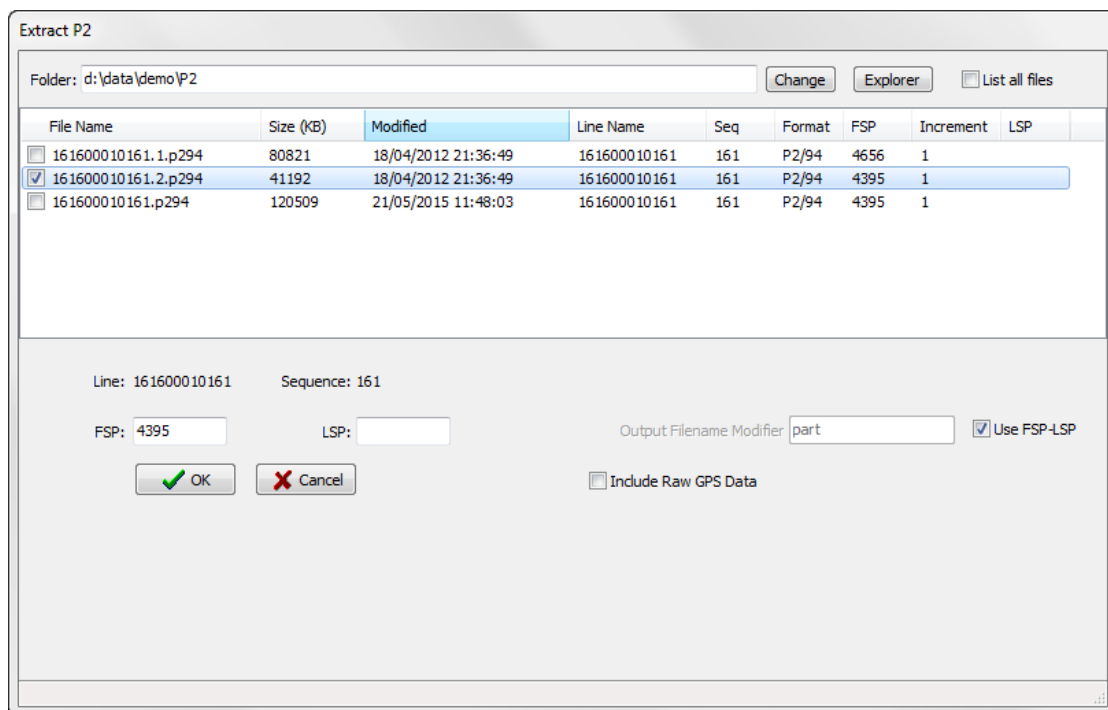

Figure 14-1: Utilities – Extract P2

The default folder is that specified in the project as the P2 folder.

Files for output must be selected by checking the checkbox at the left of the list.

The required shotpoint range for each file is specified in the *First SP* and *Last SP* fields.

The *Output Filename Modifier* is inserted into the filename before the filename extension. For example, the output from highlighted file in Figure 14-1 will be called :

     ABC1001p001.part.p294

If the *Use FSP-LSP* checkbox is checked then the filename modifier will be *<fsp>-<lsp>*.

If raw GPS data is not required then the size of the output will be reduced by leaving the *Include Raw GPS Data* option unchecked.

14.2 **Split P2**

This utility splits a single file containing multiple P2 datasets into individual files each containing a single P2 dataset.

From the main menu select *Utilities | Split P2*.

From the Open File dialog select the file(s) required to split.

The output files are saved in the same folder as the input files, and are named according to the following convention:

###-name.p2

Where

= the sequence specified in the H0000 record
name = the line name specified in the H0000 record

".1" will be appended to this name if a file of this name already exists.

Once processing is complete a Windows Explorer window is opened at the location of the output files.

