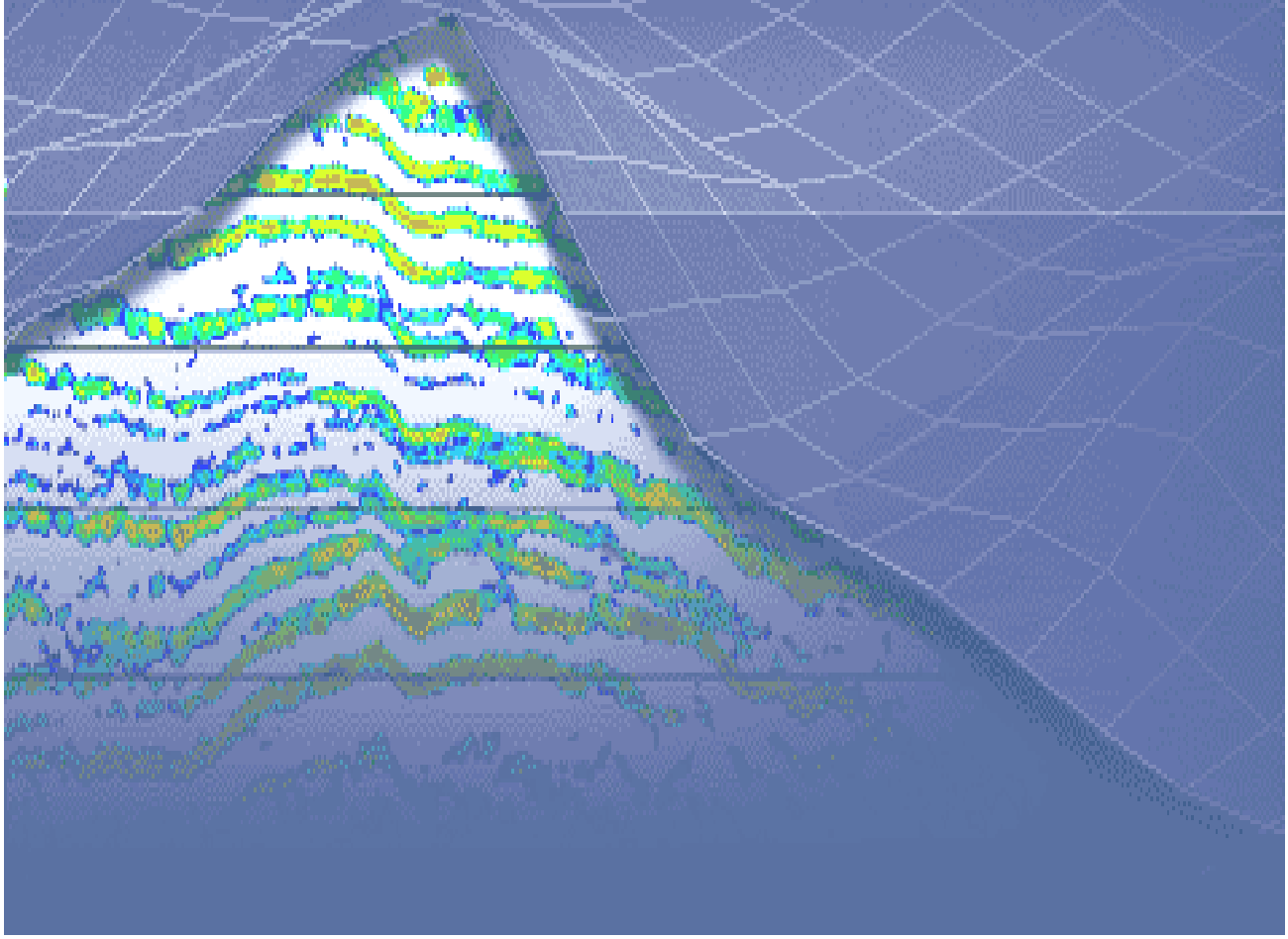
Innomar Technologie GmbH

ISE 2.9.2

Post Processing Software for the Parametric Sediment Echo Sounder SES-96 and SES-2000



Information in this document is subject to change without notice and does not represent a commitment on the part of Innomar Technologie GmbH. The software described in this document is furnished under a license agreement or nondisclosure agreement. The software may be used only in accordance with the terms of the agreement. It is against the law to copy the software on any medium or transmit in any form except as specifically allowed in the license or nondisclosure agreement. No part of this manual may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, for any purpose without the express written permission of Innomar.

Trademarks

Innomar is a registered trademark of Innomar Technologie GmbH.
Microsoft, MS-DOS, Windows and Windows 95/98/2000/NT/XP are registered trade marks of Microsoft Corporation.
Intel and Pentium are registered trade marks of Intel Corporation.
IBM and VGA are registered trade marks of IBM Corporation.

Software License Agreement

The copyright for the ISE software is owned by Innomar Technologie GmbH ("Innomar"). The software license agreement ("Agreement") sets forth the terms and conditions under which the purchaser is licensed to use the ISE software ("Software"). This is a license agreement and not an agreement for sale. Innomar continues to own the copy of the Software and any other copy that you are authorised to make pursuant to this Agreement.
Innomar grants to you a non-exclusive license to use the Software together with a SES-96/SES-2000 system, provided that you agree to the following:

Use of the Software
1. The license only applies to the purchaser of a Parametric Sediment Echo Sounder SES-96/SES-2000. The purchaser is not allowed to pass the Software to any other user without Innomar's written permission.
2. The purchaser may install one copy of the Software on the computer integrated in the SES-96/SES-2000 hardware and on another computer for post processing.
3. Neither the purchaser nor any other person are allowed to do the following:
give this Software to any other person or institution
make any copies of this Software, except for one backup copy, provided the backup copy is not installed or used on any computer
modify, adapt, translate, reverse engineer, decompile, disassemble or otherwise attempt to discover the source code of the Software
transfer the Software by telecommunication.

Copyright and Trademark Rights
The Software is owned by Innomar. The Software is licensed and distributed by Innomar for surveying work (on-line and off-line) with the Parametric Sediment Echo Sounder SES-96/SES-2000. Its structure, organization and code are the valuable trade secrets of Innomar. The Software also is protected by International Treaty provisions. You may use trademarks only insofar as required to identify printed output produced by the Software, in accordance with accepted trademark practice, including identification of trademark owner's name. Such use of any trademark does not give you any rights of ownership in that trademark. Except as stated above, this Agreement does not grant you any intellectual property rights in the Software.

Innomar reserves the right to terminate this license if any terms of this Agreement are violated.

ISE 2.9.2

Post Processing Software for the Parametric Sediment Echo Sounder SES-96 and SES-2000

User's Guide

Software Version 2.9.2

Innomar Technologie GmbH
February 2009

Innomar Technologie GmbH
Schutower Ringstr. 4
D-18069 Rostock
Germany

Telephone: +49(0)381/44 079-0 Fax: +49(0)381/44 079-299

info@innomar.com
http://www.innomar.com

Disclaimer

THE SOFTWARE IS BEING DELIVERED TO YOU AS IS AND INNOMAR MAKES NO WARRANTY AS TO ITS USE OR PERFORMANCE. INNOMAR DOES NOT AND CANNOT WARRANT THE PERFORMANCE OR RESULTS YOU MAY OBTAIN BY USING THE SOFTWARE OR DOCUMENTATION. INOMAR AND ITS SUPPLIERS MAKE NO WARRANTIES, EXPRESS OR IMPLIED, AS TO NONINFRINGEMENT OF THIRD PARTY RIGHTS, MERCHANTABILITY, OR FITNESS FOR ANY PARTICULAR PURPOSE. IN NO EVENT WILL INNOMAR OR ITS SUPPLIERS BE LIABLE TO YOU FOR ANY CONSEQUENTIAL, INCIDENTAL OR SPECIAL DAMAGES, INCLUDING ANY LOST PROFITS OR LOST SAVINGS, EVEN IF AN INNOMAR REPRESENTATIVE HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, OR FOR ANY CLAIM BY ANY THIRD PARTY. SOME STATES OR JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES, OR THE EXCLUSION OF IMPLIED WARRANTIES OR LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY MAY LAST, SO THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU.
WHERE LIABILITY CANNOT BE LEGALLY EXCLUDED, BUT IT MAY BE LIMITED, INNOMAR'S LIABILITY AND THAT OF IT`S SUPPLIERS SHALL BE LIMITED TO THE AMOUNT PAID FOR THE SOFTWARE.

Third Party Components

The ISE software contains the library “ProLatDLL 3.0 Coordinate Conversion Toolkit” from Effective Objects. This library is included as it is and INNOMAR is not responsible for any errors during the application of the coordinate conversion functionality or problems caused by the use of converted and processed data.

Remark

INNOMAR did its best to make software and manual free of faults. However, if there should be a reason to complain or criticize, Innomar will always have an ear for your suggestions and hints and will try to help.
Innomar reserves the right to change technical data.

Contents

Chapter 1 ISE Post Processing Software

This User's Guide is a task orientated manual which describes how to use the ISE software application for processing echo sounder data of the Parametric Echo Sounder SES-96 and SES-2000. To use this product effectively, you should be familiar with the following:

- Microsoft Windows Operating System and personal computers
- Sediment Echo Sounder System SES-96 or SES-2000
- Underwater Acoustics and Echo Sounding Terminology

For additional information about personal computers and Windows read your computer manual or visit your local book store.

➢ For additional information about the Parametric Sediment Echo Sounder SES-96 and SES-2000, please read the Hardware and Software Manuals of your system.

Introduction

With the Sediment Echo Sounder SES-96/SES-2000 you have a sub bottom profiler with advanced online signal processing capabilities. The first results are the picture on the screen and a hardcopy on paper. Often the users want to process the data again to get as much information as possible. The possibility of the system SES-96/SES-2000 to digitise and store the echo sounder data allows further processing. With the software package ISE the user has a nice tool for different processing tasks, like digitising layers, correcting echo plots with tide data, motion sensor data or GPS data and extracting the information to compatible formats. The ISE software is fully compatible with all recorded data files from the systems SES-96 light, SES-96 standard, SES-2000 compact, SES-2000 light, SES-2000 standard, SES-2000 medium, SES-2000 ROV and SES-2000 deep.

ISE Contents

The ISE software consists of a Microsoft Windows Program and this manual in printed and in digital form. It is advisable to read this guide for gaining the highest benefits from this software.

ISE User's Guide

This user's guide describes how to use the ISE software in general and tries to show solutions for realising different processing tasks. After a short description of the main function it will show in a task orientated way how to use the software effectively. Some facts about the document structure:

- **Bold** marks subordinated headlines.
- *Italics* is used for file and path names.
- Keys belonging to the keyboard are enclosed in brackets. If some keys have to be pressed at the same time, they are separated by '+' (example: Press [Ctrl]+[Alt]+[Del] to restart your computer).
- The symbol ➢ marks a very useful hint or key fact.

Hardware Dongle

The ISE software requires an USB hardware dongle, which is compatible with all USB interface standards. Plugging the dongle into a free USB socket will start the installation process automatically on most PC's. Optionally you may install the drivers from the CD manually. Please follow the installation instructions in the upcoming dialogue, which basically means to select the source drive and directory, where the drivers are located. The driver is located in the directory called "MatrixDongleDriver".

ISE Disk and Installation

The ISE software is shipped on a 3,5'' Floppy Disk or a CD-ROM depending on the delivered system. So it is easy to install the software on the SES-96/SES-2000 system unit as well as on a personal computer for processing tasks in the office. Use the Windows Explorer for copying the ISE software to the personal computer. You need the program file *ISE.EXE* and the *PROLAT.DLL* from the disk. Create a folder at any place on your computer and copy the file to this folder. Start the program like every other program under the Microsoft Windows environment. If you like, you can create a link to the program on your desktop.

- ➢ When using the ISE software for the first time on a PC, then it requires the installation of the drivers for the USB hardware dongle.
- ➢ Do not start the software directly from the floppy disk or a CD-ROM because the creation of temporary files will not be possible then.
- ➢ For better performance it is recommended, not to start the software from a network drive due to the creation of temporary files. It is possible to set up the directory for the temporary files within the ISE software and the use of a local drive is most efficient.
- ➢ Please check after your installation the directory where all temporary files will be saved during the use of the ISE software. The setting can be found under the ISE menu Options|Environment|Temporary Files and should point to a location with sufficient space and write permission.

Requirements for your personal computer

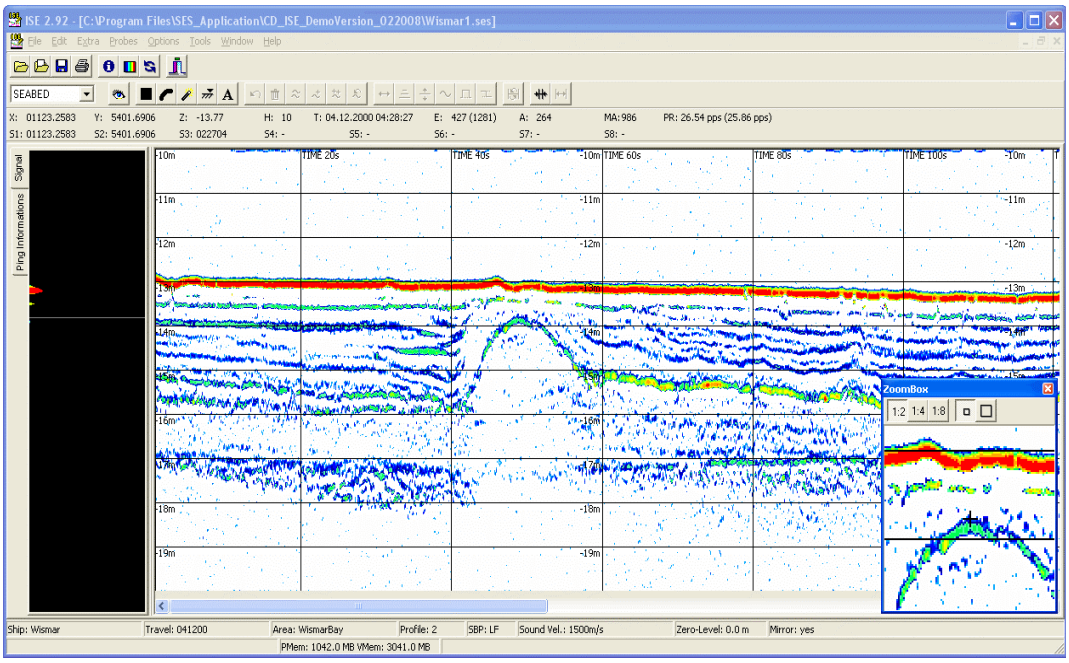
You need a personal computer based on the IBM PC with the Microsoft Windows Operating System installed in it. The ISE software is compatible and tested with Windows 95, Windows 98, Windows NT, Windows 2000, Windows XP and Windows Vista. As a minimum for a processing workstation we suggest an Intel Pentium CPU system with min. 1 GHz, at least 512 MegaByte RAM and a hard disk of more than 2 GigaByte. For processing big data files, the working speed can be dramatically increased by using more RAM and a faster processor. Your screen resolution should have 1024x768 pixel or more. A colour depth of min. 256 colours is preferred. A free USB slot is necessary for the hardware dongle. A mouse or compatible control device is absolutely necessary for input. If you want to print out some echo plots with ISE, you need a printer which is compatible with the Microsoft Windows Operating System. Then you have to install the right printer driver software. If you need assistance, please ask your local dealer of the printer hardware. A printer which is shipped with the SES-96/SES-2000 system is fully compatible with the ISE software.

Chapter 2 Using ISE

ISE is a post processing software tool for the parametric sediment echo sounders SES-96/SES-2000. With ISE you can load the digitally stored data, apply different processing algorithms and processing methods, like tide correction, to the data, print the data, digitise layers and extract these data to common file formats, like ASCII. ISE is not a complete signal analysis program, with which you can analyse signals with spectrum and phase information as it is possible with some seismic processing software, because the digitally stored data contain only the envelope of the received echo signals. The filtering and analogue signal processing is integrated and optimised in the hardware of the SES-96/SES-2000 systems. Nevertheless some of the SES-96/SES-2000 systems have the capability to store raw and not demodulated data, which can be converted to SEG-Y, XTF and ASCII format for processing with third party software.

The ISE Screen

When you start ISE, the ISE screen appears. The software is designed as a common Windows MDI application. This means you can open and work with different data files at the same time in the same application space. The only limitation for opening files is the memory space. The ISE screen is divided into a main menu, the workspace, where all opened windows are arranged, a tool bar with some speed buttons, for instance access to functions, and a status bar at the bottom of the main window with some program information. Each opened data window has its own tool bar with some speed buttons and an info panel at the top and a status bar at the bottom. Additionally, you can open some tool windows which are placed on the screen where you want. They give access to special functions or contain extra information about the data. An example is the zoom window, where you can see the data at the mouse cursor position in a zoomed picture. Each data window has the file name of the opened data file in its title bar. The screen appearance will be saved into a configuration file, so when you start the program again, you will get the same window positions as you had when you left the application.



Using a mouse with ISE

It is necessary to have a mouse or a similar pointer instrument, like a touch pad on a notebook, installed with the processing PC. Beside the navigation through menus and hotkeys the left mouse button is mainly used for drawing layers and for selecting positions inside data windows. By clicking the right mouse button inside an open data window the echo plot can be dragged, when its size exceeds the window size. This is normally quicker than using the scroll bars, especially when not only the horizontal scrollbar has to be changed for selecting an area.

- For several situations the mouse cursor changes the appearance, to give an indication which editing mode is active.

The ISE Menus

On top of the ISE window you will find the main menu from where you can access most functions of the program. Some of the menu commands are accessible with a Hot Key, which is shown in the menu string.

- Menu commands are disabled if they are not accessible for certain reasons.

File Menu

The File Menu allows you to select files to open, save layer files, save pictures, export data files and print data files. The last four opened files are hold within the File Menu for quick access. The following menu commands are accessible:

Command	Description
Directory Browser	Starts the Directory Browser which is a dialog for an extended overview of the data files in a directory. You can select files to open them with a time orientated view and have easy access to files of the same date, the same profile or the same area.
Load Echo Data	Starts the dialog for open data files.
Open Layer File	Opens a layer file into the active data window.
Close File	Closes the active window.
Open Layer Definition	Opens a definition file for the layers which are attached to the active data window.
Save Layer File	Saves the actual layer information in the file which was previously loaded into the data window.
Save Layer File As	Saves the actual layer information in a new file where you can give a name to it.
Save Layer Definition	Saves the definition of the layers of the active data window into a file.
Export Graphic	Exports the actual window contents (annotated echo plot) into a graphic file.
Export DAR File	Exports the data of the actual window into a file which contains only the processed data and the position data.
Export Layer Data	Exports the layer information of the active window into ASCII files for easy import into other software packages, e.g. GIS or volume calculation tools.
Export Layer as CODA File	Exports the layer information of the active window into ASCII files in CODA format based on layer segments.
Export Layer as PIPE File	Exports the layer information of the active window into ASCII files in PIPE format based on layer segments.
Export Layer as SVG File	Exports the layer information of the active window into SVG files (Scalable Vector Graphics) based on layer segments.
Export Signal Traces	Exports the data from signal traces within a marked block into ASCII files.
Export Window	Captures the application window into a graphic file.
Print	Prints the data of the active window.
Setup Printer	Configures the printer attached to your PC.
Exit	Closes all open data files and exits from the application.

Edit Menu

The Edit Menu commands allow you to set up and select your working tools for the layer digitisation. You have an Undo command and you can copy the actual picture to the clipboard. The Edit Menu contains the following commands:

Command	Description
Undo Last Segment	Removes the last edited segment from the active layer.
Delete Layer	Deletes the whole active layer.
Copy Layer	Copies the layer contents to the ISE clipboard.
Paste Layer	Copies the ISE clipboard contents into the actual layer.
Merge Layer	Merges the ISE clipboard contents into the actual layer.
Undo Layer	Replaces the actual layer contents with the ISE layer undo buffer contents
Pen	Gives access to the configuration of your layer editing pen, like the colour, the pen width and the pen mode.
Capture Mode	Starts the capture mode for the layer editing.
Text Block	Inserts a text block into the actual data window.
Mirror Layer	Performs a mirror function to the whole layer data.
Scale Layer	Scales the layer in the horizontal direction.
Add Offset	Adds an offset to the active layer in the vertical direction.
Smooth Layer	Smoothes the active layer.
Remove Peaks	Tries to remove peaks from the active layer.
Copy Graphic	Copies the actual data window as a bitmap graphic into the Windows Clipboard.
Mark Block	Marks a block of the data for separate processing of parts of the data.
Unmark Block	Resets a previously marked block.

Extra Menu

This menu contains commands for special tasks, like the configuration of the signal processing, the water depth calculation and some user adjustable functions such as the colour palette or the ruler definition. The Extra Menu contains the following commands:

Command	Description
File Information	Shows the parameters of the file in the active data window, e.g. recording time, frequency, amplifier setting etc.
Palette	Lets you change the colour palette of the actual data window. Possible options are different colour scales and grey scales.
Signal Processing	Selects and configures the digital signal processing for the echo sounder data in the active window.
Interpolate Coordinates	Interpolates the coordinates in the active window. This is a temporary procedure. The data file itself will not be modified.
Ruler Lines	Changes the number of ruler lines which can be seen on the echo plot. The start value and the distance between two lines are configurable.
Motion Sensor Lines	Inserts curves of the values from a motion sensor. The values of heave, roll and pitch can be selected with an user defined offset within the data window.
Way Lines, Fix Lines, KP Lines, Cross Lines…	Inserts vertical lines into the echo plot based on serval sources. e.g. based on distance, KP's, Fixes or predefined cross lines.
Time Lines	Inserts vertical lines into the echo plot after defined time periods.
Marker Lines	Enables or disables the view of the markers in the active data window and shows a list of all markers.
Insert Water Depth as Layer	Calculates the water depths for the active data window. The user can edit some parameters for the calculation, like the sensitivity.
Insert Sub-bottom Layer	Calculates a sub-bottom layer based on a previously edited layer above. The user can edit some parameters for the calculation, like the sensitivity.
Write Water Depth to Active Data File	Overwrites the on-line calculated water depth or overwrites a SIS field with the calculated water depth from the active layer.
Insert Layer with User Defined Parameter	Calculate a layer based on property values of two other layers above and below
Swell Filter	Applies a software filter to echo data plots to remove heave ripples.
Remove Ghost Echo	Applies a software filter to remove echo signals caused by reflections which produce time shifted signals as an

	overlay to the main signal
Move Profile to Trackplot List	Moves the active profile to the track plot window.
Manipulate SIS Fields	Interpolates or deletes selected SIS fields within a particular area.
Save manipulated SIS to SES-File	Save the changed SIS fields into the SES file.
View Tide Graph	Shows the tide graph if there is a tide data file attached to the echo data file.
View SIS-Value Graph	Shows a graph of the values of a selectable SIS Field.

Probes Menu

This menu gives you access to the sediment probe data base and the sound velocity profile. The probe data can be edited, loaded and saved to a disk and also combined with layer data in the open windows. The Probes Menu contains the following commands:

Command	**Description**
Sound Velocity Profile	Opens the dialog for the input and activation of a sound velocity profile.
Correct Echo Plot with Sound Velocity Profile	Corrects the echo plot and active layer in an open data window with a given sound velocity profile.
Numerical Profiles	Opens the Editor for the numerical profile data base.
Overlay Echo Plot with Numerical Profiles	Enables the overlay of numerical profiles on the actual data window with different options.
Sediment Probes	Opens the Editor for the sediment probe data base.
Overlay Echo Plot with Sediment Probes	Enables the overlay of sediment probe data on the actual data window with different options.

Options Menu

This menu gives you access to the different tools of the ISE application, like the zoom box or the track plot window. The Options Menu contains the following commands:

Command	**Description**
Toolboxes	Configures which tool box window should be visible on the screen.
Environment	Configures some application wide options.