14.3 **List P2**

Use this utility to produce a list of lines contained in a P2 file. The list is output to a CSV format file with the information as per the following example:

Filename	Linename	Seq	FSP	LSP	FST	LST
D:\Data\Demo\P2\161600010161.2.p294	161600010161	161	4395	5635	27/12/2010 00:49	27/12/2010 04:08

14.4 **Coordinate Conversions**

This utility is used to compute coordinate conversions between the CRSs defined in the database. A typical use would be to check the test point conversion using the parameters read from the geodetic records in the P2 file.

To convert coordinates:

- Optionally select the degree format from the dropdown list.

- Optionally check the *Metric* checkbox to convert non-metric coordinates to metres.
- Select the CRSs from the dropdown lists.
- Enter the coordinates to be converted in either the left or right hand panels. If converting from grid coordinates then only these need to be entered.
- Click the appropriate *Convert…* button.
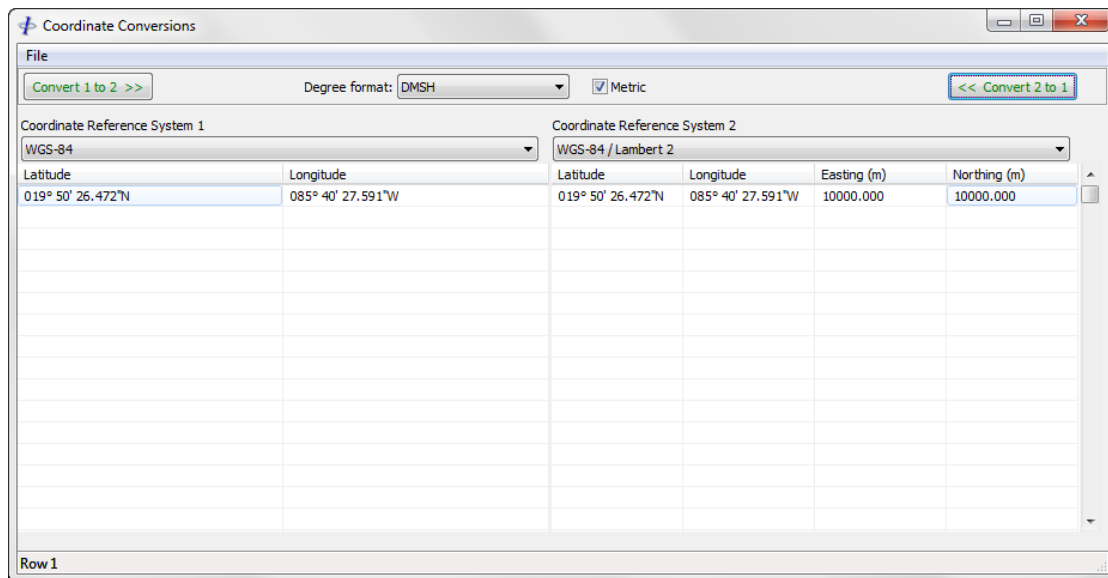- From the menu select *File | Report* to create and display the report.

Figure 14-2: Utilities – Coordinate Conversions

14.5 Open Project database Folder

This utility opens a Windows Explorer window which defaults to the *<project_database_folder>*.

14.6 Open Reports Folder

This utility opens a Windows Explorer window which defaults to the *<project_reports_folder>*.

15 ONLINE SERVICES

The Online Services module provides facilities enabling the archiving and uploading of a *<line_database_folder>* and or the P2 file assigned to a line and residing in the project P2 folder.

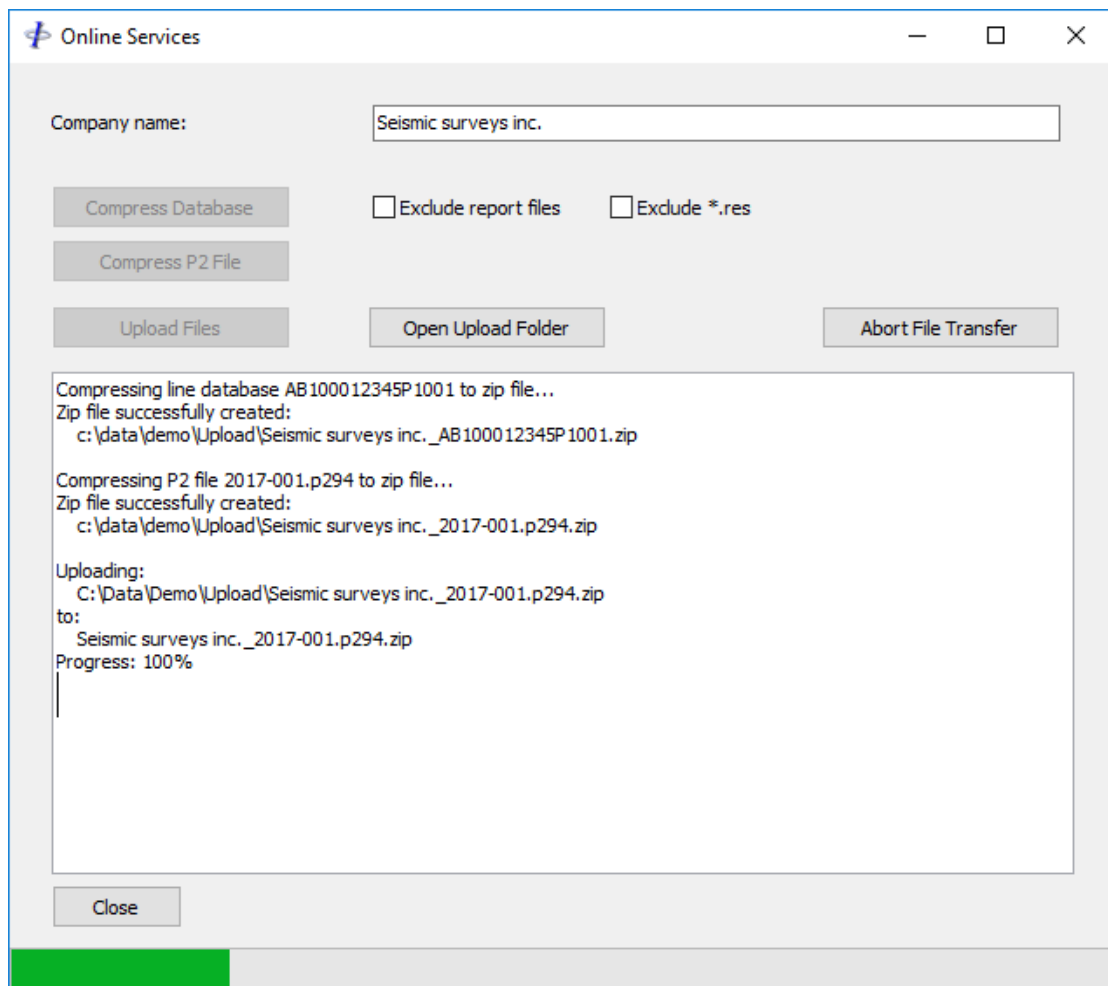This module is accessed from the main menu by selecting *Help | Online Services.*

Figure 15-1: Online Services

15.1 Database Operations

15.1.1 Compression

To compress all files in a *<line_database_folder>* in the Current Project click on the *Compress Database* button and from the list select the line required. All database files for the selected line are compressed into a single zip archive. Any existing archive for the same line will be overwritten.

The archive is located in a folder called "Upload" which is created directly under the project folder as specified in the Project settings.

If data transmission bandwidth is limited it may be desirable to decrease the size of the database. Two options are available to achieve this:

- By checking the *Exclude *.txt* checkbox prior to compression all report files will be excluded. Their combined size varies according to how many network adjustments have been performed. Their value for the purpose of support is limited.
- By checking the *Exclude *.res* checkbox prior to compression all network adjustment QC data output files will be excluded. Their combined size is typically 40-50% of the size of the database. Their usefulness for support purposes is limited.

It is recommended that no files are excluded unless limitations in bandwidth prevent timely and reliable uploading of the database.