Tools Menu

The Tools Menu allows you to start different tools for separate tasks which are not directly attached to a data window but sometimes very useful. For instance, you can start a tool for the editing of the profile information of the data files or you can start a tool for the generation of a profile list of the whole contents of a directory. The Tools Menu contains the following commands:

Command	Description
Profile Number Editor	Starts a tool for the manipulation of the profile number, the ship name, the travel name and the area name in a data file.
Profile List	Generates a list of all profiles in a directory.
SIS Extract	Starts a tool for the extraction of SIS strings into ASCII data files.
SIS Replace	Starts a tool for the replacement of SIS strings in data files with SIS strings in an external text file.
SIS Process	Starts a tool for several functions regarding coordinate processing and processing of the SIS fields, e.g. interpolation, clipping, offsets, course calculation
UTM Converter	Starts a tool for coordinate conversions
Motion Processing	Starts a tool to apply or modify lever arm corrections
Layer Combination Tool	Combines two ASCII layer files and calculates the difference between them.
Antenna Offset Tool	Starts a tool for the calculation of the position offset if during the recording the GPS antenna was not directly mounted above the transducer (processes ASCII files)
Decimate Text Files	Decimates text files with tables, for instance exported x, y, z files, by removing lines
Add Text Files	Combines two or more text files to one target file.
Comma Point Editor	Switches between comma and semicolon character in ASCII files which is sometimes useful for data exports.
Filename Editor	Changes the file name of a data file between short and extended style and allows systematic file name modifications.
Add Data Files	Combines two or more echo data files to one target file.
Cut Data Files	Cut echo data files and create new data files with regions of interest or to remove unimportant parts.

Process Script…	A scripting tool to apply various processing steps to a number of data files successively. e.g. load data file and calculate water depth.

Window Menu

The Window Menu contains commands for the arrangement of the open data windows on the screen. These are the common arrangements from the Windows environment, like cascade and tile. The Windows Menu contains the following commands:

Command	Description
Cascade	Arranges all open data windows in the application space in a cascaded style, starting on the upper left corner.
Tile Vertical	Arranges all open data windows vertically, so that the whole application space will be shared between the windows.
Tile Horizontal	Arranges all open data windows horizontally so that the whole application space will be shared between the windows.
Arrange Icons	Arranges all data window icons in the application space.
Minimize All	Minimises all open data windows to icons.
Close All	Closes all open SES files.

Help Menu

Command	Description
About	Shows the About Box with the software version information and the software registration data.

The ISE Tool Bars and Status Bars

The main application window and every data window have their own tool bar. These groups of buttons provide quick access to commonly used commands.

- A quick hint will appear if you move your mouse over one of the tool bar buttons.

The main application window has a status bar with program information and every data window has a status bar with some information about the loaded file. A status panel below the tool bar of the data window shows some information about the data below the actual cursor position, e.g. the time.

The Main Tool Bar

This tool bar on the upper side of the main application window contains some buttons for quick access to program functions, e.g. "open data file" and "save layer file". The main tool bar includes the following buttons:

Button	Description
Load Echo Data	Starts the dialog for open data files.
Open Layer File	Opens a layer file into the active data window.
Save Layer File	Saves the actual layer information in the file which was previously loaded into the data window.
Print Graphic	Prints the data of the active window.
Show File Information	Shows the parameters of the file in the active data window, e.g. recording time, frequency, amplifier setting etc.
Select Colour Palette	Lets you change the colour palette of the actual data window. Possible options are different colour scales and grey scales.
Signal Processing	Selects and configures the digital signal processing for the echo sounder data in the active window.
Exit Program	Closes all open data files and exits from the application.

The Data Window Tool Bar

Every data window has its own tool bar. A combo box for the selection of the active layer is included in the tool bar. You have twenty layers per data file for separate editing available. The data window tool bar includes the following buttons:

Button	Description
Hide Layer	Makes a layer visible or invisible. The layer data

	themselves will not be modified.
Pen Colour	Opens the standard Windows colour dialog and lets you select the pen colour for the active layer.
Pen Width and Mode	Selects the pen width for the active layer in the range between one and 5 pixels. Additionally, you can select between freehand and line mode.
Capture Mode	Starts and stops the capture mode. During the capture mode the program tries to calculate automatically the layer position under the cursor or in a special mode for a bigger range starting from the cursor position.
Text Block	Inserts a text block into the actual data window.
Undo Segment	Removes the last edited segment from the active layer.
Delete Layer	Deletes the whole active layer.
Copy Layer	Copies the layer contents to the ISE clipboard.
Paste Layer	Copies the ISE clipboard contents to the active layer.
Merge Layer	Merges the ISE clipboard contents into the actual layer.
Undo Layer	Replaces the actual layer contents with the ISE layer undo buffer contents
Mirror Layer	Performs a mirror function to the whole layer data.
Scale Layer	Scales the layer data in the horizontal direction.
Add Offset	Adds an offset to the active layer in the vertical direction.
Smooth Layer	Smoothes the active layer.
Remove Peaks	Tries to remove peaks from the active layer.
Remove Overlaps within Layer	Rebuilds a layer and deletes all overlapping parts. It's also a tool to remove peaks when editing layers.
Manipulate SIS Fields	Interpolates or deletes selected SIS fields within a particular area.
Mark Block	Marks a block of the data for separate processing of parts of the data.
Unmark Block	Resets a previously marked block.

The Main Status Bar

The Main Status Bar shows the available system memory. It is divided into free physical memory and free virtual memory which is the amount of free hard disk space available as system memory. The whole free memory can be used by the application for loading data files and processing tasks. The more free physical memory you have,

the faster the computer system can handle the data and the faster the program can run.

The Data Window Status Bar

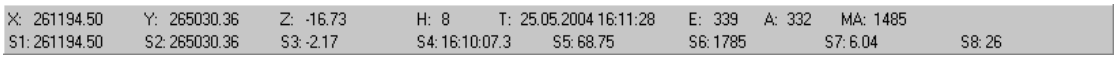
The Data Window Status Bar shows some information about the file, loaded into the data window. You will see information of the survey, like the name of the ship, the name of the travel, the name of the area, the profile number and the speed of sound.

The Data Window Status Panel

The Data Window Status Panel is situated below the Data Window Tool Bar. You will see different values depending on the actual cursor position. If you move your mouse cursor over the echo plot these values will be updated instantly. On the panel there are shown the X position from the SIS data, the Y position from the SIS data, the Z value in the echo plot, the date and time, the total height of the echo plot, the ping number, the actual amplitude and the mean amplitude around the cursor position.

If in the environment option the display of all SIS strings is enabled, the status panel has two lines. The second line shows the contents of all eight SIS strings.

If the loaded data file is a Side Scan file then the projected coordinates are also shown with the offset from the track (heading data in one SIS field or from a motion sensor required)



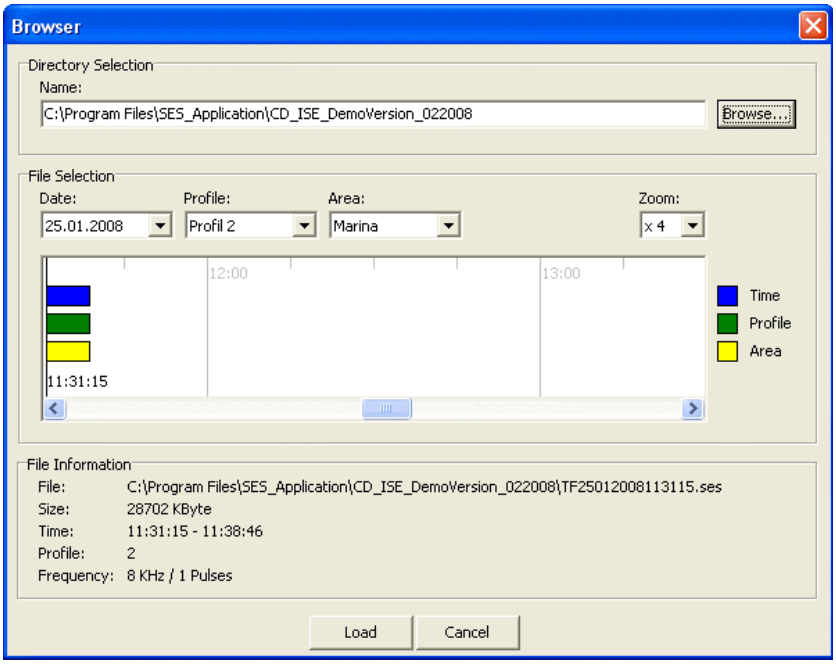
The ISE Dialogs

If a menu command has been selected or a button has been pressed, sometimes a dialog window can appear on the screen. Here the user has to edit some parameters for the selected function or to select between alternative options. Some of the dialogs are self-explaining, e.g. the colour palette dialog or the pen dialog, but others require some descriptions. The dialogs have to be closed, before the user has access to the open data windows again.

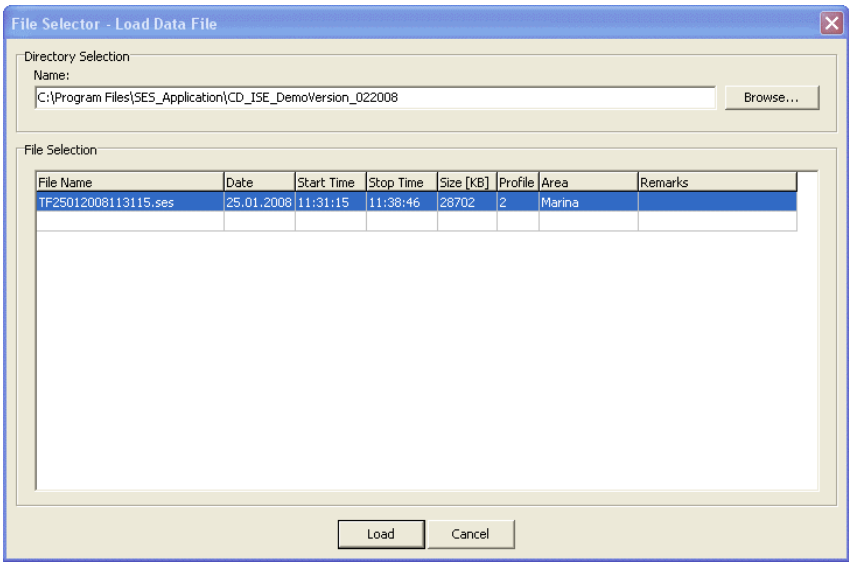
The Browser Dialog

The Browser Dialog gives easy access to the files in a directory on the hard disk. The time line shows all profiles of one day with their starting time and their ending time. The day can be selected with the most left combo box. This combo box contains all days which are stored in the selected directory. With the browse button it is possible to navigate through the whole hard disk and to select the right directory. The second combo box contains all profile numbers which were used at the active day. With the third combo box the user can select the area of interest. Every time a new profile number or a new area is selected, the belonging files will be marked by a colour bar in the main time view. The profile will be marked by a green bar, the area by a yellow bar. The blue bar is the time bar. With the right combo box you can choose between

zoom factors of one and four in order to get a more detailed view or an overview of the time window. The actual selected file has a vertical line at the starting time. Some file parameters are shown at the lower part of the browser dialog. These are the file name, the file size, the recording time, the profile number and frequency. By pressing the Load button the marked file will be opened and loaded into a new data window.

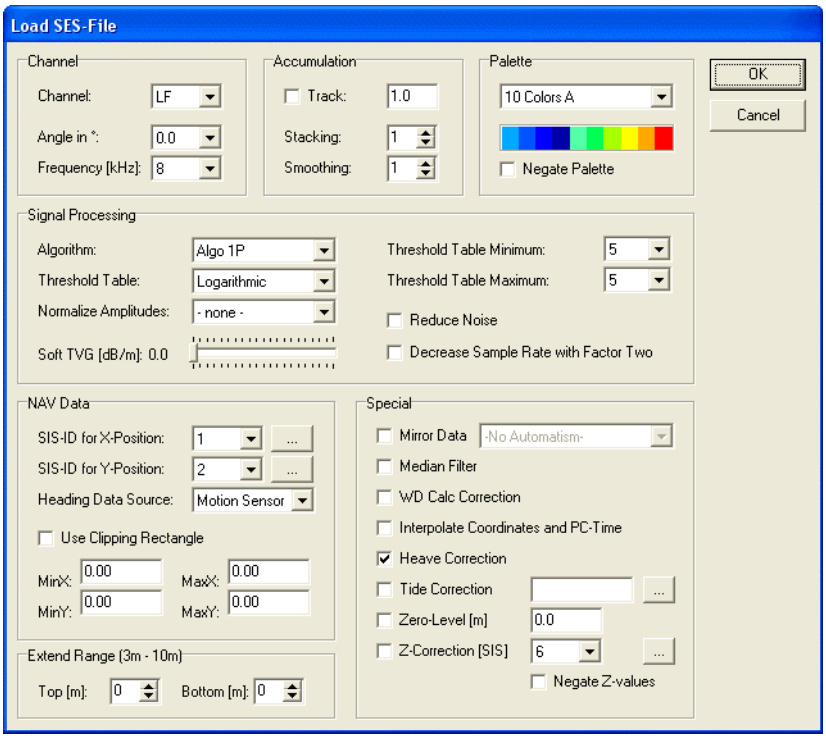


As an alternative the File Selector can be used to choose a data file to be loaded into the ISE software. This recommended File Selector can remember the last selected file in its list and allows therefore a quick work through many files in a directory. Some additional information is given in the list, like Start/Stop time, profile number and area name. A similar File Selector exists for edited layer files to be loaded into data windows. Both browser dialog are enabled via the ISE menu Options | Environment, where a checkbox exists to switch between MS Windows common dialogs and the ISE File Selector.



The Load Data Dialog

After selecting a file in the Windows Open Dialog or the Browser Dialog the Load Data Window will appear. If in the Windows Open Dialog a DAR File has been selected, only the colour palette has to be marked which will be used for the processing. If a SES-96/SES-2000 data file has been selected, some more options are accessible. First you have to choose the channel, where LF means the Low Frequency-channel and HF means the High Frequency-channel. Also both channels can be loaded at the same time. (HF/LF) If the file is a beam steering file, all beam steering angles are listed in the following combo box. The selected angle will be the first processed angle after the load operation. All angles are loaded into the memory and the user can switch between them in the data window. The data window is shown like a tabbed notebook where every page contains the data of one angle. The same principle is valid for multi frequency files. If the loaded SES-96/SES-2000 file is a multi frequency file, the different frequencies are listed in a combo box and loaded into pages of a tabbed notebook.



The second step for the load operation is the selection of some signal processing parameters. First choose the accumulation, where you can select the stacking rate and smoothing rate. If there are coordinates in the file, you can choose a stacking depending on the track. This is useful for creating horizontally scaled echo plots, independent of the vessel's speed. The colour palette, the algorithm and the threshold table mode are selectable. Furthermore, the threshold table is adjustable with the minimum and maximum value. The table itself will be calculated automatically according to the transmitter settings and the other signal processing parameters. A Soft TVG is available with steps of 0.1 dB/m and an optional noise reducing algorithm can be selected.

The selection of the SIS IDs for the X position and the Y position is necessary for the operations relating to the coordinates, like the track plot view or coordinate

interpolation. Two buttons are available to look on a sample of the SIS information which is recorded within the selected file. The definition of a clipping rectangle allows the exclusion of coordinates outside a specified area. The echo plot range can be manually extended on the top and the bottom of the plot.

Some special operations are selectable. First we have the mirroring of the data which is useful if the profiles were surveyed in different directions. There is also an automatism available which mirrors SES files automatically in order to show all files in a desired direction. The option for water depth correction should always be selected when editing bathymetry. During the change of ranges we have some received signals where the echo is not conform to the new range. These small areas can cause false calculations of the bottom line and will be therefore specially processed. The median filter is the most likelihood filter to remove spike noise from the digital echo data. Such noise, which appears randomly from ping to ping may be caused by other acoustical sources for example. The option for interpolating the coordinates increases the positions in the file. The SIS data is normally received once per second but the number of pings is much higher. Therefore, it is possible to interpolate between two coordinates and to give every echo signal a position. The heave correction can be switched on or off for the load operation. Furthermore the tide correction can be switched on or off. For the tide correction a tide data file has to be selected. See Appendix A for details about the tide files. The definition of a new Zero-Level allows to put a constant offset to the echo plot. All given water depth values are combined with this new Zero-Level then. Additionally a correction of the echo plot based on other recorded z-values, like from a RTK GPS system or from a depth sensor when using ROV based systems. The source ID of the z-values needs to be selected, where a preview of the overall range of the SIS values inside the selected SES data file is available. The option to negate the recorded z-values is useful when for example positive values were recorded for a depth below Zero-Level.

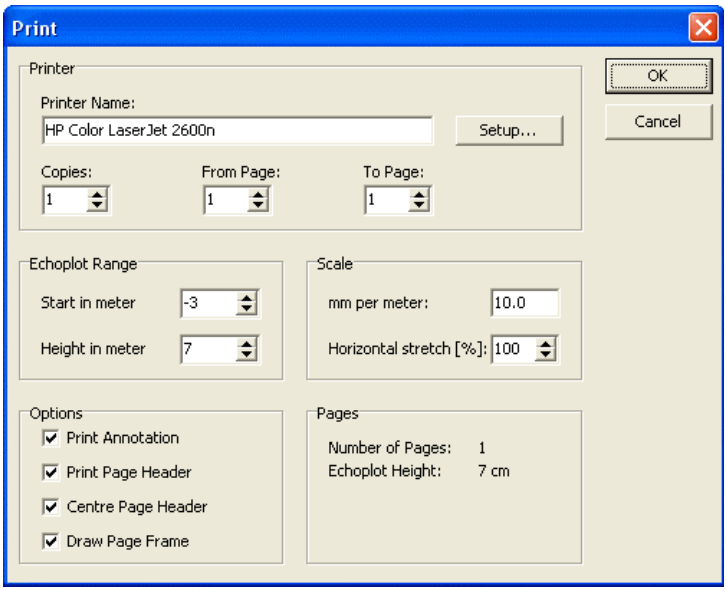
The last option is to decrease the sampling rate of the recorded signal by factor two, when the echo plots are getting big due to big ranges inside the data file.

The Print Dialog

With this dialog the user prepares the printout of an echo plot. Every printer which is installed under the Windows environment can be selected. The number of copies, the starting page and the last page are selectable, too. Often it is necessary to choose the right paper orientation in the vendor specific printer option dialog. This dialog is accessible via the set-up button.

The set-up of the echo plot range allows the printout of only parts of the data window. This is sometimes useful for generating echo plots of a whole area with the same printed range even if they originally have different ranges. With the definition of the vertical scale factor and stretch factor it is possible to adjust the echo plot to the paper size. The number of the resulting pages and the total plot height are calculated automatically and shown in the dialog window.

Some options for the printout are selectable: the print of a border line around the plot, the print of some information in a header and the print of the position data on the left and on the right of the echo plot.



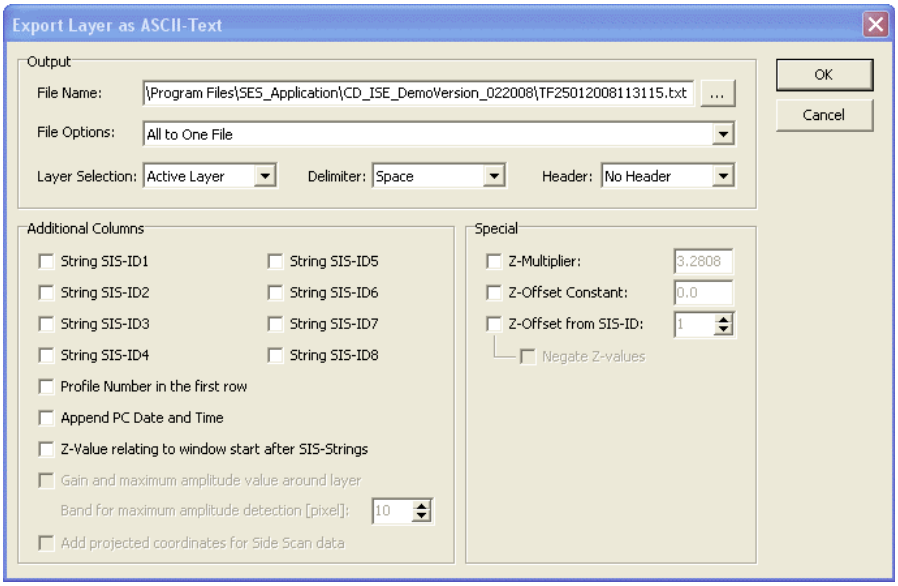
The Export Layer Data Dialog

This dialog appears just before the export of the edited layers into compatible ASCII files. The target file can be selected. Two ways are possible, the generation of a new file and the attachment to previously generated files.

Furthermore, it is possible to select which layer has to be exported, which character has to be the delimiter character and if a header has to be included in the file.

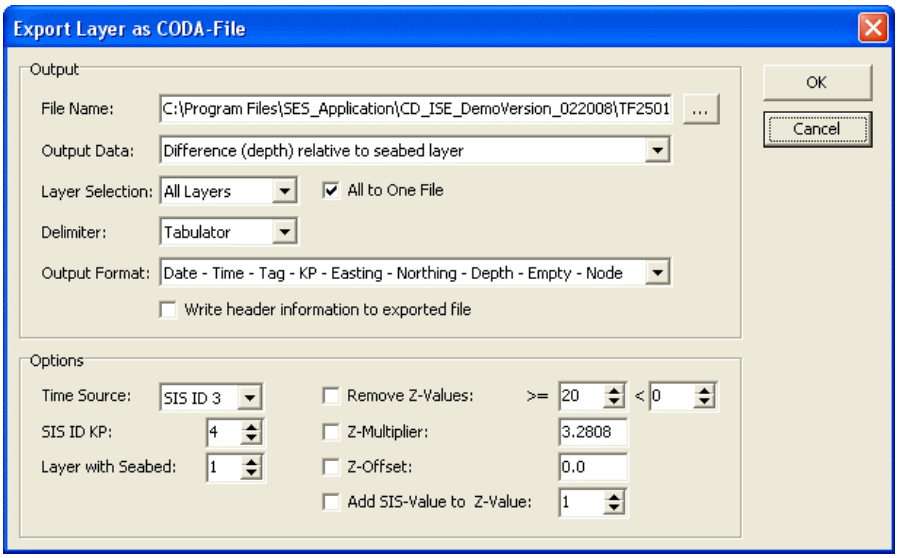
Normally, the X position, the Y position and the Z value of the edited layer will be exported as a table. It is possible to choose additional columns for the table. Every SIS string can be separately exported into the ASCII file. One check box allows the export of an additional column with Z values related to the start of the visible data window, independent of the absolute Z value. Another check box enables the export of the profile number into the first row of the ASCII file. This might be useful for some label functions in external software packages. Date and time from the PC can be exported too. There is also a check box which allows to export the gain and the maximum amplitude around the layer which will be exported. This function will be enabled in amplitude mode only. If the data file is a Side Scan File, then additional columns with projected coordinates can be written to disk (applied offset from track line of the digitised information).

Special options are the calculation of a multiplier to the Z value (for unit conversions for instance) and an offset to the Z value and the combination of the Z value with the selectable Z value from the SIS data. This is a very useful method to correct ship movements in the vertical direction if during the survey a RTK DGPS system was used which has provided accurate Z information.



The Export Layer As CODA File Dialog

This dialog is to export layer data as CODA files, an ASCII based and custom made format. Like with the standard ASCII export, layers can be written to a single file or to multiple files or attached to existing files. A file name depending on the active data file is proposed automatically. Per default the delimiter is a Tabulator character, as specified by this format (please refer to the file format description in the appendix).