To compress a P2 file click on the *Compress p2 File* button and select the line from the list.

15.1.2 Upload

The computer has to be connected to the internet.

To upload files, click the *Upload Files* button and select the files to be uploaded. Multiple files can be selected for upload.

If the computer is not connected to the internet then the files to upload should be copied from the Upload directory and uploaded elsewhere after requesting and obtaining FTP details from FGPS.

Upload progress is displayed, as shown in Figure 16.1. To abort the upload, click the *Abort File Transfer* button.

16   APPENDIX A: QUICKSTART

There are several kinds of surveys that Seispos is used for:

- 3D surveys with multiple streamers and observations.
- 2D surveys with a single streamer and an insufficient number of observations.
- Q Marine surveys with multiple streamers and many thousands of observations which may require decimation.
- Shooting vessel only.
- OBS acoustic acquisition for cable or node positioning.

This document is written for 3D, 2D and shooting vessel data sets. OBS cable positioning processing is addressed in a separate document, TD_SP12.2 OBC Receiver Processing, which is available on request.

This section provides step-by-step instructions for setting up a project and processing the first line of a project. It also provides instructions for simplifying the processing of subsequent lines.

A project can consist of a single line or eventually all the lines from a survey.
A surveys worth of data can be stored in one database or spread out over several databases with varying numbers of lines in them.

Seispos assumes that all the lines in one database have an almost identical configuration. If the survey configuration has changed significantly at any point during a survey then it is recommended that a new project be created, specifying a different database folder, typically renamed according to the first sequence to be input into that database. See the later section to this document titled "To process Subsequent Lines".

Menu or button operations are shown in *italics* with a vertical bar (|) separating sub-menu operations.

This guide is not intended as an exhaustive set of detailed instructions. The user is advised to refer to the manual for details.

Where alternative operations are possible to achieve the same end, the following instructions advise arbitrary instructions for the sake of simplicity which the user may wish to modify once sufficient experience of the system has been gained.

16.1 To Create a New Project:

   a)   Select *Main Menu | Project | New*.
   b)   Enter the project name and folder locations following the example shown in Figure 16-1.

c) Select the appropriate acquisition system form the dropdown list.

d) Note that the recommended convention for naming the database folder is to append the sequence number of the first line to be processed in that project, e.g. …\Database_001.

e) **For 2D surveys** check the *Create 2D Nodes and Observations* checkbox.

f) Optionally enter the *Fan mode tail width*. This is the total distance in metres between the tails of the outer streamers.

g) Click the *Ok* button. The specified folders will be created if they do not already exist, and the new project will become the current project.
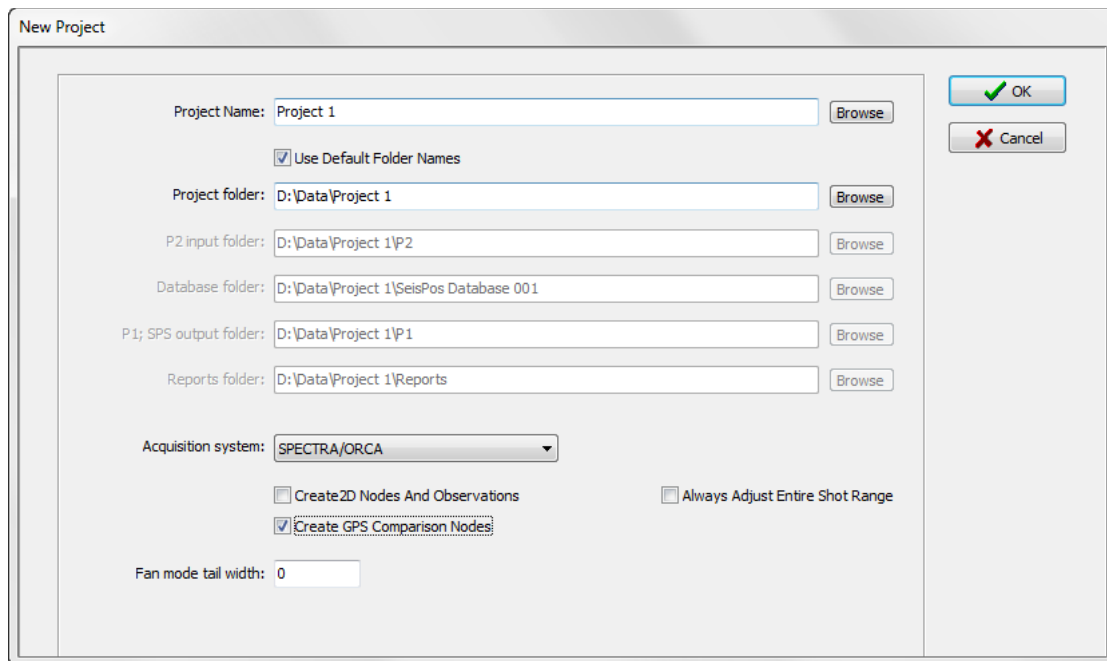
Figure 16-1: Quickstart – New Project