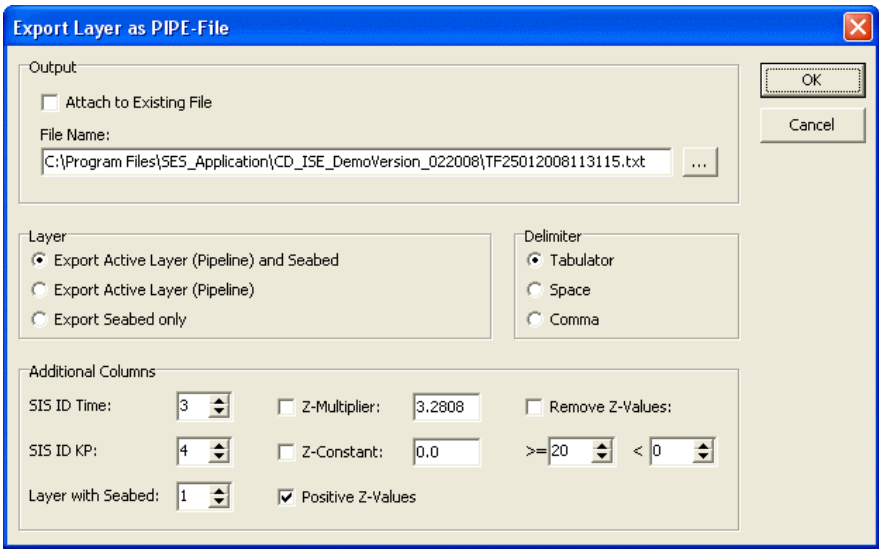


Additional to the coordinates some more columns are part of the CODA file format. The SIS ID for the GPS time and the SIS ID for a KP value (Kilometre of Pipeline, or generally Kilometre of Survey Line) must be selected. Since relative depths from seabed are usually exported, the actual layer containing the seabed information, is required too. Some special options are selectable. A Z-Multiplier can be given, for example for unit conversions (e.g. metre to feet). If the checkbox for absolute Z-Values is checked, then real Z-values are written rather than relative Z-Values. A constant offset can be applied to the Z-Values and a filter exists to delete all Z-Values which are outside a given range. Furthermore a value taken from a SIS ID can be

added to the absolute Z-values. This can be useful if an external depth (multibeam depth) is available in order to get the absolute depth of a layer according to the external depth.

The Export Layer As PIPE File Dialog

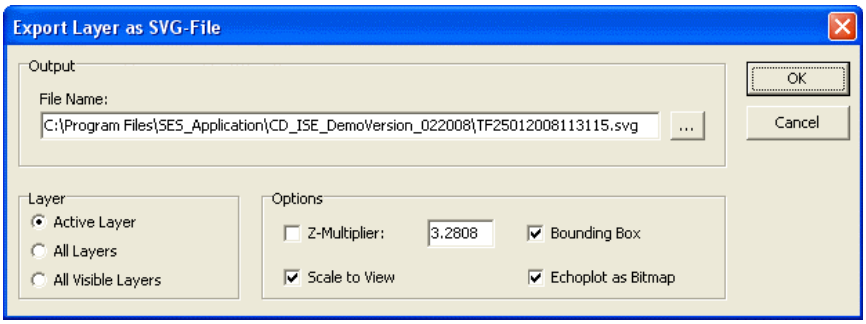
This dialog is to export layer data as PIPE files, an ASCII based format, based on the CODA format, but custom made for pipeline surveys. A layer, caused by a pipeline can be written to a single file or attached to existing files. A file name depending on the active data file is proposed automatically. Per default the delimiter is a Tabulator character, as specified by this format (please refer to the file format description in the appendix). The column with the description can either contain "seabed" or "topofpipeline", so this format is more or less fixed. The export allows to write the seabed information only, the layer (pipeline) information only or both data sets together.



Additional to the coordinates some more columns are part of the PIPE file format. The SIS ID for the GPS time and the SIS ID for a KP value (Kilometre of Pipeline, or generally Kilometre of Survey Line) must be selected. Since relative depths from seabed are usually exported, the actual layer containing the seabed information, is required too. Some special options are selectable. A Z-Multiplier can be given, for example for unit conversions (e.g. metre to feet). If the checkbox for positive Z-Values is checked, then all Z-values are written as positive values. A constant offset can be applied to the Z-Values and a filter exists to delete all Z-Values which are outside a given range.

The Export Layer As SVG File Dialog

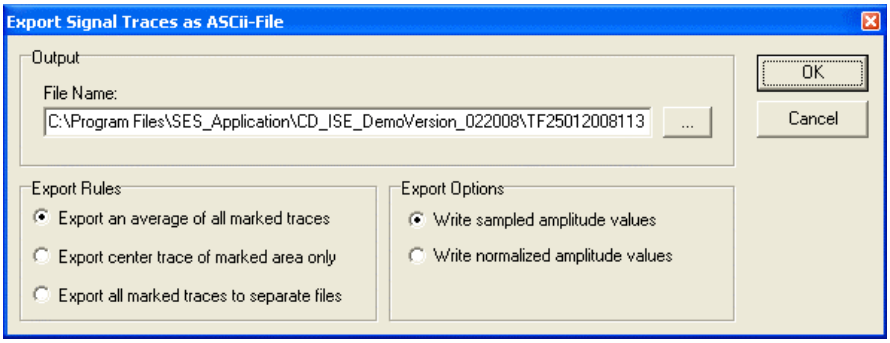
This dialog allows the export of layer data into a SVG file, which is based on the XML specification and stands for 'scaleable vector graphics'. SVG files can be imported by several graphic programs and may be used for presentation purposes of interpreted results. The default file extension of this ASCII file format is "svg". A filename is proposed based on the data filename itself, but can be altered.



It is possible to write the active layer, all layers or all visible layers into the exported file. Some option exits, for example to include a bounding box, to write the echo plot as a background picture (in Bitmap Format) and include a hyperlink into the SVG file. A Z-Multiplier can be given, for example for unit conversions (e.g. metre to feet). The checkbox 'Scale To View' should be used to relate the vector graphic file information (all graphical polygons) to the page size, when loading the file with a graphic program. Reference for all drawing coordinates is the upper left corner.

The Export Signal Traces Dialog

For advanced signal analysis with external software packages this dialog allows to export single signal traces or groups of signal traces into ASCII files. Once an area of the echo plot is marked, the signals of this area can be exported. A base file name is automatically proposed and will be extended with the individual ping numbers of the selected area. When exporting the signal traces one option allows to write an average of the selected pings, to write the data from the trace in the middle or to write all of the selected pings into separate files. When exporting the data it is possible to write the sampled amplitudes as shown within the ISE software or alternatively a normalized amplitude. The normalization will take into account the amplifier setting and the water depth. As a result the exported amplitude values are comparable for files or areas where different amplifier settings were used or the water depth has changed.



The standard extension of the exported ASCII files is "txt". The file format is the same as what is generated with the ASCII export tool. Please refer to the appendix with the file formats for details.

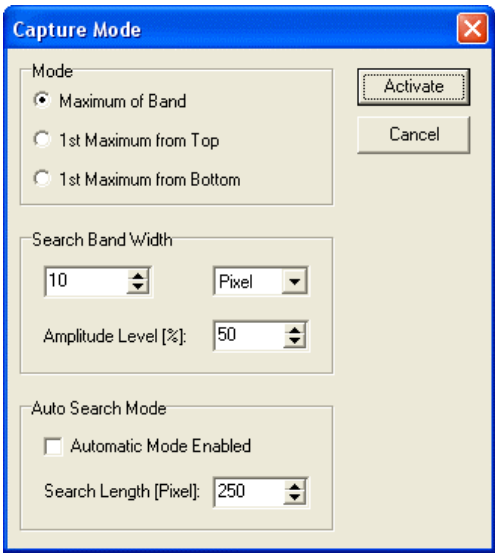
The Capture Mode Dialog

The Capture Mode Dialog allows the set-up of some parameters for the automatically layer detection. A search band around the cursor can be defined. Within this band the

automatic detection will work. Three modes for the search algorithm are possible. The normal mode is to select the maximum of the band. Sometimes it can be useful to select one of the other modes to avoid strong fluctuations during the edit process.

The amplitude level selection works like a threshold for the layer detection. The final layer position will be calculated form the detected maximum and the defined threshold level. If the automatic mode is enabled a pre-calculation of the layer always appears during the edit process. By pressing the mouse button, the layer will be drawn. The length of the pre-calculated area can be adjusted. The standard mode for the editing process calculates only the layer position below the mouse cursor.

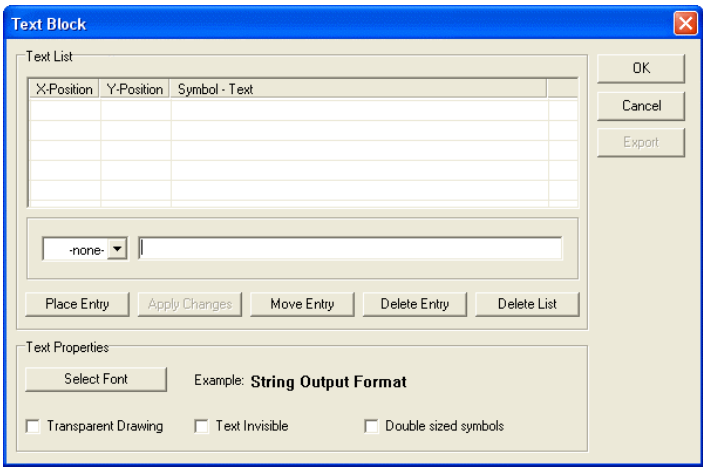
The Capture Mode button in the status bar is always pressed when the capture mode is active. To disable the capture mode press the Capture Mode button again.



The Text Block Dialog

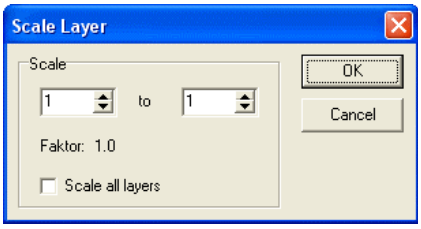
For presentation purposes and for commenting echo plots it is possible to overlay text and symbols onto the echo plots. A list of up to 50 individual lines can be edited and placed on the echo plot at any position. Once a text line is placed on an echo plot, it can be moved to a new position later. The appearance of the whole text is adjustable, so any Windows font or colour may be applied. The example string in the dialog will show the appearance. It is not possible to give every line individual font properties. Additionally the user has the possibility to add a predefined symbols. There are several symbols selectable from the pull down list. One checkbox allows to write the text transparent or with a with a filled background colour. Another checkbox allows to hide the text completely, for example to print echo plots without descriptions, but to keep the text overlay. After editing the text in the box and pressing the button Add Text, the user has to select the position for the text on the echo plot. The edited text will be visible on printed echo plots and on exported graphic files too.

- The whole text will be saved together with layer files, but the selected font not.



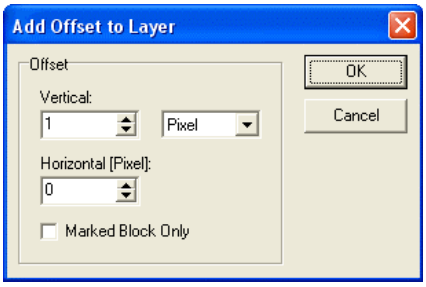
The Scale Layer Dialog

Use this dialog to change the horizontal scale of the edited layer. According to the accumulation rates it is possible to change the scale between 1 to 16 and 16 to 1. This means a layer can be stretched to different accumulation rates even if it was edited during another accumulation setting. The scaling factor will be calculated and written to the dialog window. An option exists to scale all layers in one step.



The Add Offset Dialog

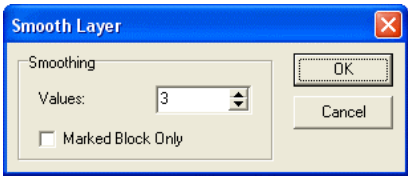
Within this dialog it is possible to define an offset to the selected layer. The offset value is a metric value or a pixel value for vertical offsets and a pixel value only for horizontal offsets. Both directions, positive and negative offsets, are selectable and the operation can be performed on marked sections only.



The Smooth Layer Dialog

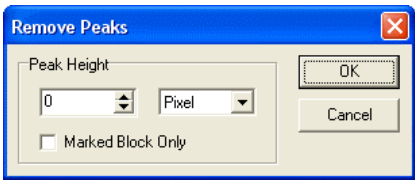
The active layer can be smoothed to get a more continuously line and to remove small peaks in the layer line. The smoothing rate is defined by the number of values for the calculation. Higher values result in a more smoothing effect. By enabling the check box Marked Block Only the smoothing function affects only the marked area in the echo plot.

- The smoothing operation with even values will produce a small horizontal shift of the recalculated layer, therefore odd values are selectable only.



The Remove Peaks Dialog

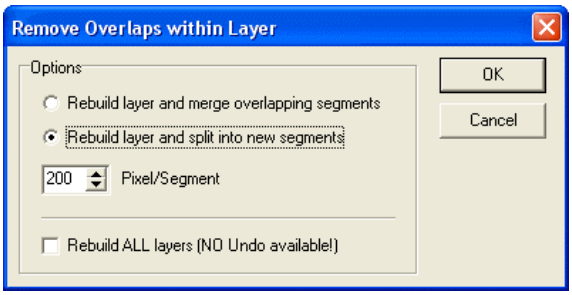
The Remove Peaks function can be used to remove peaks in the active layer line which sometimes appear in automatically calculated layers. The peak height can be defined in pixels or metric values. By enabling the check box Marked Block Only the function affects only the marked area in the echo plot.



The Remove Overlaps within Layer Dialog

During the digitalisation with the "Capture Tool" it might be, that two segments are overlapped. That means that one position can have two different z values. Some software packages have difficulties to handle such positions. In order to avoid such problems the "Remove Overlaps within Layer" button will remove all overlapping layer parts.

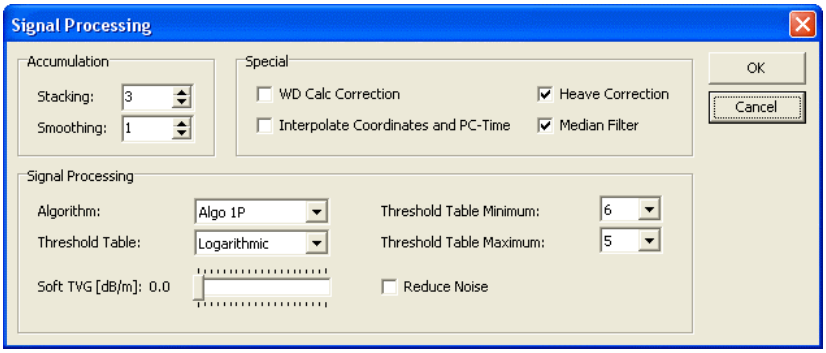
This function is also a very useful tool to remove spikes within a layer. Spikes can be removed by redrawing the particular place by using the "Capture Tool" or even free hand. The "Remove Overlaps within Layer" tool rebuilds the layer and merges all drawn layer parts together. The new layer can comprise of one segment or can be split into more than one segment with a certain length.



The Signal Processing Dialog

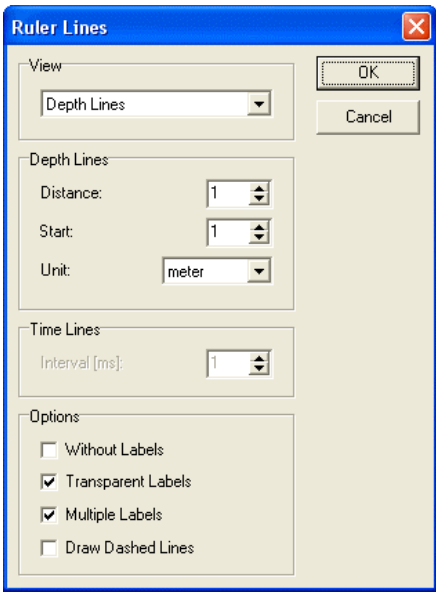
This dialog has some of the possibilities of the Load Data Dialog. The accumulation parameters, the algorithm, the Soft TVG and the threshold table can be adjusted. The water depth correction, the heave correction, the median filter and the coordinate

interpolation can be switched on or off. The coordinate interpolation can only be applied to a data file once.



The Ruler Lines Dialog

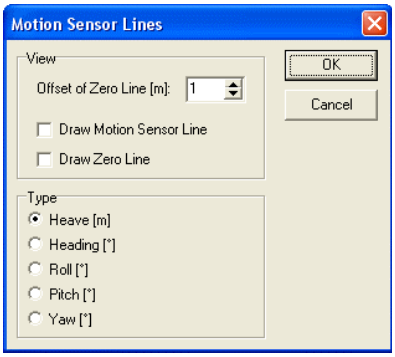
The number and distance of the ruler lines can be defined manually. Apart from disabling the ruler lines completely, the echo plots can have ruler lines based on depth or based on travel time. The distance between the depth lines or the time interval is adjustable. The start value for the depth lines can be set up as well. The smallest distance between two lines is one unit of selectable metres, feet or fathoms for depth lines and one millisecond for time intervals. Please note that the display of time lines will result in incorrect values, when the echo plot is corrected for different speed of sound values in the water column and the sediment body.



Checking the option for transparent labels will create a transparent drawing of the numbers. When the echo plots are containing a lot of echoes or noise, then not checking this option will draw the text on a filled background. The checkbox for multiple labels creates continuously ruler lines with annotation on the whole echo plot, otherwise the ruler lines have an annotation only at the beginning of the echo plot, meaning on the left side.

The Motion Sensor Lines Dialog

The recorded values from an attached motion sensor can be plotted as a curve on the echo plot. Set up an offset from the top of the data windows, enable the overlay of the curve and, optionally, of the zero line. The data selection is possible between the heave, the roll and the pitch values.



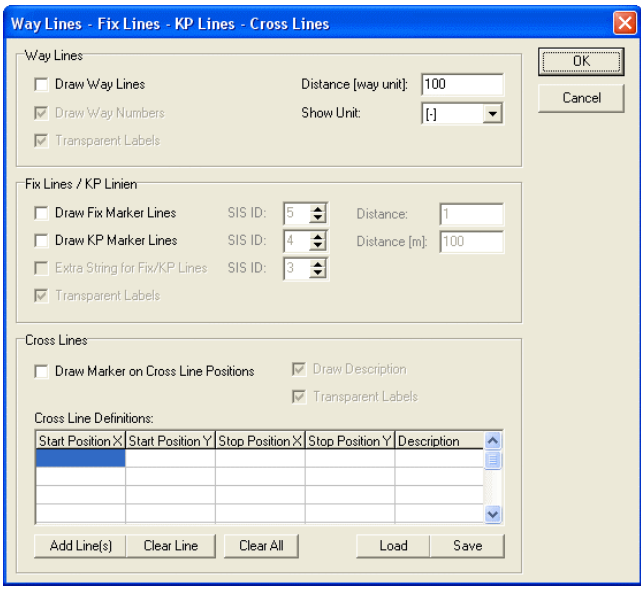
The Way Lines, Fix, KP Lines, Cross Lines Dialog

This dialog has been changed a lot in comparison to previous releases of the ISE software. Now the user have a lot more possibilities to overlay the echo data with vertical lines by using several sources.

The user can generate way lines as usual to get an idea about the lateral dimensions in the plot. It is possible to draw vertical lines onto the echo plot at defined distances. The Draw Way Lines check box has to be enabled for the drawing of the lines. Some optional units are selectable to write them to the line labels. It is possible to enable or disable the numbers on the lines and to draw them transparent or with a cleared background for better visibility.

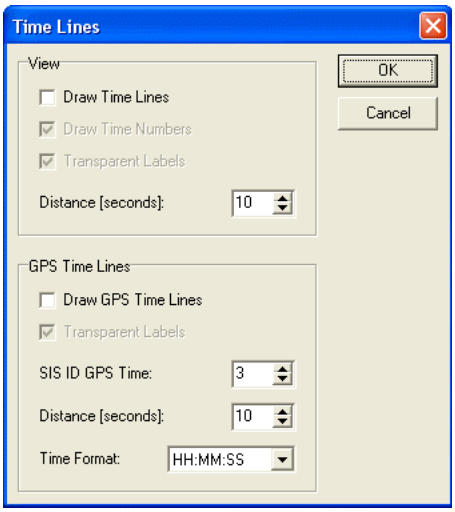
Additionally it is possible to select a SIS field in order to read logged KP values (kilometre of pipeline or kilometre of survey line) or Fix line values. At given distances or counters a vertical line will be drawn onto the echo plot together with the KP/Fix value. Further more the user has the opportunity to add some additional information as long those information's are stored on a SIS field. In order to display such information within the echo plot the checkbox Extra String For Fix/KP Lines must be enabled and the desired SIS field has to be selected. The text can be drawn transparent or with a cleared background for better visibility.

Last not least the user is now able to create cross lines. In order to define cross lines it's just needed to put in the start and the end coordinates of a cross line. Also a line name should be entered in the according list field. Another way is to create an ordinary text file with the needed information and a space as delimiter. Such a file can be loaded by the Load button. If the data has been created by the list field itself, it's possible to save the data to an ASCII file. A event line will be displayed if the vessel's track is crossing a defined line. A vertical line with the line name as annotation will be shown in the echo prints.



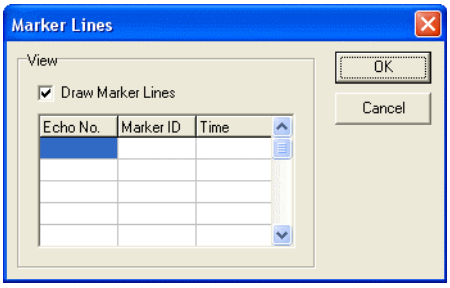
The Time Lines Dialog

Within this dialog it is possible to define a time period for drawing vertical lines onto the echo plot. Two possible options are available. First the Draw Time Numbers check box enables the drawing of the time period at the line position in relation to the start of the file. The period is adjustable in steps of one second. The next possibility is the drawing of time lines based on recorded time values, e.g. from a GPS receiver. The source ID for the SIS field with the recorded time is required, the distance between the time marker and the used time format within the recorded SES data files.



The Marker Lines Dialog

This dialog shows a list of all markers in the active data window. The list contains the echo number, the marker ID and the time. Additionally, the user can decide to hide or show the marker on the echo plot. They are drawn as vertical lines over the plot with the marker ID on top.



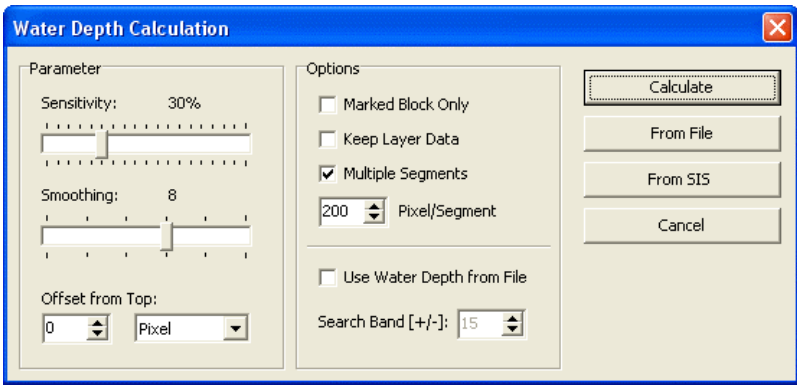
The Water Depth Calculation Dialog

If the water depth line has to be inserted in a data window, this dialog appears. With the sensitivity value it is possible to adjust the threshold for the water depth calculation. Smaller values result in a higher sensitivity. Sometimes it is necessary to test some value settings for good results, but the default setting with respect to the system hardware should be about 20 or 30 percent. The smoothing is a useful option for decreasing fluctuations in the calculated depth line, but should normally be done after the removal of spikes with the smoothing function. The input of an offset from the top lets the calculation start after the range has started. If the echo plot has strong amplitudes on the upper part, caused for instance by air bubbles of the ship's screw, this area can be skipped for the water depth calculation.