16.2 To Process the First Line:

The process generally follows the Main Toolbar buttons from left to right.

Note: In all modules the default parameters are recommended and should only be changed if deemed necessary.

1) Copy the P2 file(s) to the P2 folder which was specified when creating the new project. .zip files are supported.

2) On the main toolbar click the *Input* button.

a) Select the P2 file to process by checking the checkbox on the left of the list item.

b) Optionally enter the first and last good SP. This will be the default range for all operations except Precondition, for which the full range is used to overcome filter edge effects.

c) Click *OK*. The P2 input will commence as a background process, and a Log Window will be displayed. Follow any prompts during this process.

d) Once the Log Window indicates that input is complete, the *Close* button will be enabled. Click on this to close the Log Window. Two pop-up windows also appear listing the warnings and format violations that Seispos detects. These error messages are for your information and are not necessarily critical. Most acquisition systems generate P2 files with non-standard features. These error windows can be closed down if they do not show anything significant. These reports can be accessed at any time by clicking on the *Report* button.

3) **Optional:** On the main toolbar click the *Database* button.

a) From the database menu select *File | Select Line* and select the line that has been input.

b) If any corrections to the database are required, e.g. changing C-O or propagation speed etc. these are best done at this stage.

c) **For 2D surveys:**

   Note: this step only needs to be done if the *Create 2D Nodes and Observations* checkbox in the project setup was not checked.

   If processing a 2D survey there are typically no recorded observations available to position the head or tail of the streamer. A layback model is usually needed to connect the vessel to the head of the streamer and the tail of the streamer to the tailbuoy.

   To create the necessary extra nodes and observations, from the menu select *Utilities | Create 2D Nodes and Observations.*

d) If dynamic velocimeters are in use then follow the instructions provided in the document *TD_SP08 Dynamic Sound Speed*. This step is not necessary when processing P2/11.

e) **Optional**: In order to correctly compute differences between multiple DGPS systems, from the menu select *Utilities | Create GPS Comparison Nodes*.

   Note: this step does not need to be done if the *Create GPS Comparison Nodes* checkbox in the project setup was not checked.

f) **Optional:** In order to correctly compute sub-array separations, from the menu select *Utilities | Create Sub-array Separation Nodes*.

   Note: if using the *Dynamic Offsets* option in the network adjustment (enabled by default) then this option is not necessary.

g) If any changes made to any of the database tables are to be made to subsequent lines in the project then it is recommended to save the defaults by clicking the *Save Defaults* button for the affected tables.

h) Exit the Database module.

4) **For normal surveys:**

On the main toolbar click the *Interactive Precondition* button ▦, and select the line that has been input. In the dialog that then appears click the *PLOT* button. It is not recommended to make any changes at this stage.