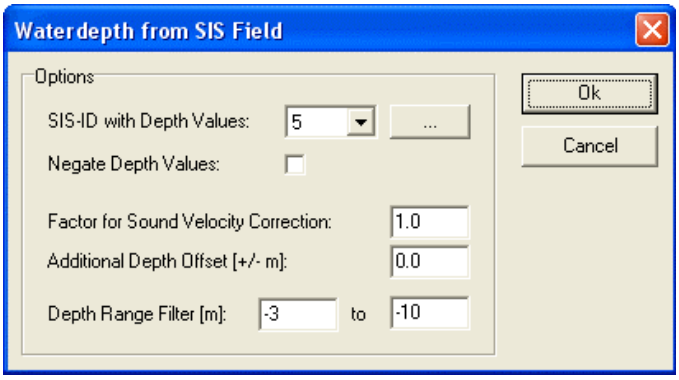
If the option for the marked block is enabled, the water depth will not be calculated outside the marked range. If the option for keeping the layer data is enabled, all previously edited layer information will not be overwritten. The option to generate multiple segments for the calculated water depth layer allows a manual removal of parts of the data with the Segment Tool Box afterwards. These sections may be digitised manually, in case the automatic calculation has failed due to poor data quality. The length of the individual segments is adjustable in Pixels.

For the recalculation of the water depth an option exists to use the on-line calculated depth and search for the new water depth within a band around this value.

The button From File skips the water depth calculation and inserts the water depth line from the online calculated water depth.



SES systems which have a multi purpose input port are able to receive the water depth from another device e.g. Multibeam system. Those received depth values are stored on a SIS field and can also be used to create the seabed layer. The button "From SIS" opens the "Water Depth from SIS Field" dialog.

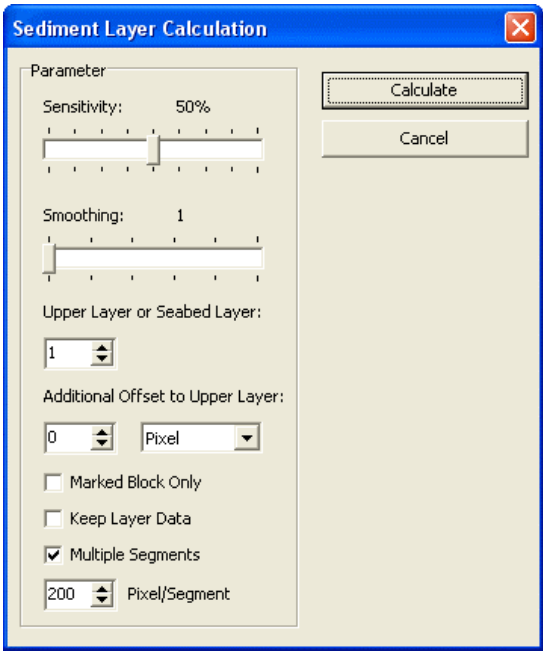


The dialog allows to select the SIS-ID with the external water depth information. The button next to the SIS-ID field gives an overview about all available SIS fields to select the right one. In case of using different speeds of sound and/or different draft settings between both devices it will be necessary to apply a factor and/or an offset to the depth value to match the external depth values with depth data of the SES system. In order to remove spikes a range filter can be applied to the data.

The Sediment Layer Calculation Dialog

Comparable to the water depth calculation dialog this function allows to insert a layer in the data window. The echo plot is processed not from the start of the range but from a given layer number or the already digitised water depth layer. The success of this calculation is mostly depending on the type and quality of the echo data. Usually a manually editing with the band mode is required, but if there are very distinct layers within the data, then this processing function may be used.

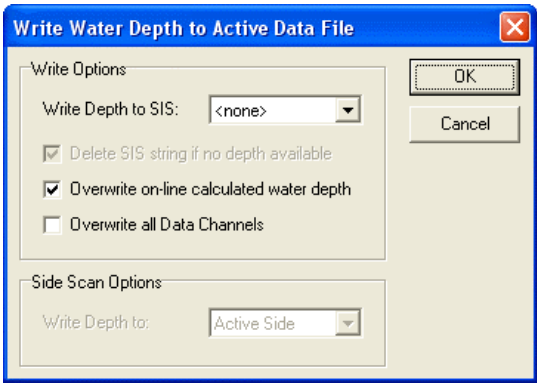
The options for the marked areas, the segment size, the offset from top etc. have the same functionality as described in the water depth dialog above.



The Write Water Depth To Active Data File Dialog

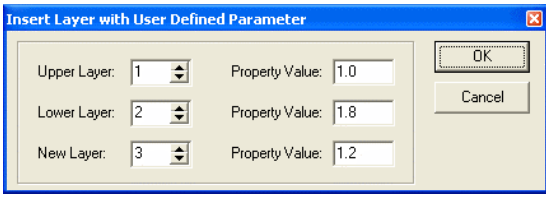
Once a water depth was digitised and exists as a layer within the data window, this dialog allows to write that information directly to the according data file. Optionally the information can be written to one of the SIS fields or to the header value of the binary data files with the on-line calculated depth. Please be aware that the online calculated values will be lost in this case. Since the data files in most cases contain more than one channel (e.g. primary high frequency and secondary low frequency) the digitised depth can be written individually to each channel or can be used for all channels available.

One option especially for side scan data files exists, to write the digitised depth to a selectable side or to use this depth for both sides.



The Insert Layer with User Defined Parameter Dialog

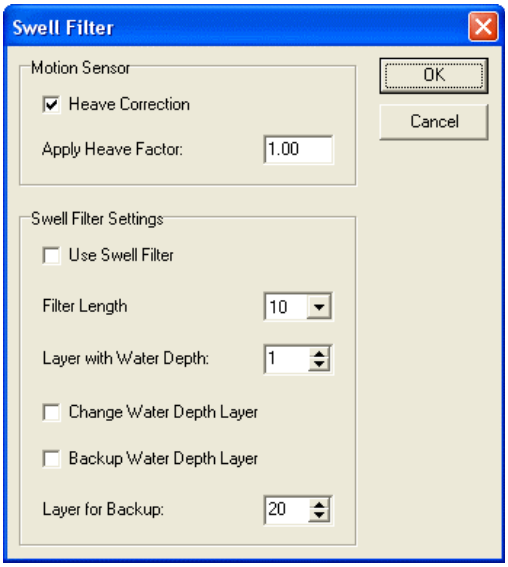
This dialog allows the calculation of a layer in between two existing layers. Assuming two layers (or one layer and the water depth) were digitised and some kind of parameter can be applied to each layer (for example a density value), then this tool can calculate the position of a given value between those two layers. This is based on a linear change of the parameters. All the positions of the given parameters are connected to build a separate layer, which will be drawn onto the echo plot.



The Swell Filter Dialog

If during data acquisition no motion sensor was available for doing a heave compensation, this filter allows a software swell compensation. Before applying a swell filter, the bathymetry must be digitised and stored as a separate layer. One option exists to apply the swell filter to this digitised layer too. In this case it is recommended to backup the original bathymetry to another layer, so the swell filtering can be applied during a later stage again, since the swell filtering is not stored in the data files itself and needs to be recalculated whenever a data file is reloaded. The dialog gives the option to select the layer number to take the bathymetry data from. The given filter length is a unit free value and it depends on the heave ripple length

and on the ping rate which value will give the best result. As a general rule the swell filter will remove long swell or long heave ripples with longer filter values and short ripples with small values.

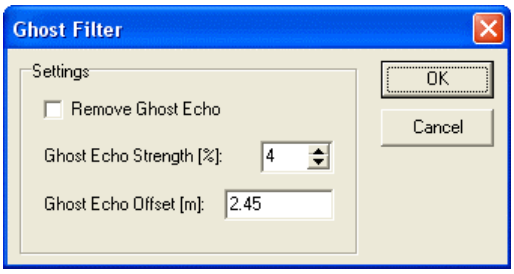


The implemented software swell filter is not able to determine between ripples inside the data caused by heave or swell movement and ripples caused by depth variations in the seabed, e.g. sand ripples. When applying the swell filter on data sets, which have heave data included, it is recommended to apply the normal heave compensation first, then to digitise the bathymetry and afterwards to apply the swell filter. Such a situation may happen, if the performance of the heave compensation is poor and some heave is still left within the data set. An adjustable factor can be given for the heave values, in case the amplitude response of the motion sensor was not good enough.

- Be aware, that a software swell filter may remove not only heave ripples from the data, but real ripples on the seabed as well. Therefore a motion sensor with heave output is preferred and it is recommended to use the heave correction in advance of the swell correction.

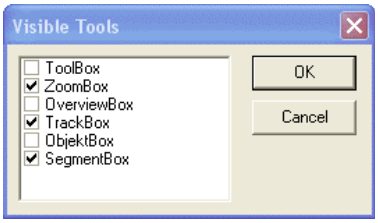
The Ghost Filter Dialog

The Ghost Filter dialog gives the possibility to remove signal parts from an echo plot, which are caused by reflectors within the sound propagation path. Such signal parts have nearly the same echo curve, but with a time delay. For example a parallel echo below the seabed will be visible on an echo plot. The filter approach is to subtract a calculated and weak signal with a given delay (in metres) from the original signal. The more accurate the offset of the parallel reflection is given, the better the filter will remove the unwanted ghost echo.



The Toolbox Dialog

This dialog allows the selection of the visible tool boxes. Every tool box can be separately enabled or disabled.

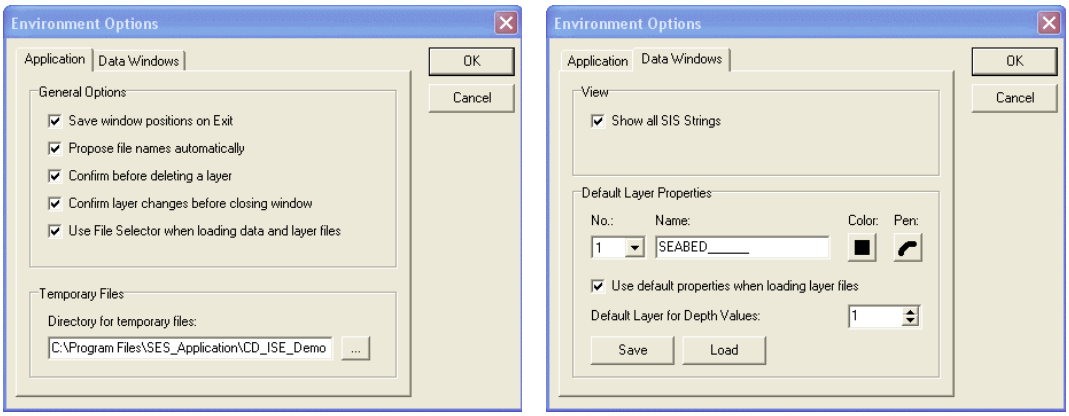


The Environment Dialog

Within this dialog it is possible to set up some options for the application itself. The option for saving window positions means the storage of all positions and settings regarding the visibility of the application window and the tool windows. At the next start they will be restored. Several functions and operations will produce new files. The option to propose new file names will automatically generate file name strings in the dialog windows, which may be used or changed. The proposed filenames are based on the names of the loaded data files. One option allows to enable or disable the confirmation dialog, before deleting a layer. To switch between MS Windows common dialogs for loading files and the ISE File Selector another checkbox is available on the first page.

The directory for storing temporary files can be selected and changed within this dialog too. Per default the directory of the ISE program itself, where it was started the first time, will be used.

- It is recommended, not to use any network drive or slow removable drives, because this will decrease the applications processing speed. Please use a local drive and directory to store temporary files.

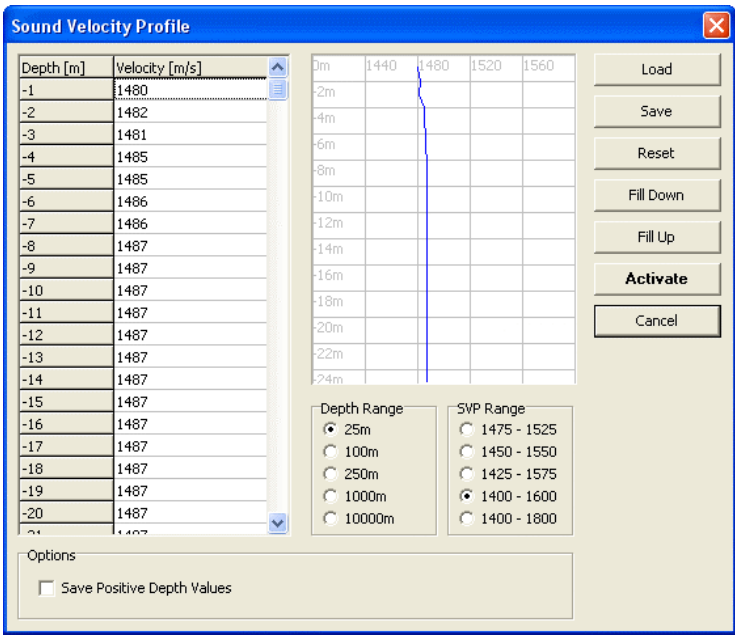


Furthermore the environment options dialog allows the definition of the default layer properties, like pen colour, pen width and pen mode, as well as the definition of a layer name for each of the layers. These given layer names are used during export of files and for better orientation during processing. One checkbox enables the use of the given default properties, even if a reloaded layer file was stored with different settings for the layer properties. The layer properties can be saved into files for different processing projects.

If the option to show all SIS strings is enabled, then the data window status bar has two lines, one with the information below the cursor position and the second one with all the SIS strings of the ping below the cursor position.

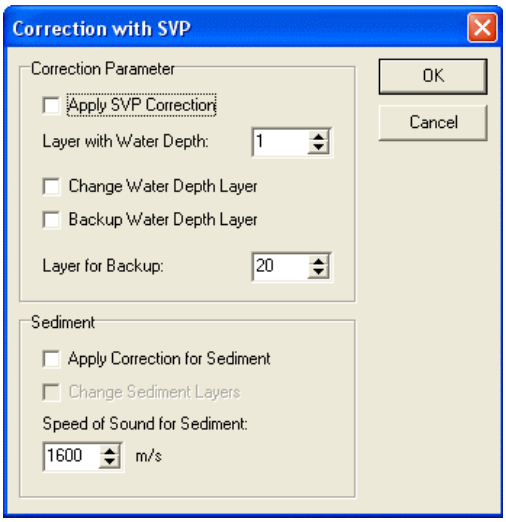
The Sound Velocity Probe Dialog

This dialog allows the definition of a sound velocity profile which is valid for the whole application. It can be used in any open data window. For each metre, starting at -1m, a value can be defined. Each field is manually accessible. One option allows the filling of the whole table with the value from the cursor position down or up to the last field. An edited table can be stored to disk and restored, too. The generated files are standard ASCII files. If the user activates the edited table, the ISE software interpolates automatically in areas with non-defined fields. From the last edited field to the end of the table the value will be constant. The same rule is valid for the beginning of the table if the editing does not start at -1m. The Reset function clears the whole table, so the sound velocity probe becomes inactive. There is one option regarding the saving procedure. The user can switch between positive and negative depth values in the saved ASCII files.



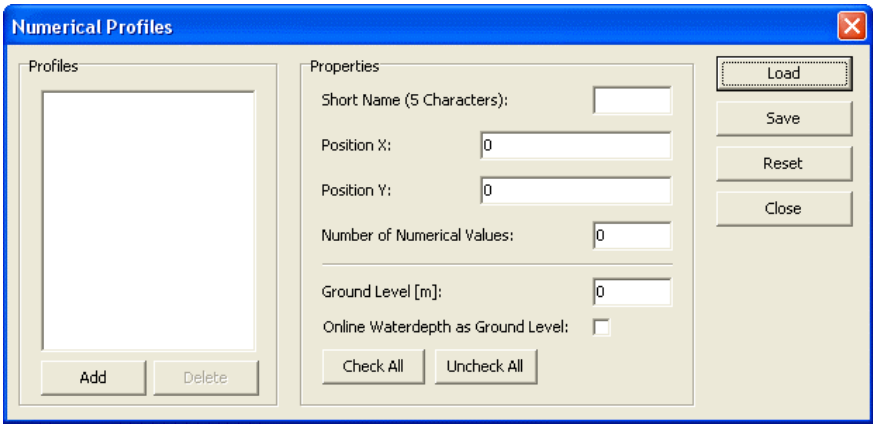
Once a sound velocity profile is defined, the water depth layer can be corrected with this profile. The dialog for the manipulation of a layer with the sound velocity profile allows to keep a backup of the original layer on another specified layer number. Since the corrected echo data is not saved, the echo plot needs to be recalculated, whenever the SES data file is reloaded.

Additionally to the correction of the water column and the water depth inside the echo plot, an option for the change of the speed of sound for the sediment body exists. Based on the same selected depth layer a new value for the speed of sound can be applied to the whole echo data below this layer. This is useful to get corrected echo plots with more accurate depth and thickness of sediment layers because the speed of sound inside the sediment is usually different than in the water column.



The Numerical Profiles Dialog

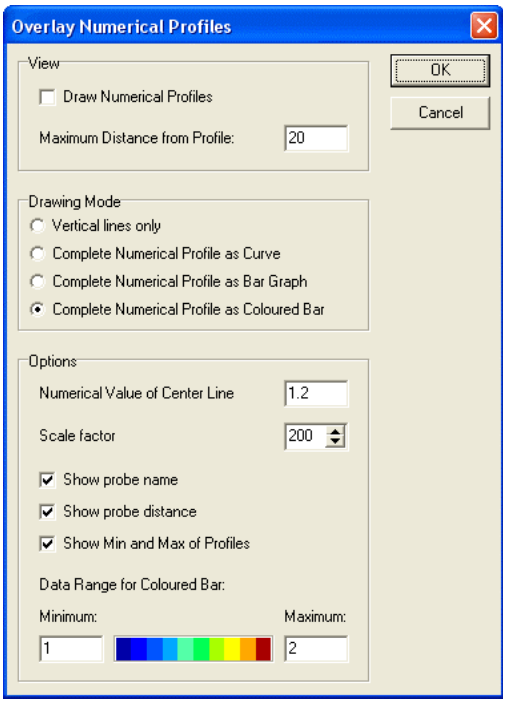
The main function of this dialog is the editing of the numerical profile data base. This data base is application wide accessible.



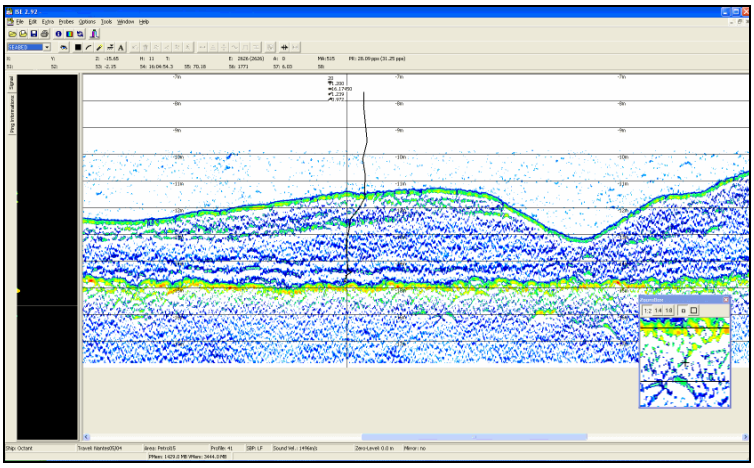
On the left side of the dialog appears a list with the defined profiles. The properties of each profile, e.g. the position and the number of measured values, are shown on the right side of the dialog. A ground level can be applied individually to each profile. One option allows the possibility to use the on-line calculated water depth as the ground level. Two buttons are to check/uncheck this option for all profiles at the same time, because the database may become quite large for some projects.

The Overlay Numerical Profiles Dialog

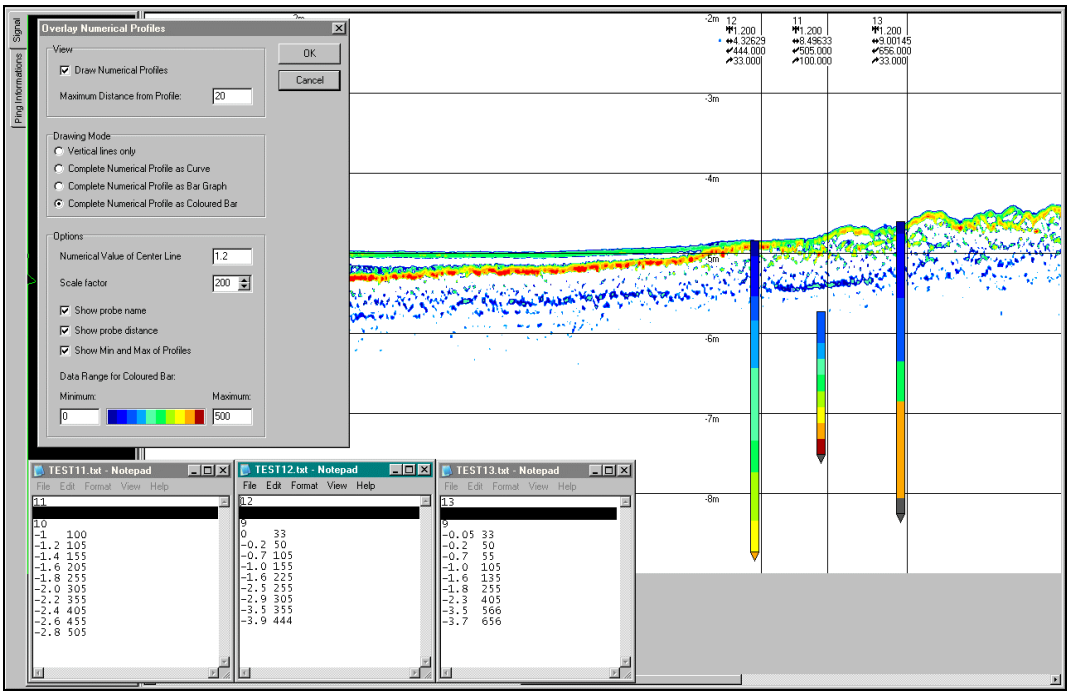
Once a numerical profile data base is edited and activated, the information can be combined with echo plots. The overlay can be switched on or off for each data window separately. First a radius has to be defined in which the profiles have to be positioned. If the profile position is outside this radius, the data will not be drawn on the plot. The ISE software calculates the minimal distance of the numerical profile from the track line and puts a vertical line on that position in the echo plot. Three further drawing modes are available, one is a continuous line and the other one is a bar graph of all measured numerical values (horizontal bars) and the last one is a coloured bar with an adjustable range for the bar colours. The numerical profile name, the calculated distance and also the minimum and maximum of the measured values can be written on the plot. The numerical curve as well as the bar graph are scaleable. The centre value for the vertical numerical profile line is adjustable.



The following example shows a data window with numerical values from a density profile as an overlay to the echo plot.

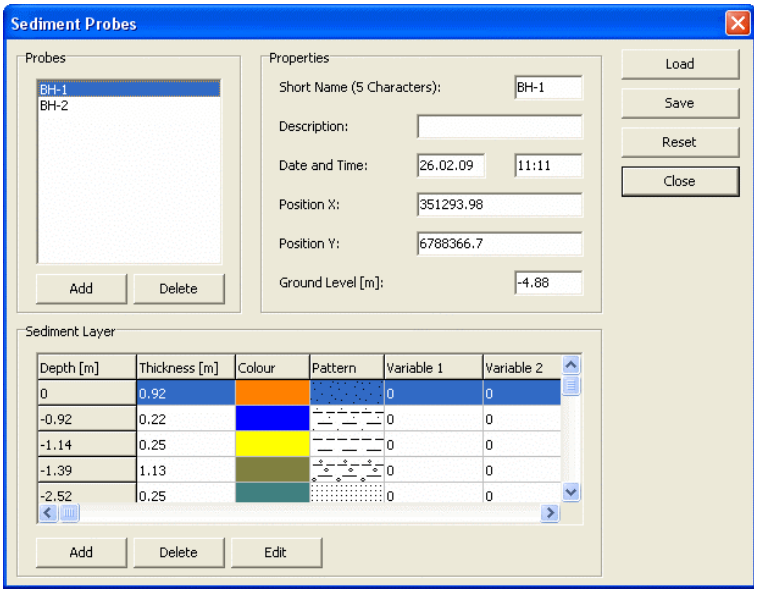


The following example shows a data window with numerical data from shear wave measurements, visualized as coloured bar graphs.



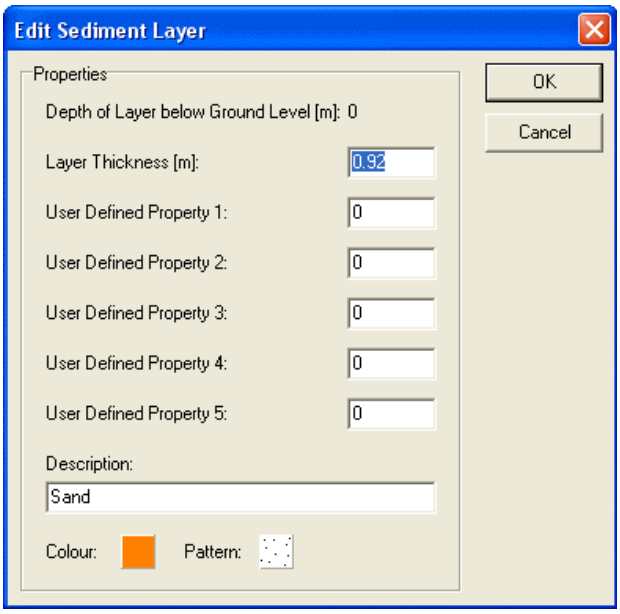
The Sediment Probes Dialog

The main function of this dialog is the editing of the sediment probe data base. This data base is application wide accessible.

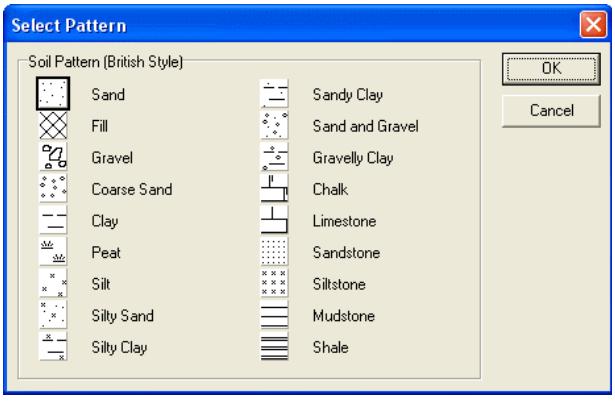


On the left side of the dialog a list with the defined probes appears. The properties of each probe, such as the position, sampling time and ground level, are shown on the right side of the dialog. The bottom part contains the list of the different layers of each probe. Each layer is editable and can have different properties, e.g. thickness, colour, sediment pattern, user defined variables and a description. The variable fields may be

used, for instance, for density, granularity or SPT values. The three buttons below the layer list are used for the editing of the layers. The Add button and the Edit button are starting the Edit Sediment Layer Dialog. Within this dialog each property of a single layer can be edited. The depth of each layer will be calculated automatically depending on the probes ground level and on the thickness of the upper layers. The depth will be updated if a single layer is deleted.



A mouse click on the colour field or the pattern field arises the Windows Colour Dialog or the Pattern Dialog. The pattern list contains the standard sediment classification symbol set of the British Style.

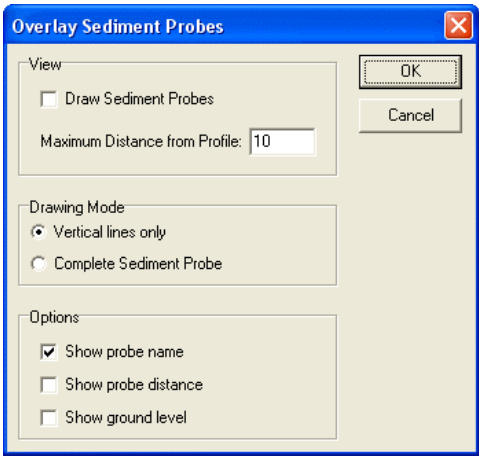


The sediment probe data base can be saved and reloaded. The Reset function clears the whole probe list.

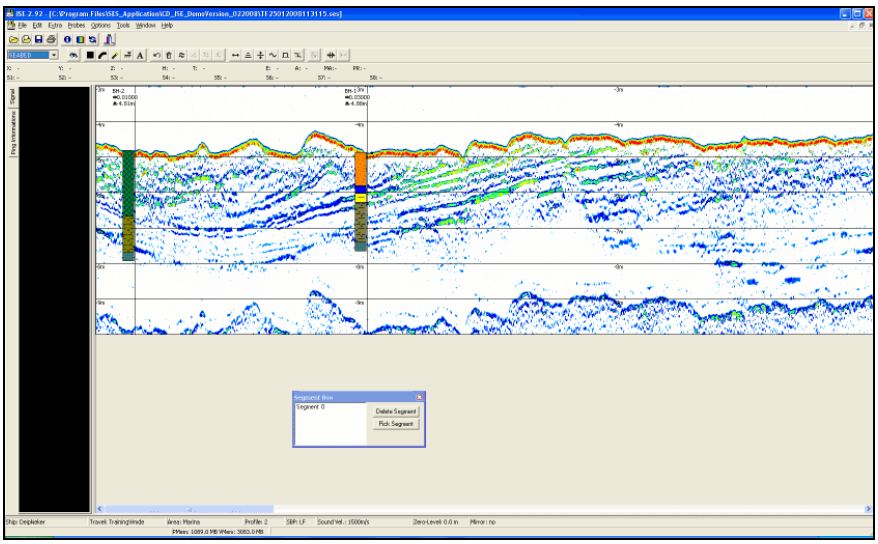
The Overlay Sediment Probes Dialog

Once a sediment probe data base is edited and activated, the information can be combined with echo plots. The overlay can be switched on or off for each data window separately. First a radius has to be defined in which the probes have to be positioned. If the probe position is outside this radius, the data will not be drawn on the plot. The ISE software calculates the minimal distance of the probe from the profile and puts a

vertical line on that position. The probe name, the calculated distance and also the ground level can be written on the plot. Each sediment probe can also be shown with all the layer information, like a coloured bar with the soil patterns.



The following example shows a data window with a sediment probe overlay.



The ISE Tool Boxes

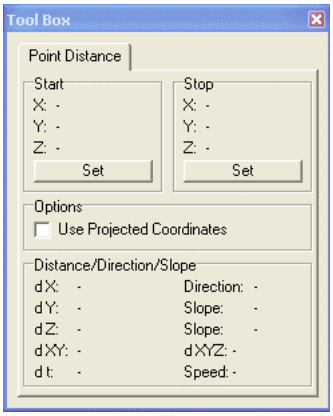
The ISE application has some useful tools or views in a separate window or box. These boxes can be opened even though no data window is active or loaded. Then, however, the functions are often disabled. The position of these small tool boxes are stored in a configuration file, so they always appear at the same position as where they have been closed.

The Tool Tool Box

This tool box has some functions for the work with the coordinates. First it is possible to measure distances between two points. After pushing the Set buttons the mouse cursor changes to an arrow. The point of concern which is then selected will be put into the tool box. After the selection of two points, the differences in all directions, the distance on the flat plane and distance in three dimension plus the course or direction

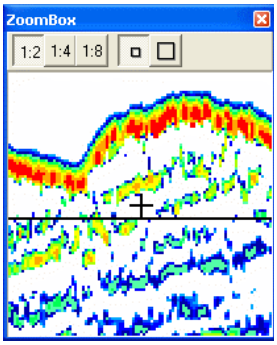
will be calculated. If the data files are side scan files, one check box allows to use of projected coordinates (offset from track applied) for the calculation of the true distance between the two points. Furthermore the slope angle and the slope steepness in percentage between the two picked locations are given.

- The calculation with coordinate points is also possible, if the selected points are not in the same window, which is useful to measure distances between features in different data files.



The Zoom Tool Box

This small window gives a zoomed view around the cursor. It is updated immediately when the mouse is moving over the echo plot. Different zoom levels and two zoom window sizes are selectable. The box is useful for accurate layer or target editing.

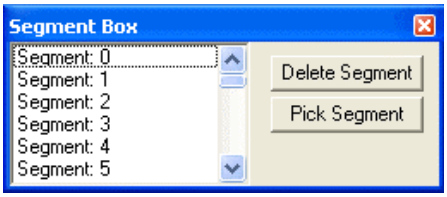


The Overview Tool Box

This resizable window gives an overview of the total echo plot, even if it exceeds the screen size. The visible part on the computer screen is highlighted. By dragging with the mouse the highlighted section can be changed to navigate within the echo plot and to access interesting parts quickly.

The Segment Tool Box

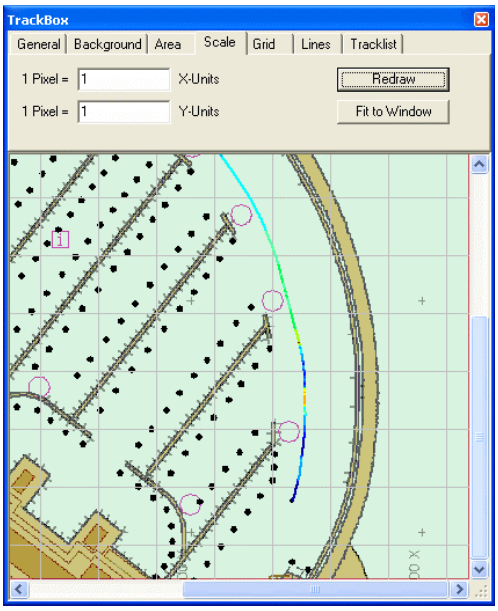
This tool box contains a list of all edited layer segments. During the edit process different segments are created. Selecting one segment in the Segment Tool Box highlights this segment in the active data window. Each segment can be deleted from the list and, therefore, also from the layer in the data window. Additionally it is possible to pick a single segment with a left mouse button click via the button Pick Segment. The closest segment to the mouse cursor position will be selected from the whole list.



The Track Box Tool Box

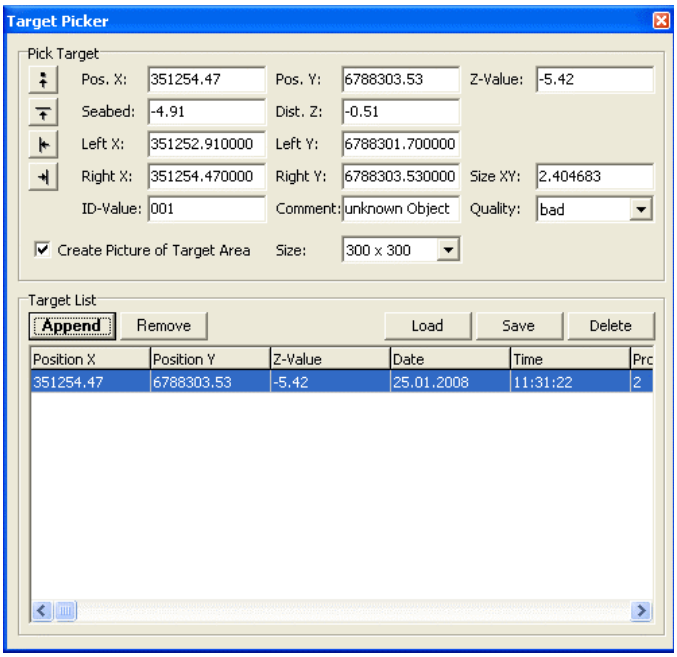
This more complex tool allows a profile overview like in a map. It is not a complete mapping tool but can give a good orientation about the surveyed profiles. The actual position of the cursor in the active data window is marked with a small cross in the track plot. The track plot window has different options, arranged in tabbed notebooks:

On the first page it is possible to select the drawing mode and to save the track plot window into a graphic file. The pixel mode draws a pixel for every position, the line mode connects all positions of a track. The second page allows the import of a base map into the Track Box Tool to have some background display of a chart for example. The coordinates which are given, must fit to the coordinates of the track data of course. The next page allows the definition of the area which should be visible in the plot window. The Min/Max buttons calculate the area bounding all profiles. On the fourth page a scale factor for the X and Y direction can be selected. An option exists to adjust the scale factor automatically, so the whole data contents are fitting to the actual window size. With the next page a grid can be defined with individual grid spacing for both directions. Once a grid is defined, it can be switched on and off with a checkbox. The following page allows the definition of constant lines for a better orientation in the track window or for the input of pre-defined profile lines. The last page contains a list of all tracks. Each track can have its own colour and can be removed from the list.



The Target Tool Box

This tool box is useful for the generation of lists with single reflectors. By selecting a point on the echo plot the position and a z value are collected. Together with the picking of the seabed depth, the depth above or below the seabed will be calculated. If a single reflector is marked with its left and right border, the dimension will be calculated too. The mean amplitude of the reflector, of the seabed at this position and the amplitude ratio will be calculated as well. An ID value, a comment and a quality index may be given optionally. Once a target is defined, it can be appended to a list of targets in the lower part of the tool box. All interesting values are written to this list, including all SIS strings for the target position. This ASCII list can be saved to disk and also be reloaded for further attachments. When a value in a column is not defined, e.g. no borders were selected, then minus characters are written to the list. This results in a fixed number of 30 columns. Additionally there is a possibility to create a picture for each target. The size of the target image can be selected by the pull down list named size.



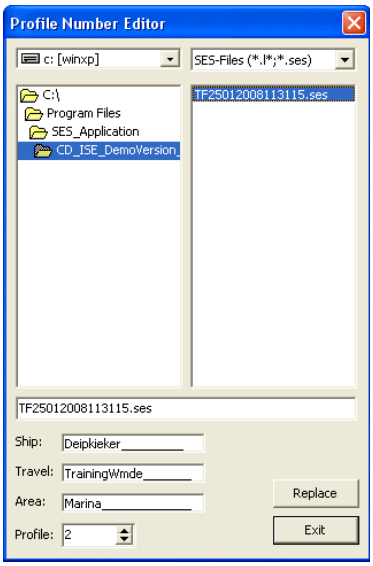
The ISE Tools

Some tools are included in the ISE software package which are not directly involved in the edit process but are sometimes very useful. They can be started even though no data window is open.

➢ The tools work directly with the files on the disk, so be careful because the data will be manipulated irreversible. Always make data backups prior to processing.

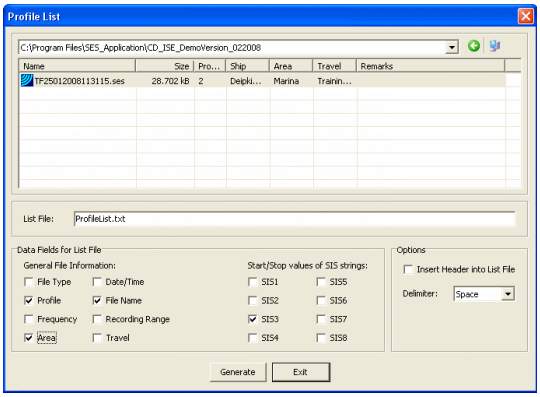
The Profile Number Editor

With this editor it is possible to edit the general file information. The profile number, the ship's name, the travel name and the name of the area are editable. This tool works for the SES-96 data files and the DAR files. If a file is selected in the file list, the actual contents are shown and can be changed by pushing the Replace button.



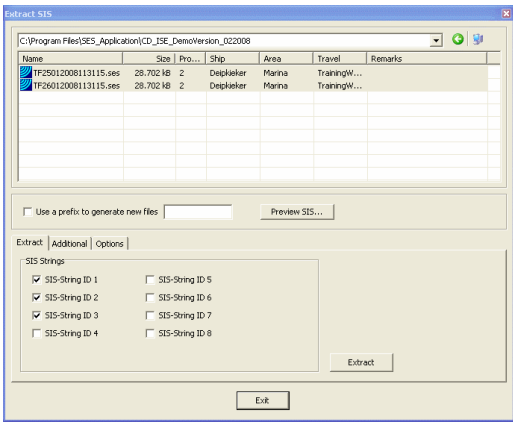
The Profile List Tool

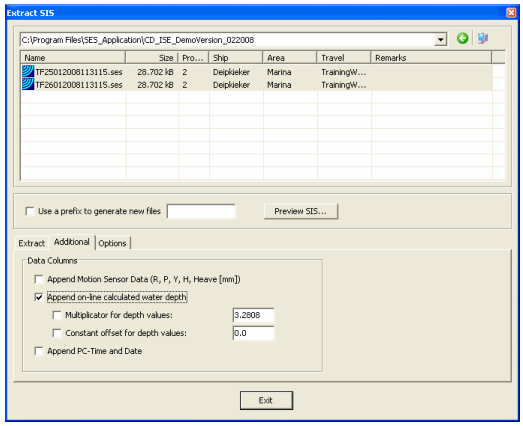
With this tool it is possible to generate a list of all profiles from a directory on the disk. The user can edit the name of the list file and can include several data columns. There is an option to write a header into the list file as well. The list contains the information about the file type, the file name, the date and time of creation and the profile number. It exists an option to write all of the SIS information from the start and the end of the files into the generated list file. The profile list is a normal ASCII file.



The Extract SIS Tool

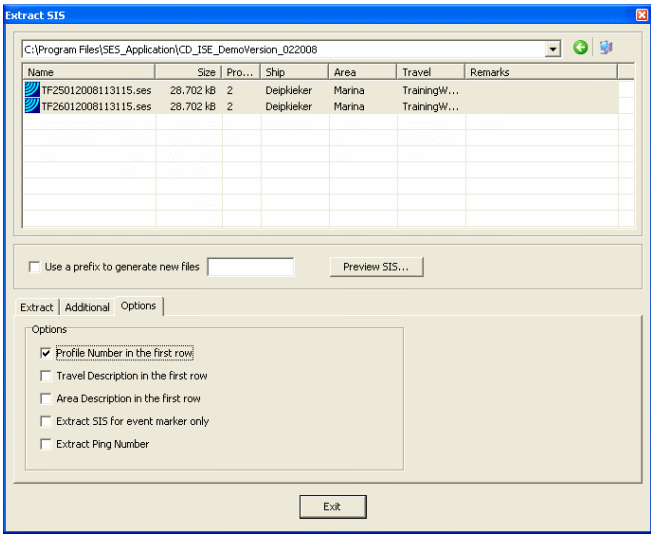
For a simple extraction of the recorded SIS fields from the data files this tool should be used. Each of the eight SIS fields can be selected. It is possible to select more than one data file for the extraction. The SIS data are recorded into ASCII files within the same directory. The newly created files have the same file names as the source files plus an optional and editable prefix and they will have the file extension TXT. A space character is used as a delimiter for the SIS fields.





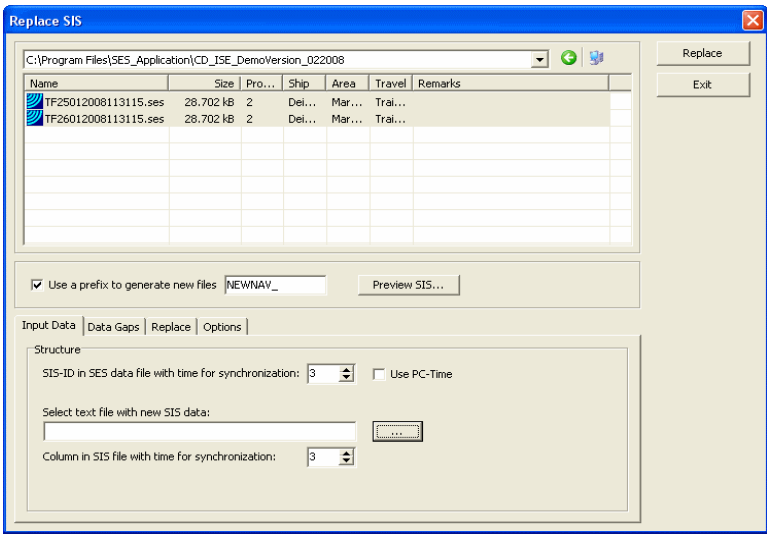
The first page is used to select, which of the eight SIS fields should be included into the exported files. The second page allows the selection of some additional information to be included. The export of all motion sensor data into the files is possible, the export of the on-line calculated water depth and the export of the PC time from the control computer. Please note, that motion sensor data will be only appended to SIS data strings, when the SES data files are containing SIS information. The depth values may be corrected for an offset and a multiplication factor, for

example for unit conversions. On the third page one check box enables the export of the profile number into the first row of the ASCII files. This might be useful for some labelling functions in external software packages. The description fields for travel and area can be extracted too, so the lines can be easier labelled in external software packages for charting purposes. To extract SIS strings for event markers only a separate checkbox exists on the this page. Another check box allows the extraction of the ping number in a separate column, so a possibility for referencing exists later.



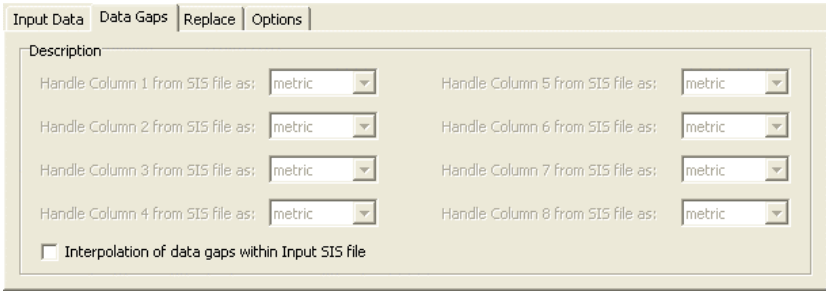
The Replace SIS Tool

This tool allows the replacement of the position information in SES data files. If the SIS data was exported or recorded and processed separately, it is possible to replace the old data if a synchronisation information is available. Normally, this is the GPS time. The input has to be an ASCII file. You can find details about the typical structure in the Appendix A. The new created files can be generated with an optional file name prefix.

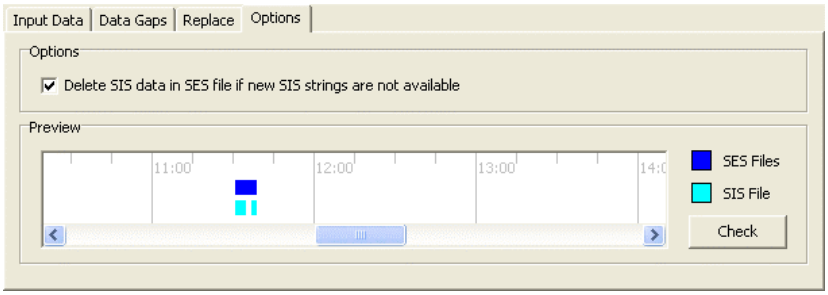


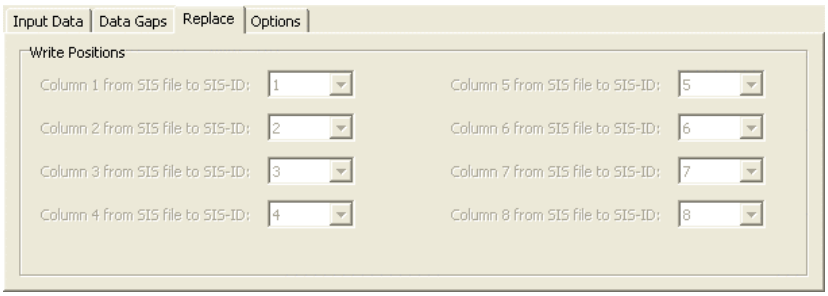
There are existing four pages, which should be checked all prior to the replacement procedure. The first page covers the SES data file structure and the ASCII file structure. The SIS field ID as well as the text file column with the time for the

synchronisation must be defined for both file types. Optionally the PC time of the control PC can be used for the synchronisation, if no GPS time was available with the positioning system. The time string format can be different than the format inside the SES data files.