For Q-Marine surveys:

Because of the large number of observations it is not advisable to plot all observations at once. It is advised to a) Precondition all data by selecting from the Main Menu *Execute | Auto Precondition*. b) Start the Interactive Precondition module. c) Drag all observation groups from the left *Group* list to the right *Do Not Plot* list. d) Drag one group only, or groups containing a small number of observations, from the left *Group* list to the centre *Plot* list. e) Click the *Plot* button.

a) Time series plots of all selected observations are displayed. It is advisable to browse all the data, applying any edits or changes in gating, filtering and interpolation parameters if desired. Note that the default gate and filter settings of Seispos are best suited to lines with shot point intervals of about 10 seconds or less. If the shot intervals of the data to be processed are longer than 10 seconds then gate and filter lengths may need to be increased to have any effect. Note also that making use of the Plot Nominal, Network and Raw – Processed buttons at the top of the page can help when evaluating data quality and orienting nodes and observations.

b) If changes have been made to parameters then selecting *Menu | Parameters | Save Precondition Parameter Set* will cause the new parameters to be applied to subsequent lines in the project.

c) Exit from *Precondition* – at this stage the following actions will have taken place:

    i) All modifications will be saved.

    ii) All data will be interpolated to the shot time will be written to the Shot Event database table.

5) On the main toolbar click the *Compass Bias Estimate* button 📈 and select the line.

a) The default parameters are recommended but may be changed if required.

b) Click on the *Run* button.

c) Browse the report which appears once the computation has run. If any mean biases are unacceptably high then reject the highest one only on each streamer and repeat the operation. Alternatively, check the *Auto Reject* checkbox and re-run.

d) Exit from the Compass Bias module, saving Compass Use and parameter changes if prompted.

6) On the main toolbar click the *Adjust Network* button 🔳 and select the line. A network display window and control panel will appear.

a) In the *Options* page

   i) Choose whether to solve streamer rotation and or apply stretch. In general if tailbuoy data are available then streamer rotation should be solved. Also in general if with a fully braced acoustic network then do not solve stretch. A stretch model is normally useful when there are only measurements to the head and tail of the streamer or distinct subnets with gaps between them.

   ii) Optionally check the *Compute magnetic variation* checkbox. This may be particularly useful for **2D surveys** for which accurate magnetic bearing observations are required for manual laybacks.

b) In the *Observations* page

   i) **For Q-Marine surveys** it is recommended to check the *Solve Speed Of Sound* checkbox. This option is enabled by default for Q Marine.

   ii) If dynamic velocimeters are in use and have been set up according to the instructions in the document *TD_SP08 Dynamic Sound Speed* then check the *Use Dynamic Speed of Sound* checkbox. For processing P2/11 this action should not be necessary.

   iii) **Optional:** Use the Precondition Summary (*Main Menu | Report | Chronological Reports | Precondition Summary*) to identify network observations with mean values which differ significantly from the nominal and optionally reject these observations in the Network Adjustment Observation list. Observations are numbered for ease of identification. Click on the *OK* button when done, and close the Precondition Summary.

   iv) Click on the *Standard Deviations* button. Check that all SDs are appropriate and make any necessary corrections by selecting the SDs in the list and entering a new value in the SD entry field then clicking on *Apply*.

   v) For RGPS bearings:

      (1) Set the Angular Units to radians.

      (2) Use the nominal value from the corresponding range or measure the distance between the observation nodes on the network display by depressing the right mouse button on the *Network Display* and dragging.

      (3) In the SD entry field enter $2/x$ where x is the distance from the above step. This will give the observation(s) an SD equivalent to 2m horizontal accuracy.