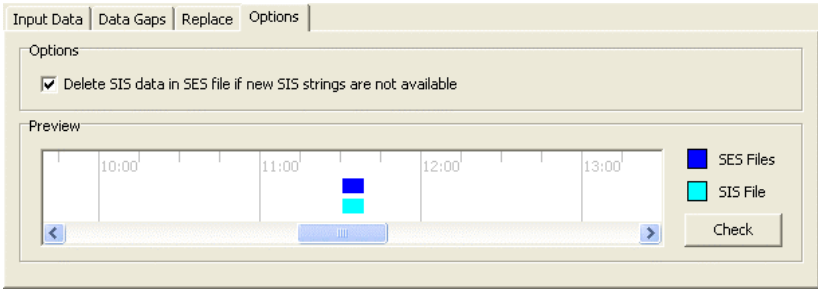


The Data Gaps tab allows a interpolation of data gaps in the new SIS data file during the replacement procedure. Such gaps might be came into being due to removing of position outliers. In order to check whether gaps does exist in the new SIS data file the Options tab provides a tool which compares the time periods in the SES file and the SIS data file. If the result of the checking procedure looks like the figure below the Data Gap interpolation should be used in order to have position data for each available time stamp.





On the third page a set up is done, which defines where the new information from the ASCII file will be written to inside the SES data files. This means each column can go to an user selectable SIS field ID. The number of enabled set up controls depends on the number of columns, available within the text file.



The fourth page allows to check whether the data inside the text file with new SIS information covers the range of SES data files or not. Please be aware, that any data which has no new replacement might be deleted, meaning it will be set to zero. The coloured bars are indicating at what time periods data are available in both sources.

One note regarding the selectable time formats. The formats with decimal digits are divided into time strings with one and two digits, but the highest resolution for replacing SIS strings is 1/10 second only.

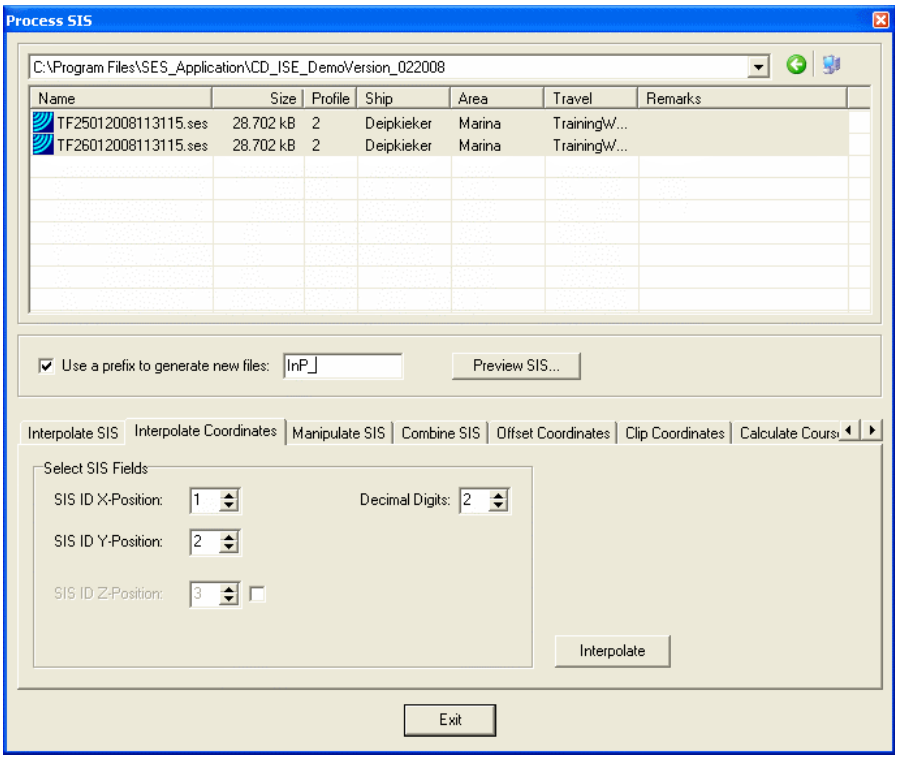
- Be careful not to overwrite your synchronisation string in the SES file if you need further processing steps within this tool.

The SIS Process Tool

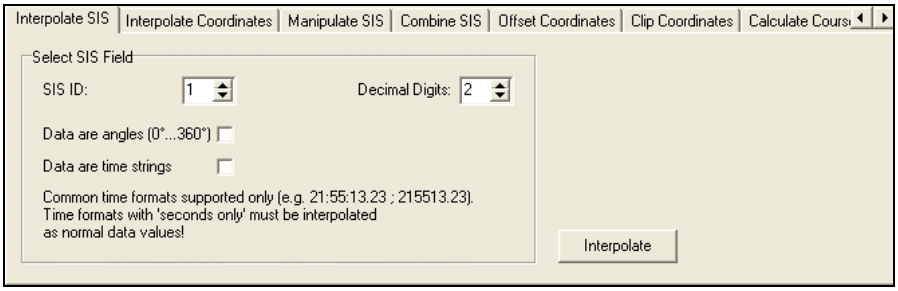
The tool allows several operation to process coordinates within a SES data file. The interpolation of the X, Y and Z coordinates, the coordinate clipping, the averaging of SIS data, the calculation of course information and other functions are available. The dialog is divided into separate registers for each operation. The source for each SIS value to be processed is selectable for all operations. Multiple files can be processed with one step, when they are selected in the file list.

- Please be aware that all of these functions will overwrite the original data files unless no prefix for new file names is given. Overwriting data within SIS fields may become irreversible, therefore a backup is strongly recommended.

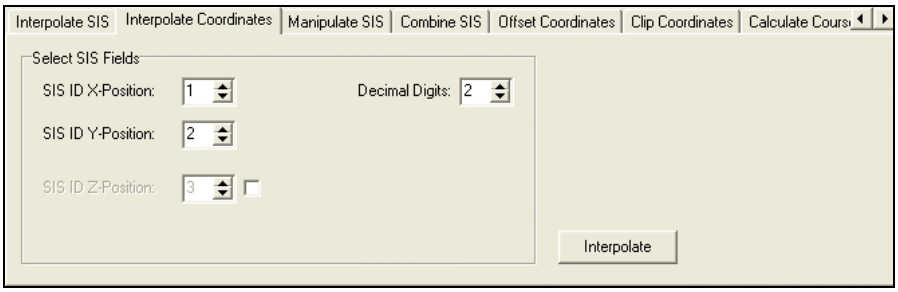
A prefix can always be defined, so new data files will be generated, containing the prefix and the original filename.



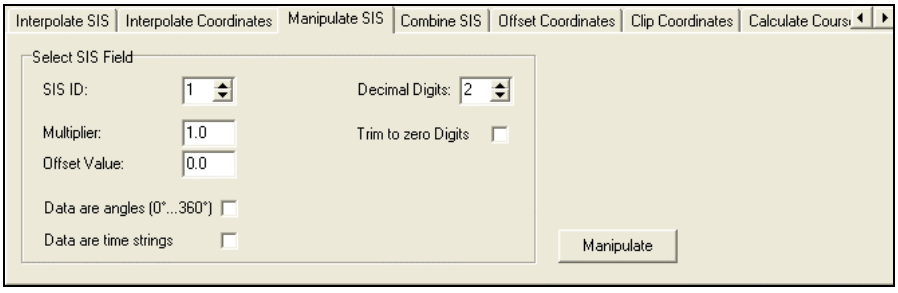
The first tab 'Interpolate SIS' is related to the interpolation of a single SIS data field. If the data contain angles, e.g. a heading value, than the checkbox must be checked accordingly. Furthermore the number of decimal digits can be defined.



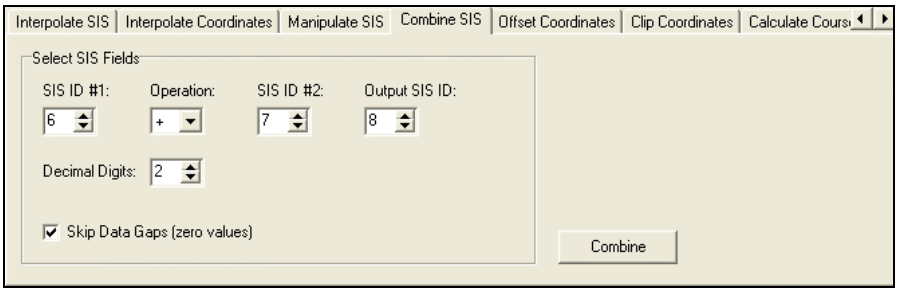
The interpolation of coordinates requires the source ID's of the SIS fields containing the X and Y coordinates and optionally the SIS ID of the Z value. A linear interpolation will be calculated. As a result every ping will have its own position information, which is necessary for some special processing steps, like detailed digitisation of objects and structures, side scan mosaicing and track accumulation and lateral correction of echo plots. The number of digits is also selectable and affects the new calculated values.



An offset value can be applied to an individual SIS field. If the SIS field data contain angles or time, then the checkbox must be checked accordingly. The given offset value for angles must be in degrees. The given offset value time strings must be in seconds or decimal seconds. The number of decimal digits can be defined too.

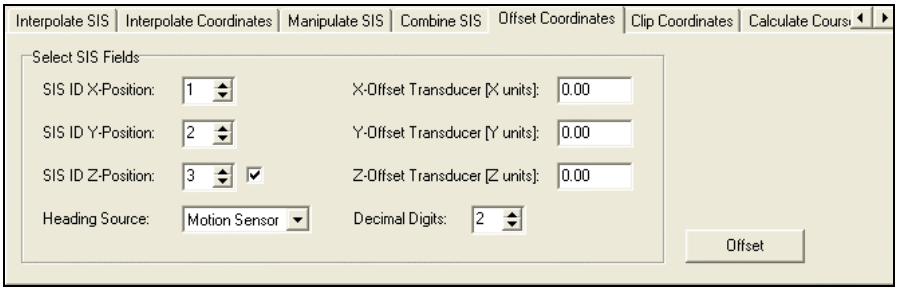


The Combine SIS tab offers a possibility to do mathematical calculation between two SIS ID's. The tool provides the addition, subtraction, multiplication and division.

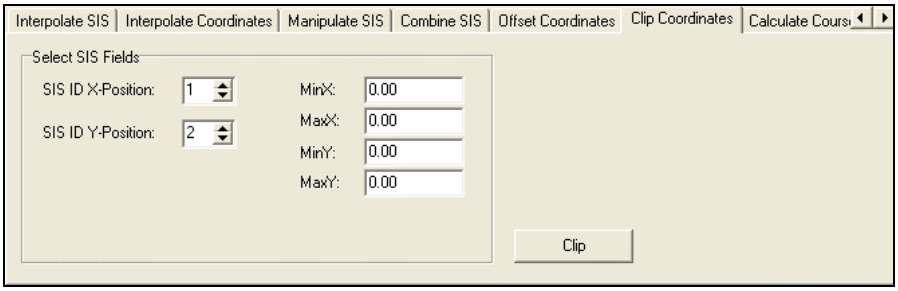


Within the next tab an offset can be applied to coordinates. The SIS ID's of X,Y and optionally Z must be selected. A heading value, which may come from the motion sensor data or a from a recorded SIS field, is required too. The offset values must be given with the same unit as the source coordinates.

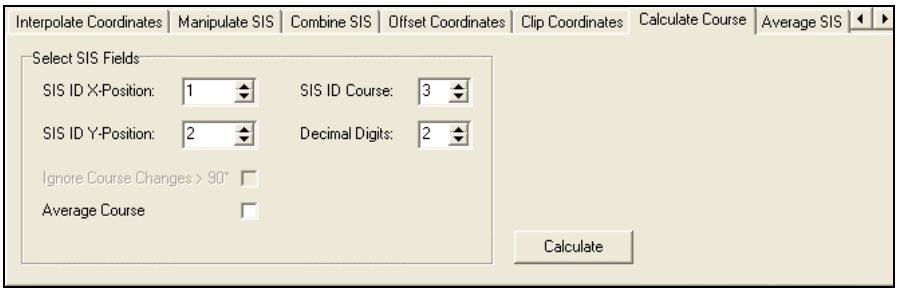
- Positive offset values are to the right and to the forward direction.



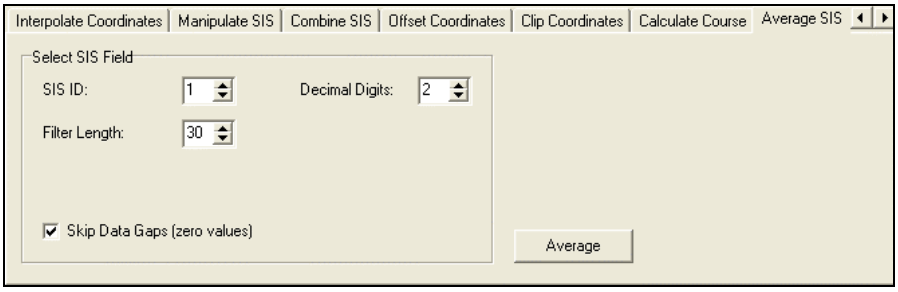
The function 'Clip Coordinates' will delete all coordinate values in the selected SIS fields, which are outside a given rectangle. The rectangle must be defined with the minimum and maximum values for X and Y. Remember that these values are processed unit free and must have the same unit as the source coordinates.



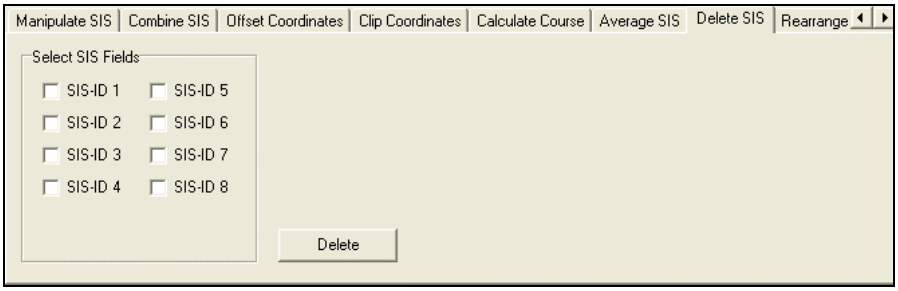
Calculating a course within SES data files might be useful for example for the processing of side scan data where no heading sensor was available. The SIS ID's for the coordinate values are required. It is necessary to select a SIS field ID to write the calculated course to. The data on that position will be overwritten. One option allows the smoothing of the new course data by an averaging algorithm. The number of digits is selectable too.



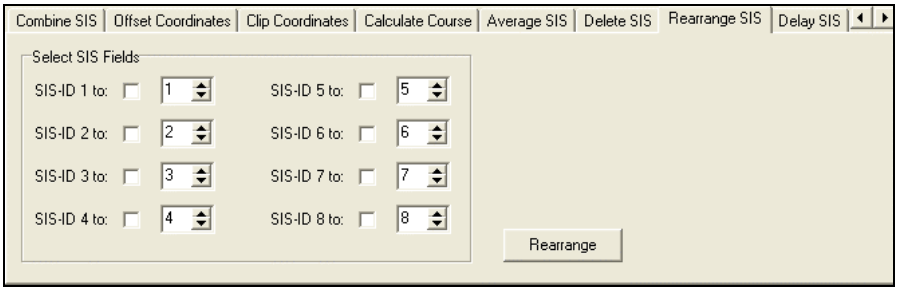
There exists a function for averaging the values of a single SIS field. Necessary parameters are the SIS ID, the number of decimal digits, depending on the type of data and the strength of the averaging filter. This strength is given in number of pings, which are used for the averaging algorithms, where a large number will smooth the data more, than a small number.



Another option in this dialog is the permanent deletion of the SIS fields in a file. Each field can be selected individually for this task.

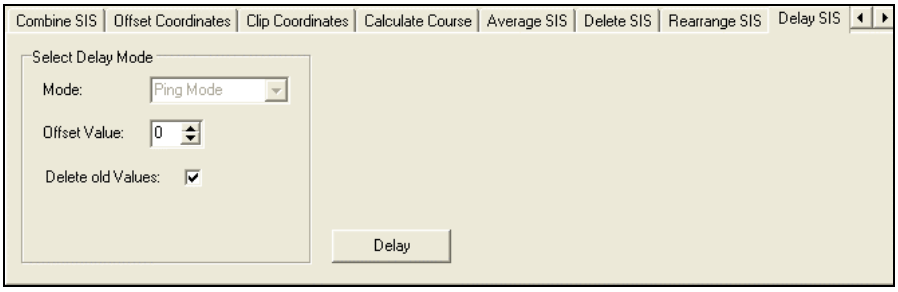


The function to rearrange SIS fields can be used to move data from one SIS field to another one. This might be helpful in case some data were recorded with changes in the SIS definition during the acquisition.

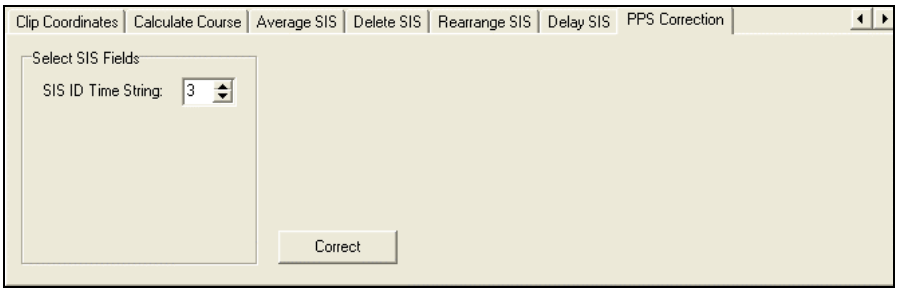


The next tab allows to shift SIS data within the SES data files. When the Ping Mode is selected, then the offset value is given in pings, for which the data has to be shifted.

Positive values are shifting the data forward, negative values are causing a delay for the SIS data.



This optionally processing requires the connection of the PPS pulse to the SES-96/SES-2000 system (not available with all systems). The correction will scan the files for any time delays between the PPS pulse and the recorded SIS data and will shift the SIS data accordingly.

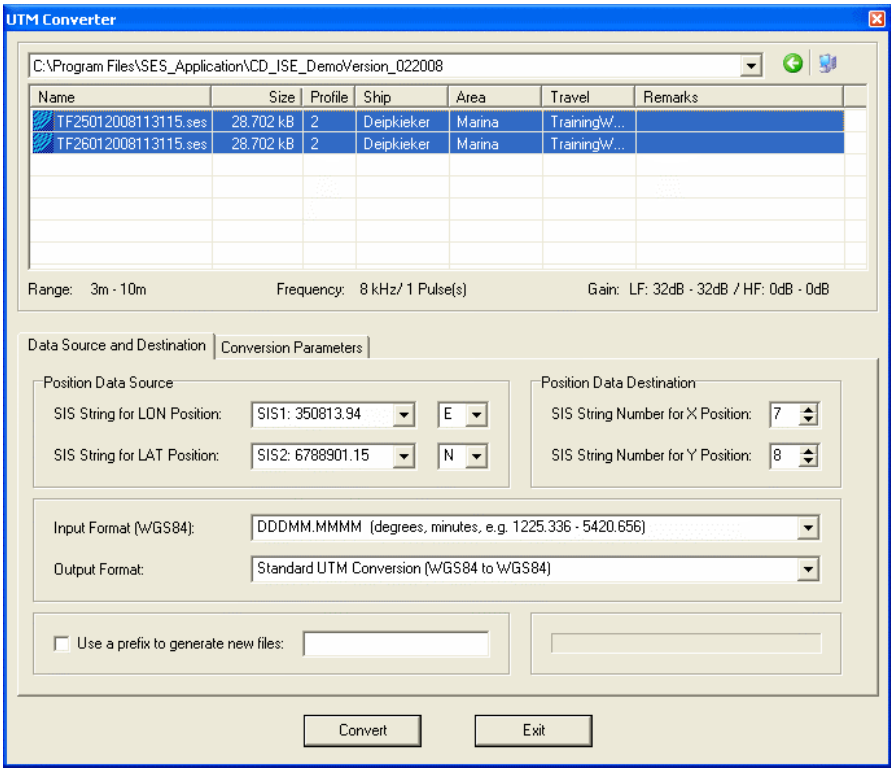


The UTM Converter Tool

This tool allows the conversion of recorded LAT/LON positions to UTM coordinates. It has the same appearance and functionality as within the SESWIN on-line software. The directory browser on top of the dialogue allows the selection of single or multiple files. The SIS fields which contain the LAT/LON coordinates must be selected and correctly classified as East/West for Longitude and North/West for Latitude. The SIS ID's for the destination fields, where the new UTM coordinates will be written to, must also be defined. Furthermore the Input Format of the LAT/LON strings can be adjusted according to the recorded data.

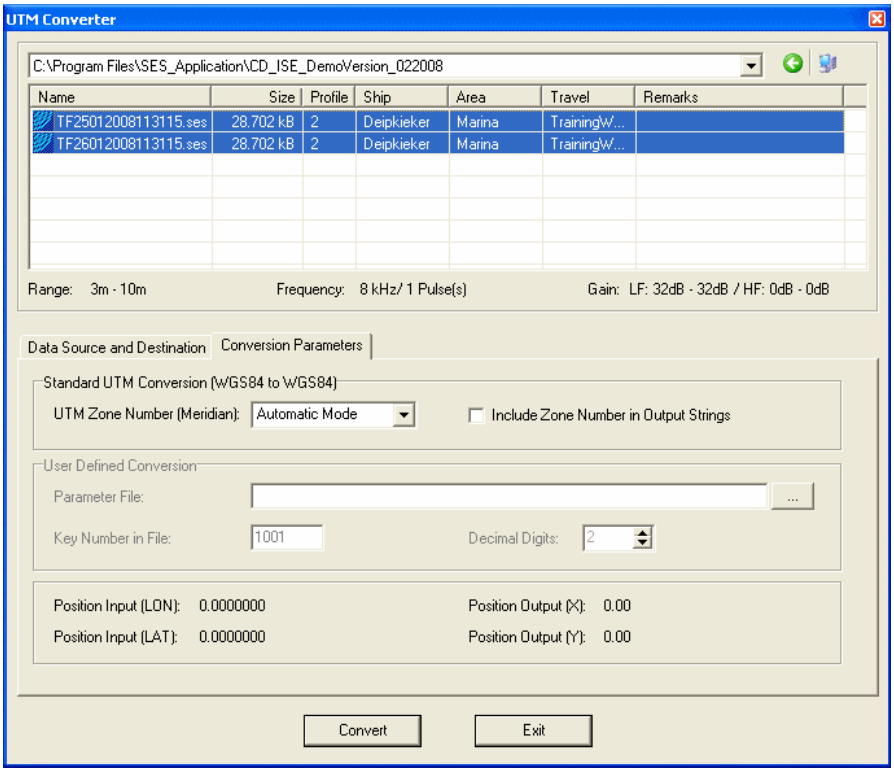
The Output Format can be either a standard UTM conversion or a user defined conversion, which requires special instructions on the next page of the dialogue.

Unless no prefix is given, the conversion will overwrite the existing data files. Otherwise new files are created, containing the prefix and the original filename.



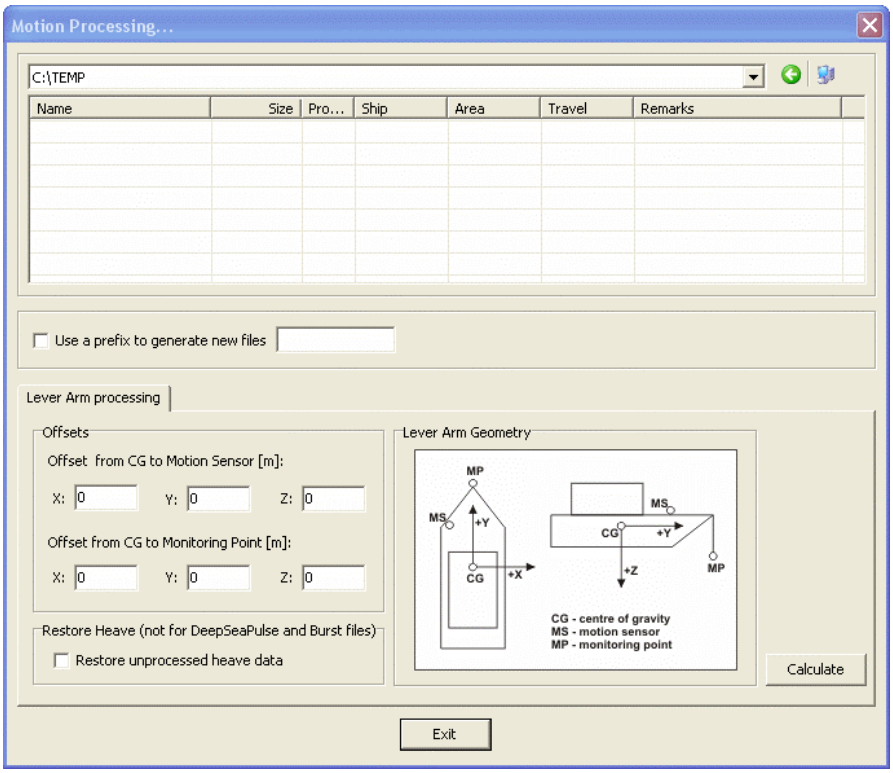
The second tab within the conversion dialogue is used to define some parameters for the conversion process. If the Standard UTM conversion was selected, a UTM zone number can be given or will be automatically determined by the converter. This zone number can optionally be included in the output strings. If the user defined conversion was selected, than a Parameter File is required, which follows the specification of the 'ProLat DLL Coordinate Transformation' library from Effective Objects. A key number is required to identify the parameter set within the Parameter File.

The dialogue shows an example of the coordinate conversion, based on the given options and the selected SES data files to check the settings.



The Motion Processing Tool

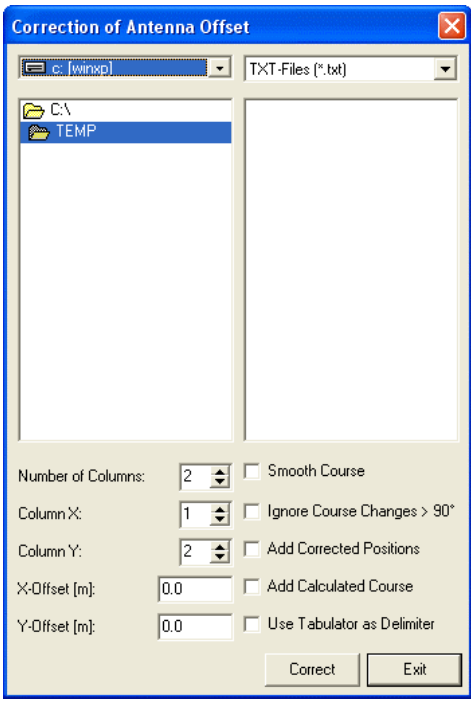
The Motion Processing Tool provides a lever arms correction during the post processing. A lever arms correction becomes necessary when the motion reference unit (MRU) is located on a different location than the transducer (MP).
There are two vectors which has to be defined prior starting the calculation. The first vector has to point from the vessel's centre of gravity (CG) to the place where the motion sensor was placed during the survey. The second vector has to point from the centre of gravity (CG) to the monitoring point (MP). The monitoring point means the location of the transducer. In case the MRU is already located in the centre of gravity only the second vector is needed for the calculation.
More often the lever arms correction has been already applied by the motions sensor set up. In that case the lever arms correction has been done by the motion sensor itself. A correction with same vector values will deteriorate the heave values dramatically. But sometimes by increasing or decreasing the vector values slightly the heave calculation can be improved.
During the processing the origin heave data won't be overwritten. If needed the origin heave data can be restored at any time.



The Antenna Offset Tool

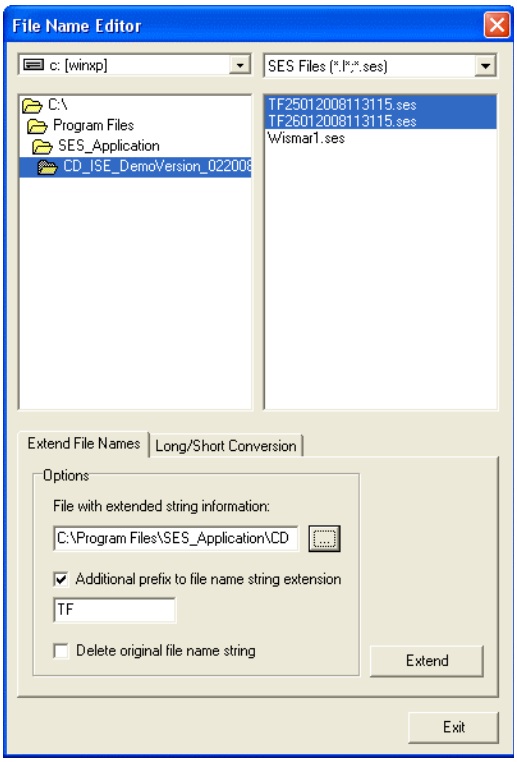
This tool allows the processing of antenna offsets with the recorded position data. This is necessary if the GPS antenna was not mounted over the transducer. The calculation is only possible with ASCII files. The user has to choose the number of columns in the source file and the IDs for the X position and the Y position. The offset can be edited for both directions. Additionally, it is possible to select some options, like the smoothing of the resulting course and the skipping of course changes bigger than 90 degrees. The newly calculated positions are attached to the source file in extra columns as well as the calculated course if required.

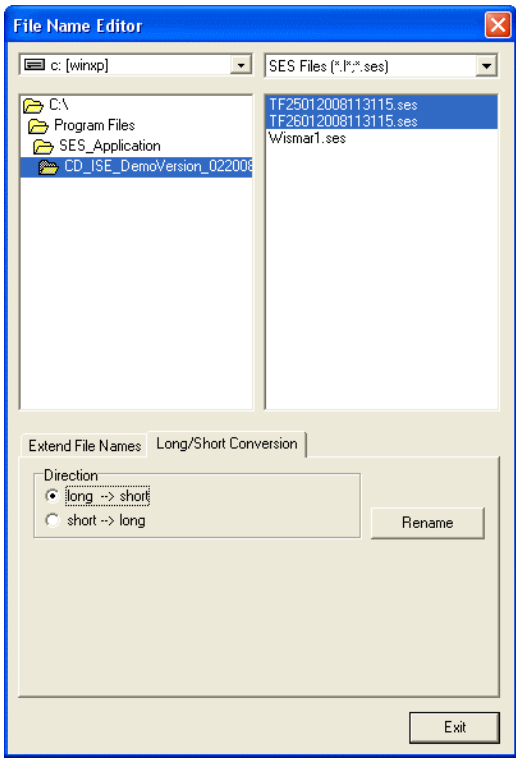
- The offset correction can have errors because the calculated course from the positions contains no information about the ship's rotation. This can only be measured by a true heading sensor, like a gyro compass.



The File Name Editor

This small utility has two parts. First it allows the change of the file names of the SES-96/SES-2000 data files. The short form contains only eight characters, the long form has the complete date and time string as the name.



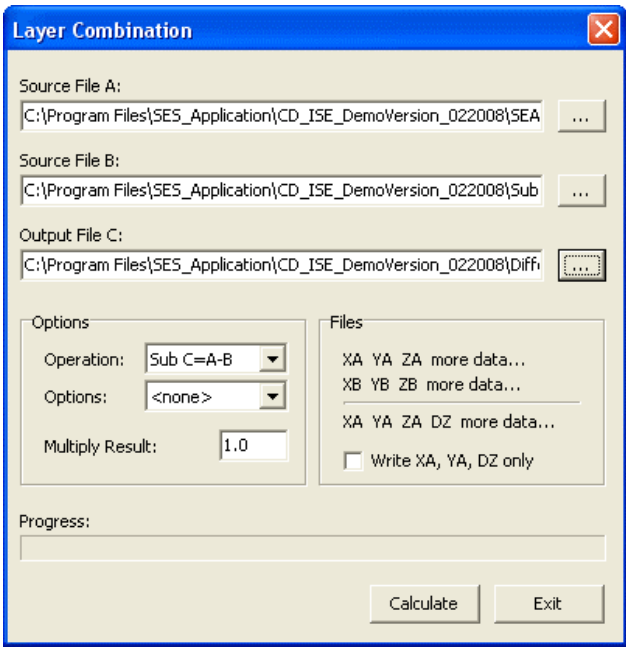


The second possible function with this tool is the modification of the names of a list of files, whether they are data files or processed picture files already. In some situations it might be useful to extend the file names with information collected and stored within

the SIS fields, for example event numbers or KP values (kilometre of pipeline). This gives an easier reference instead of using date and time only. For this file operation a text file is required, providing a list of the filenames together with the additional information string to be added to the file name. As an example it would be possible to generate a profile list with the existing ISE tool for this purpose, by writing file names and data from a single SIS field (e.g. Start/Stop KP values). Additionally to the strings from that file a constant prefix string may be added as well, for example to get a separator. By deleting the original file name contents the result would be a set of new files just having the provided information in the new file names.

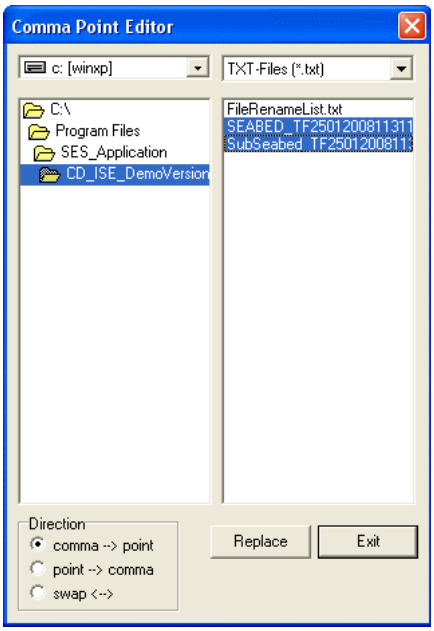
The Layer Combination Tool

Sometimes it is necessary to calculate the difference of two layers for a further volume estimation. The dialog allows the selection of two different ASCII files with layer information. It is possible to add or subtract the two layers. Only the positions, where both layers contain data, are processed and exported into the output file. A correction factor can be applied to the result of the operation. This option is useful if the real distance differs from the Z distance, for instance due to different sound velocities. The output file contains the X, Y and Z information and data from more columns, plus the new calculated value. One option exists to write the X and Y value plus the new calculated value only.



The Comma Point Editor

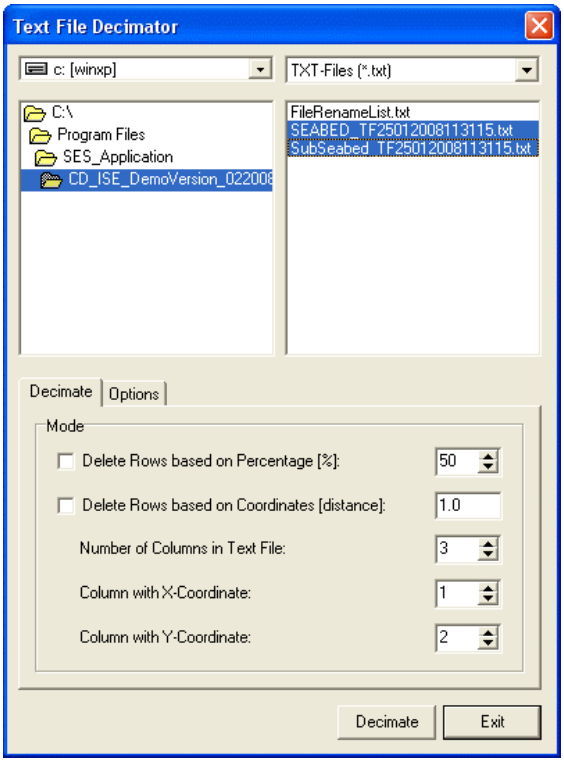
Exported layer files are often processed with other packages for visualization tasks or volume calculations. These software packages have sometimes different standards for the delimiter character between the data fields. This tool can replace all commas or points in ASCII files. One option swaps all comma and point characters within the selected files.



The Text File Decimator Tool

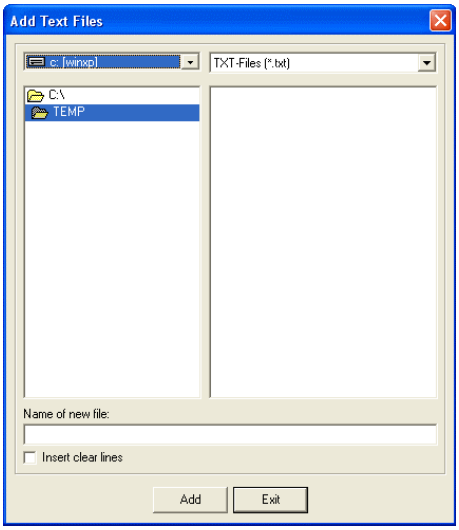
This tool allows the decimation of text files which are organised as tables with many rows. For example the exported X, Y, Z files of the ISE software can contain many values if the coordinate interpolation was used. Decreasing the amount of rows can increase the further processing speed within external software. Two ways of decimating such text files are available. First a decimation based on a percentage, where for example a rate of 50 percent means a deletion of each second line. The second method is based on real coordinates, which means to delete rows in a way that just one row is kept per given distance. This method requires to define the total numbers of columns within the text file, the column numbers for the X and Y coordinates and the distance value itself. The result would be a uniform data set with a constant density of data points for an exported survey line.

One option exists to keep lines inside the text files, where Start/Stop identifiers are present, like within the exported CODA files.



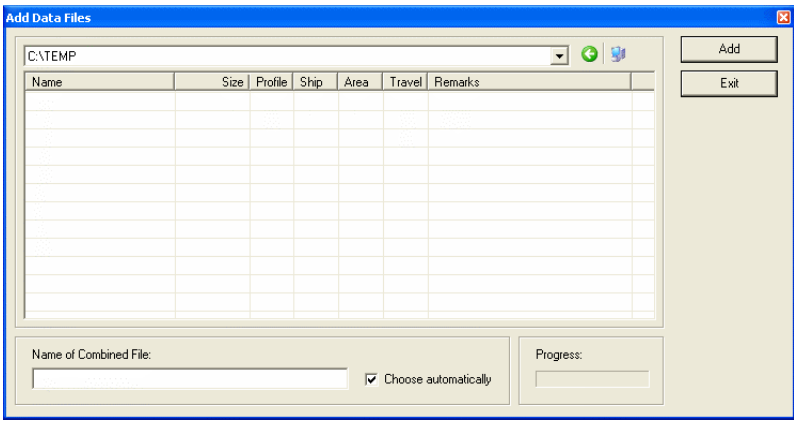
The Add Text Files Tool

Another useful function for ASCII files is provided with this tool. Often it is easier for software packages to import one file than many files. This tool allows the addition of different files to one target file. The insertion of clear lines is a selectable option.



The Add Data Files Tool

With this tool it is possible to combine one or more SES-96/SES-2000 data files to one file. The SES for Windows software limits the recoded files to approx. 60 MB. If a profile is longer, the data is split into different files. For the import and the processing it is useful to have only one file per profile.

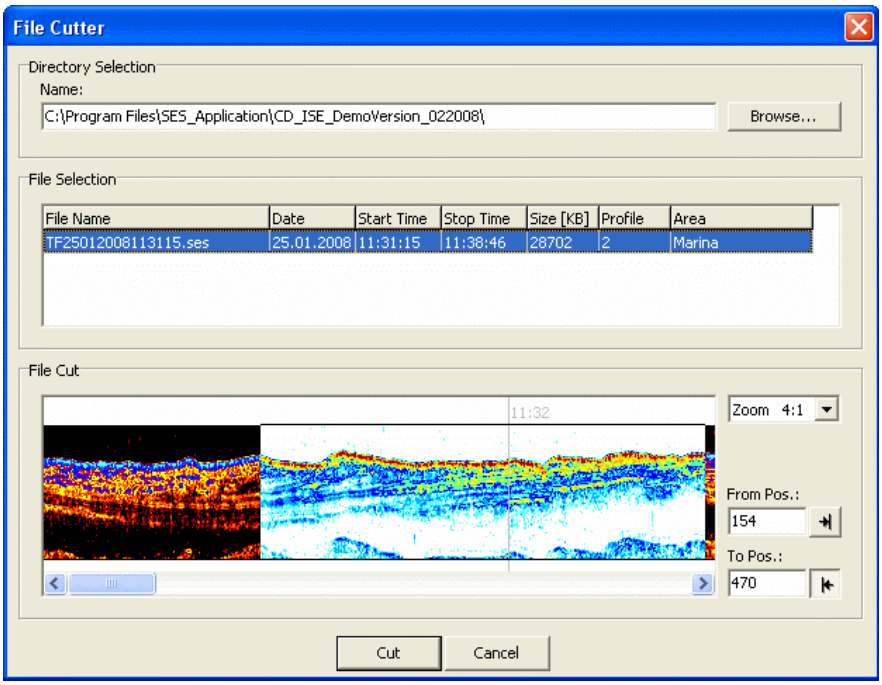


- The addition of SES-96/SES-2000 files is not limited by size. However, if the file size is bigger than 100 MB, the working speed becomes slow. It is wise to limit the file size to an optimum for the processing workstation.
- Add only compatible files to one target file because otherwise the processing can fail.

Some file types should not be added, for instance it is not possible to process files with different range lengths or files with different beam steering settings or with different multi frequency settings. Also a mix of beam steering and multi frequency data will not be processed correctly.

The Cut Data Files Tool

To extract sub-selections of SES data sets a File Cutter can be used. After the selected directory has shown up, the browser searches for SES-96/SES-2000 data files (*.ses). All files found are sorted by their name. Some extended file information is given within the list. A graphical file preview allows the comfortable selection of parts of a file which should be extracted to separate data files. A new and different file name must be given to these new data files, otherwise the tool will not work correctly.



By selecting another directory with the Browse Button the file list will be updated, showing all found SES data files. The files are sorted by their given names. Additionally the recording Date, Time, File Size, Profile number and Area are shown within the list. The actually selected file is highlighted. The selected file is shown as a graphical preview. The low frequency channel of the SES data is processed to display a small echo plot with an adjustable zoom rate. Vertical time marks are also plotted onto the preview window. The user may select a start and a stop position for the area of interest within the data file. The part of the data which will be extracted into a new file remains with normal colours. The false coloured parts are cut. To select the start and stop positions two buttons must be enabled accordingly the operation. With the mouse the positions are selected directly within the graphical preview of the echo plot. After pushing the Cut Button a dialog asks for a new file name and the sub-selection of the data file will be stored in a new file. These new files are processed as normal SES data files and can be loaded and edited with the ISE software.

- The new created data files need to have a different file name than the original selected data file

How to…?

This section contains typical operation procedures for various tasks and the description of the use of the Processing Software Package ISE. Based on different applications and the recorded data sets some steps for the processing will be described in detail. You should read all paragraphs because some procedures, for instance the generation of a profile list or the load procedure, are valid for most applications, but described only once. Each paragraph contains a list with underlined keywords for a better orientation.

How to generate bathymetry data from SES-96/SES-2000 profiles

Keywords:

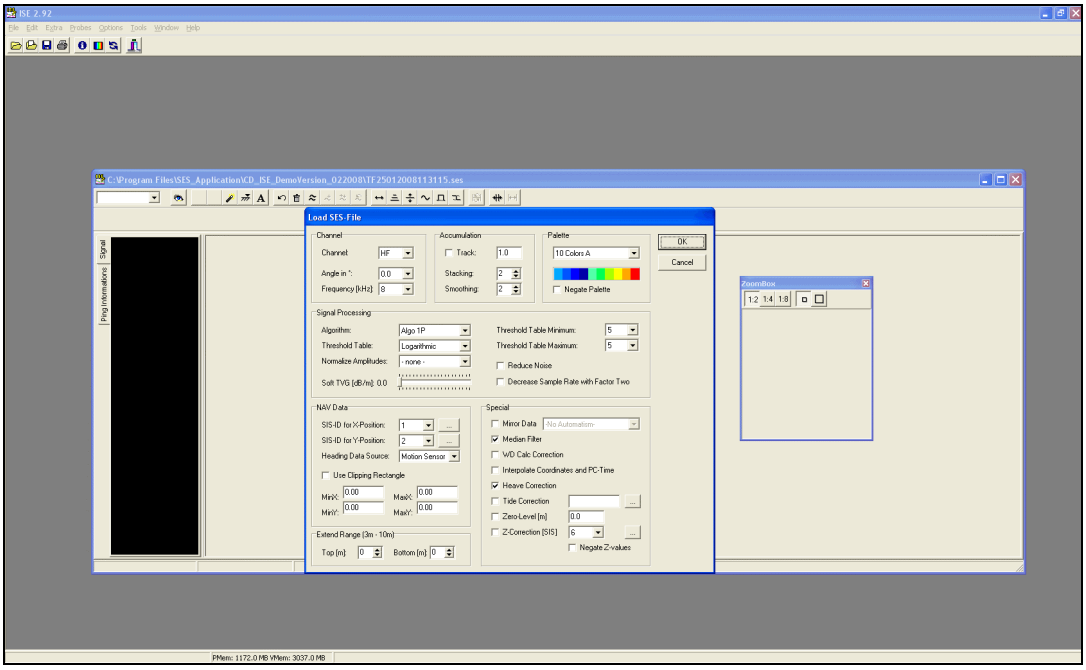
Profile List, Load, Interpolation, Water Depth Calculation, X-Y-Z

Assume the following situation. During a survey some lines were recorded with a SES-96/SES-2000 system. The task is to generate a X-Y-Z file with all water depth values of the surveyed area for further visualization or the generation of a Digital Terrain Model. The first step should be the generation of a Profile List. Use the "Profile List Tool" from the menu "Tools". Select the directory in which the data files from the survey are stored. The generated ASCII file contains a list of all profiles in the directory with their time and profile number. The list can be useful for an orientation during the file loading procedure or for reporting tasks.

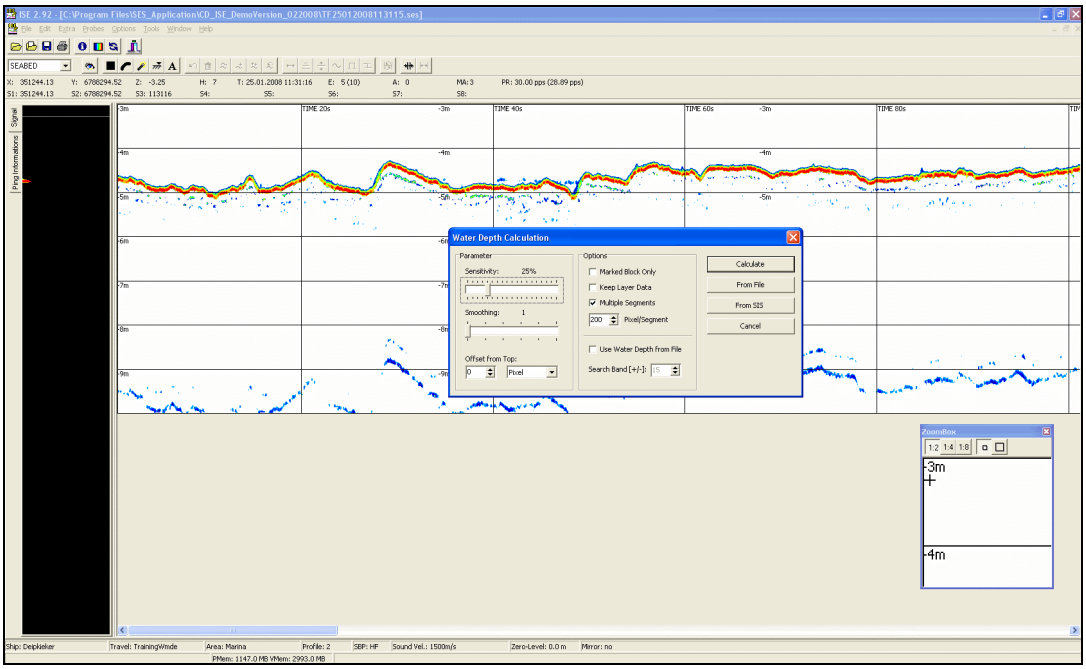
Typical update rates of Positioning Systems are one per second. In most cases the ping rate of the echo sounder is much higher, in shallow water for instance thirty pings per second. An optional step is to interpolate the position data within the file. This will generate a position for each ping which means however that final ASCII data files with X-Y-Z information become very large. To use this feature select the menu "Tools | Process Coordinates" and select the data files for the interpolation. The data files are in fact modified, so be careful with this step. It is always recommended to keep a backup of all original data files. There is also a temporary interpolation within the load procedure available.