      (4) Click on *OK*.

   vi) Click on the *Save Default SDs* button.

c) In the *Gun Arrays* page, if the gun array RGPS (or DGPS) data is considered to be of poor quality, uncheck the *Dynamic Offsets* checkbox.

d) From the menu select *File | Save Parameter Set*.

e) **Optional:** In the *Time Series* page enable the Unit Variance plot.

f) **Optional:** In the log window (located in the SeisPos main window) check the *Verbose* checkbox to display detailed information during the adjustment.

g) Click the *Start* button.

h) If the adjustment fails with the message *One or more nodes may have insufficient observations to solve*":
   i) Look at the log report to see which node cannot be solved

   ii) In the Network Display toolbar click the *Select Nodes* button ⊞ to allow graphical selection of one or more nodes to remove them from the network.

   iii) In the node list which then appears, move the selected nodes to the left list.

   iv) If nodes are removed then in the Network Adjustment control panel select *Configuration | Save Network* to save a new network which does not include any nodes cannot be solved. Save this network with a suitable new name e.g. "whole_no_tb1".

i) Once the adjustment is complete, close the Network Adjustment control panel.

j) **Optional:** From the *Reports* menu view various reports applicable to the last adjustment computed.

7) On the main toolbar click the *Quality Control* button ▦ and select the line. Browse through the QC time series plots, noting any SP ranges for which the adjustment and/or data is unsatisfactory. The data can be re-appraised and re-processed in the *Precondition* module, and the adjustment re-run for the affected SP range. Plots that should be viewed are:

a) Adjustment – unit variance should be fairly consistent and below or close to 1.
b) Streamers – there should be no spikes in rotation, and only small spikes, if any, in stretch.
c) Vessel – there should be no spikes in speed or CMG

d) Nodes – click the *Delta* button δy to display the shot-to-shot movement. Check the vessel, gun-arrays and all compass nodes, first across line then along line. If any spike appears then check using Rate of Change (*dy/dx* button $\frac{dy}{dx}$). If the spike is still present then this indicates erroneous data, and the magnitude indicated by the size of the spike when viewed in *Delta* mode. Note that erroneous absolute positioning data (usually DGPS) will affect all other nodes. A long (e.g. missed) or short SP interval will affect the Delta

display.

8) On the main toolbar click the *Output button* and select the line.
   a) In the *Records* page remove any records which are not required to write to the P1.
   b) In the *Bathymetry* page set the required options.
   c) Select *File | Save Parameters*, and enter a suitable name for the parameter file – "default" is suggested.
   d) Click on the *OK* button to commence output. A *Log Window* is displayed. Once the P1 output is complete check the log for errors and warnings then close the Log Window.

16.3 **To Process Subsequent Lines:**

1) On the main toolbar click the *P2 Header Difference* button . Check the *Suppress H631 and H632 records* checkbox. Run a comparison between the last line processed and the next line to be processed. A new project should be created if there are significant differences other than the line name and endpoint coordinates. An experienced operator should be able to decide which differences are significant. If in doubt a new project should be created.

2) If a new project has to be created:
   a) The P2, P1 and Reports folders should remain the same as the current project.
   b) From the main menu select *Project | New*.
   c) Select the current project – all fields will be populated.
   d) Edit the database folder. It is recommended to append the sequence number of the first line to be processed in this project e.g. ..\Database_xxx where xxx is the sequence number.
   e) Follow the instructions from the beginning of this document.

3) If a new project does not have to be created:
   a) Input the line as before.

   b) **Optional:** On the main toolbar click the *Database* button and select the line just input.
      i) Click *Load Defaults* for any table for which the defaults have been previously saved.
      ii) Exit from the database.
   c) Precondition the line as before. If data quality is not in doubt then instead of using the interactive Precondition module, from the main menu select *Execute | Auto Precondition*.

d) Perform the compass bias estimate – it should be necessary only to click the *Run* button as the parameters will have been saved when following the above instructions.

e) Perform the network adjustment – it should be necessary only to click the *Start* button as the parameters will have been saved when following the above instructions.

f) Browse the QC plots and re-process if required.

g) Output the P1 – it should be necessary only to click the *Run* button as the parameters will have been saved when following the above instructions

4) To process a line non-interactively (only recommended if data quality is generally good) in the Input control panel enter the first and last good shotpoint and select the process as *Automatic*. No further action will be required unless problems with the data are encountered.