Now you have to load and process all profiles which are required for the final result. With the menu "File | Load Echo Data" you can select a single file for loading it into the ISE software. Alternatively, you can use the file browser for selecting data files. Within the "Load Dialog" some parameters have to be defined. For the generation of bathymetry data it is common to use the high frequency channel of 100 kHz. Therefore select channel number 1. Use the Accumulation and Signal Processing parameters, depending on the file size and the signal-to-noise ratio. It will be wise to use a higher stacking rate if the amount of data is very high and the density of depth values is not so critical because of a very large area. For high details in the lateral dimension you should use small stacking rates and the coordinate interpolation. The selection of the SIS fields is necessary in order to define which field contains the X and which the Y data. Please use the small preview window, if you do not know which definition was made within the online software. Depending on the survey you can also use the heave correction if a motion sensor was available as well as the tide

correction if a tide file is available. Please see the chapter about the file formats for the contents of a tide file. The "WD Calc Correction" should be used if during the survey the operating range was changed very often. This option tries to interpolate some depth values at the range changes because at these points system dependent echo data gaps are possible.



After loading the data file into a window, use the menu "Extra | Insert Water Depth as Layer" to open the water depth calculation dialog. You can use the depth values from the online software or you can recalculate the depth. Per definition it is necessary to use a sensitivity of 20 to 30 percent for the depth determination in the high frequency channel. Using other sensitivity values is possible, but requires a vertical offset correction of the generated layer afterwards to get accurate results. If the data file contains high amplitude values before the real bottom, caused by gas bubbles from the ship's screw, for instance, you may use the offset parameter to skip these areas for the calculation. The "Calculate" button starts the operation and fills the active layer with the depth values. If no selection was made before, this is Layer 1. To skip areas, where the bottom was outside the selected operating range, it is possible to mark only the wanted parts of the echo plot. Use the button from the Data Window Tool Bar to select an area and enable the check box "Marked Block Only" in the water depth calculation dialog. This procedure can also be used to exclude more than one area from the depth calculation if the data quality is poor.



Once a layer is filled with depth values you may save these data to a file for further processing, for instance to overlay it to the low frequency channel later. Use the menu "File | Save Layer File As" and store the layer data to a disk. Use for instance file names which contain the time or the profile number, e.g. "wd081120001235" for the data file recorded on the 08.11.2000 at 12:35. The echo data files themselves are named after a similar method.

To export the depth data to X-Y-Z files use the menu command "File | Export Layer Data". The dialog appearing contains some more options. First define a unique file name with the same naming conventions proposed before. Typical are ASCII files with space characters as a delimiter and without any header information created. Use the check boxes to add more SIS data fields to the exported ASCII file, for instance the course information or GPS quality if available. The "Z-Multiplier" option allows the on-the-fly conversion to different units than metres. The addition of a constant value can be used to correct a non-changing tide level.

The steps described above are necessary for all the profiles you will use. After the exportation of all X-Y-Z files a final step may be the combination to one ASCII file. Use the menu "Tools | Add Files" and select all X-Y-Z files. Enter the final name into the dialog and the X-Y-Z file will be created. This file can be imported by most of the charting tools or DTM software packages on the market.

How to digitise a sediment layer and export it into X-Y-Z files

Keywords:

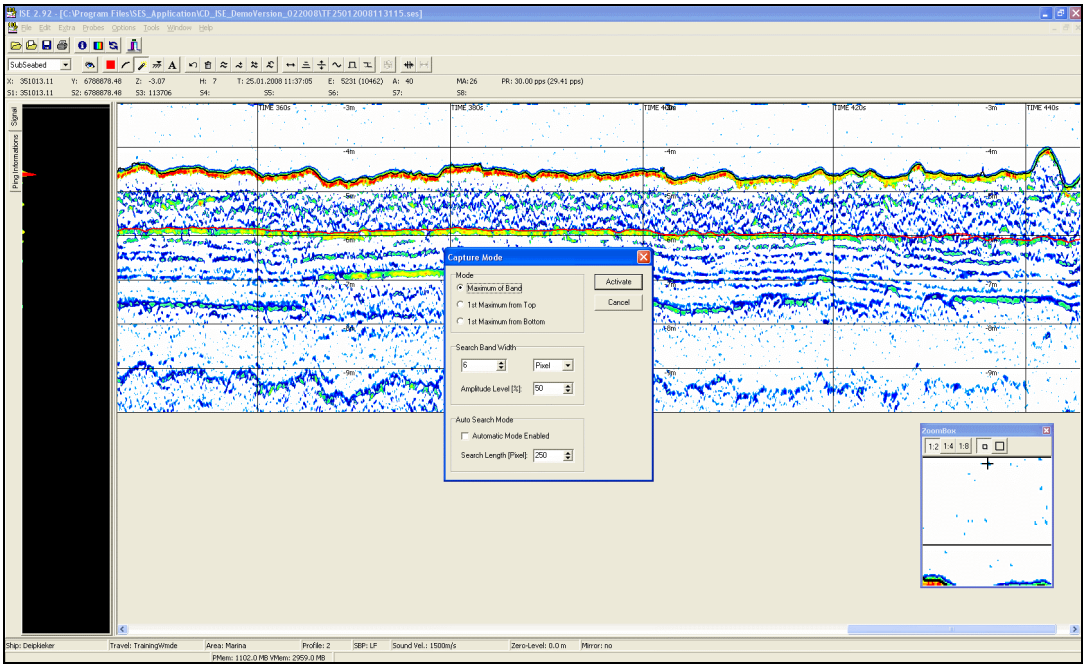
Mirror, Segment, Smooth, Search Band, Peaks, Export

A typical application for a sub-bottom profiler is to find sediment layers and determine the thickness of the overburden material. This paragraph will describe the required steps to generate X-Y-Z data files of a sediment layer. These data files can be used

together with the bathymetry files for the importation into DTM software packages to calculate sediment volumes.

Use the menu commands "File | Load Echo Data" or "File | Directory Browser" to load a SES data file into a window. You may open different data files into different windows to compare them, for instance neighbouring lines from the survey. To process the low frequency channel select channel number 0 in the Load Dialog.

If a bathymetry layer was created before and saved to a layer file, it is possible to overlay these data to the echo plot window first. If a different stacking rate was used during the bathymetry calculation, it may be necessary to scale this layer horizontally. Use the appropriate button from the Data Window Tool Bar and select a scale factor depending on the different stacking rates. A mirror function is also available in the tool bar if you have loaded the data file with the "Mirror" option. Mirroring profiles is sometimes useful to get a better impression about the embedded structures and layers if the survey lines have opposite directions.



To digitise a sediment layer, select the next free Layer number, for instance Layer 2. Define another colour to each layer for a better differentiation. There are three different ways to edit a layer in the plot. The first possibility is a free hand drawing of a line. Use the cursor and by pressing the left mouse button a line segment will be drawn at the cursor position into the plot until you stop moving the mouse and until you release the mouse button. Repeat this procedure for new line segments. This may be the only way to digitise a layer if the data quality is very poor. The accuracy of this procedure is consequently low and can consume a lot of time if the drawing has to be accurate. The Data Window Tool Bar contains an "Undo Segment" button for deleting the last drawn segment of a layer. This undo operation can be also used after the reloading of a stored layer file. To delete a specific segment, use the "Segment Box" tool box from the menu "Options | Tool Boxes". The second possibility for editing a layer is the use of a semiautomatic function. Select the "Capture Mode" button from the Data Window Tool Bar. The appearing dialog allows the definition of a search

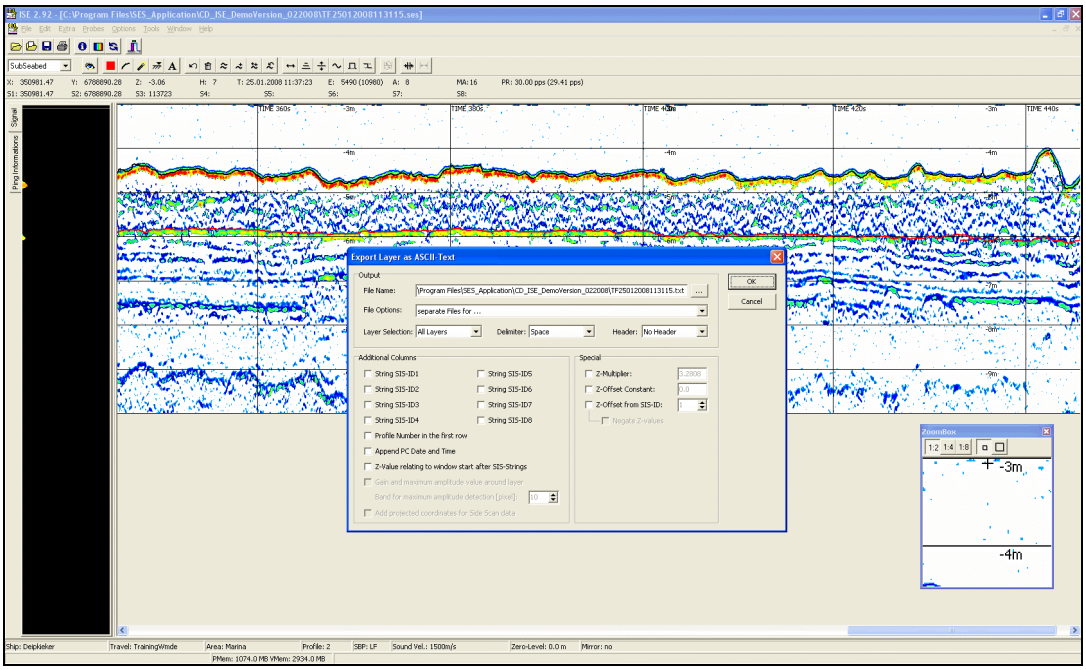
band around the cursor cross. The width of the band is selectable and the value is the width on each side. The unit can be pixel or length orientated. Adjust the value depending on the echo plot itself. If there are many neighbouring layers, the band width has to be decreased. For a faster drawing it is useful to select broader bands because you can follow a layer more roughly. The adjustable amplitude level determines the sensitivity for the layer search algorithm, like in the water depth calculation dialog. Lower values are more sensitive than higher values, but the algorithm tends to fit then to noise peaks in the surrounding area of the cursor position if the amplitude level of the layer is not very different from the amplitude level of the noise. To find the best settings for the band width and the sensitivity it might be necessary to make some experiments with the parameters. The mode is per default set to the maximum of the range of the band. This means that the algorithm fits to the strongest layer within the search band even if there are layers with lower amplitude levels inside. The other two modes are useful to fit to the first layer from both sides even if there are stronger layers within the band. These two modes are only useful in highly structured sediment areas. Normally, a setting can be used for the whole area if the conditions in the plot are comparable. By activating the "Capture Mode" with the "Activate" button, the cursor cross is extended with two lines, one above and one below, to show the predefined band during the editing. The "Capture Mode" button in the Data Window Tool Bar is pushed and another click on it releases this digitisation mode. The drawing of a layer segment works now the same way as during the free hand drawing mode. The line will fit automatically to a sediment layer during the mouse movement if the algorithm can find one. If there is only noise around the cursor, the drawn line fluctuates very strongly and fits to noise peaks. The third possibility is a nearly automatic procedure. Within the "Capture Mode" dialog the "Auto Search Mode" has to be enabled. An adjustable preview and pre-calculation length is available. Activating the "Capture Mode" now gives a real time calculation and layer tracking starting at the cursor position and looking ahead to the right side with the defined search length. The same settings as for the semiautomatic mode are valid. Large preview areas require a fast processor, so define the length depending on your processing machine, too. A click on the left mouse button will draw the actual preview of the layer into the plot as a new segment. This step can be repeated for the whole echo data window to create a complete layer. Also for the automatic mode it might be necessary to experiment for the best settings.

In most cases an edited sediment layer is not completely straight and has a rough structure. Therefore a smoothing feature is available. Use the "Smooth Layer" button from the Data Window Tool Bar. The appearing dialog allows the adjustment of a smoothing level. It is a standard average algorithm. The undo feature is not available for the smoothing, only for the drawing steps. Therefore please copy the layer temporary to another free layer number with the "Copy Layer" button from the Data Window Tool Bar if you want to test different smoothing levels. The same procedure you should use for the "Remove Peaks" function which allows the automatic removal of peaks in a layer line. The peak height is adjustable. Both functions can be selected for marked areas. This may help, for instance, to keep previously edited and smoothed layers and to extend new segments or if one of the functions will fail for the whole line. Especially the "Remove Peaks" function should be used only in marked areas and not for the whole layer line because the line can contain wanted peaks. For

adding constant offsets in the vertical direction use the "Add Offset" button from the Data Window Tool Bar. This offset is adjustable in pixel sizes and real length, too.

Once a layer is edited, save the information to a file. The same naming conventions should be used as for the data files themselves, maybe with different prefixes. The layer editing can be performed for up to twenty layers per layer file. Use the menu command "File | Save Layer Definition" to store the pen settings of a layer file. This can save time if you have to edit a lot of profiles with the same settings since it is possible to load a layer definition file to a new data window.

The final step is to create a X-Y-Z file of the sediment layer. The procedure is the same as for the bathymetry data. Please refer to this paragraph for further details of the "Export Layer" dialog from the menu "File | Export Layer Data". To export different layers of a data window to separate ASCII files, you have to activate the wanted layer number first. Use always clear naming conventions if you have to edit layers in different profiles. This can simplify further combinations of ASCII files to generate X-Y-Z data sets for each sediment layer with the "Add Files" tool.



How to generate a list of embedded single reflectors

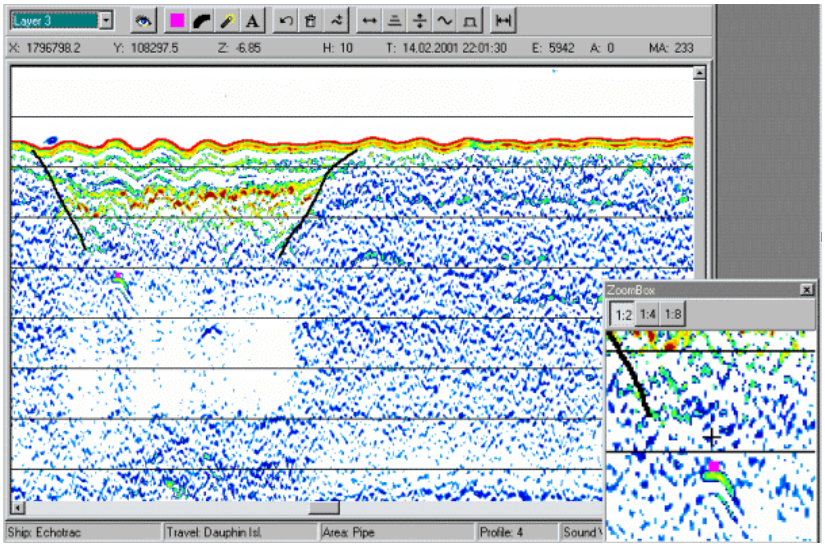
Keywords:

Zoom, Target Position

Some applications, e.g. a pipeline tracking survey, an archaeological investigation or the search for embedded objects, require a list of target points as the final product. These target points can be on top of the bottom or buried. From the editing view it is comparable to the digitisation of layers, but only for single points.

Use the same loading procedures as before. In most cases the digitisation of single reflectors has to be accurate. Therefore use small stacking rates and the coordinate interpolation. The menu command "Options | Toolboxes" gives access to the "Zoom Box" and "Object Box". These tool boxes are useful for picking single reflectors.

Within the "Zoom Box" you have a more detailed view around the cursor position. Zoom rates up to the factor eight make pixel detailed digitisations possible. Pushing the button "Select Point" in the "Object Box" enables the object picking mode. The cursor is now drawn as an arrow. A mouse click on a certain position in the echo plot will transfer the position and depth data to the "Object Box" and will draw a single dot into the data window itself. This dot is handled like a segment in a layer and can be manipulated in the same way, e.g. with the offset function. You should use a larger pen width for the active layer to find the edited points more easily on the echo plot. Some more information about the selected target can be retrieved with the "Object Box". It is possible to define the left and right border as well as the bottom depth at the target position. All these data at the left side of the "Object Box" can be written into a list on the right side of the box. This list offers the manual editing if you like to add more facts about each target position. The list can be stored to a disk as a standard ASCII file and reloaded at any time within the "Object Box" or within any ASCII editor or with third party software. The layer file with the drawn dots can be saved in the same way like a normal layer file. Use the menu command "File | Save Layer File As". Another possible situation can be to have a layer file with a bathymetry layer at Layer Number 1, a sediment layer at Layer Number 2 and some single reflectors at Layer Number 3. The Layer Number 2 might be the edges of a pipeline trench, for instance, which were edited in the same way as a sediment layer.



Another tool box might be of interest for this processing application. The "Tool Box" tool allows the measurement of point distances and the calculation of courses between two single points. This may help to check quickly whether different target positions are on the same line. If so, they should have a comparable course. This tool box is working between different data windows, too. Pushing one of the "Set" buttons changes the cursor cross also to an arrow until a point was selected.

How to generate and print horizontally and vertically corrected echo plots

Keywords:

Track Accumulation, Operating Range, Distance, Printout

Echo plots which are recorded by the SES-96 echo sounder are ping or time, not distance orientated. That means, each ping is stored, independent of the vessel's speed or actual ping rate. Therefore, an echo plot can show the same distance in reality with different lengths on the plot. To correct this the ISE software offers a time and speed independent accumulation called Track Accumulation. To use this feature the data files must contain position data in a number orientated form, typically metric, but every floating point number will be accepted.

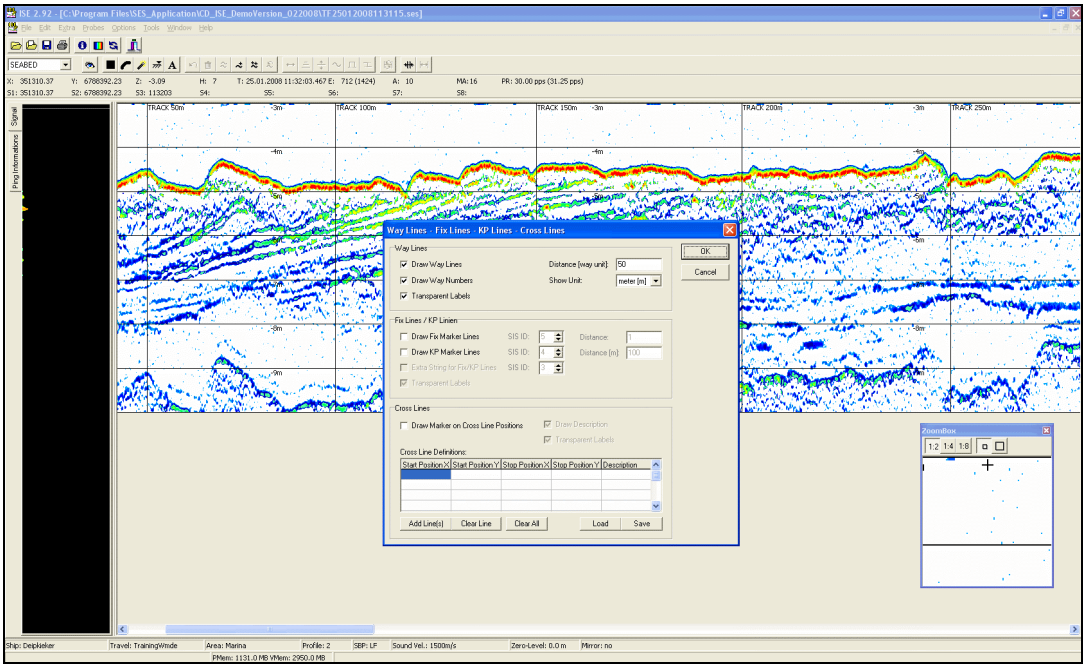
The first step required is to process the data files to generate interpolated coordinates. This gives each ping a position and is necessary for an accurate track accumulation. Keep in mind, that the data files will be manipulated and if you need the original files, please make backup copies first. Use the menu command "Tools | Process Coordinates" for the interpolation of the data files. The appearing dialog asks for the SIS field IDs with X and Y position data and if required for a Z value, too. The selection of the digits depends on the coordinate system. Select the files for the processing in the directory browser and start the interpolation with the button "Interpolate".

The second step is to load the data files with the "File | Directory Browser" or "File | Load Echo Data" command. Within the Load Dialog you must enable the "Track Accumulation" check box. The editable value is responsible for the accumulation rate. Assuming we have a metric system, a value of 1.0 means to stack echo signals for every metre. After each metre a new echo line will be drawn into the generated plot. All pings within the last metre are stacked together with an average algorithm. Independent of the vessel's speed the result of this procedure will be a constantly scaled plot for the lateral distance. The rate value for the track accumulation depends on the required plot size and accuracy for further processing steps. Additionally, the rate depends on the actual ping rate. If the ping rate is high, the track accumulation distance can be smaller. In most cases it is not necessary to use a further normal stacking together with the track accumulation, only if you have large profiles with bad signal-to-noise ratios.

To generate plots scaled in the same way for the vertical dimension, too, it is possible to extend an echo plot on the upper and lower side with blank areas. If the operating range has changed during a profile, meaning also within one file, the different ranges are put together automatically for an overall range. The bottom line, for instance, is then continuously compared to the online echo plots, where the different ranges are divided by vertical lines. Assume the following situation for different profiles. During the online mode two profiles were recorded, the first one with an operating range from -1 to -6 metres and the second one with an operating range from -2 to -7 metres. To generate plots with the same range from -1 to -7 metres, the first data file has to be extended on the bottom side and the second data file on the top side for one metre.

After the data file was loaded into a data window, it is possible to draw vertical lines at defined distances. Use the menu command "Extra | Way Lines" to open the dialog with the settings. For the highest compatibility the distance is again adjustable without a unit. Optionally, some predefined units together with the distance value may be drawn into the echo plot at the lines' top position. If the track accumulation was calculated correctly and the given parameters made sense, all lines should have the

same distance on the plot. Use the "Draw Way Lines" check box to enable the lines in the echo plot.



These prepared plots can be processed in the same way as described in the other paragraphs. To make a printout of such an echo plot, possibly with an additional overlay of some edited layers, use the menu command "File | Print". Select one of the installed printers of your Operating System. Check also the paper orientation because it should be changed to Landscape. A smaller range than the echo plot itself might be selected. For both, the vertical and horizontal scale, an adjustment is possible. The vertical range is defined in mm on the printout per metre in reality and the horizontal scale is adjusted in per cent. This scale depends on the actual printer resolution. The resulting number of pages and the total height of the echo printout will be calculated whenever you change a setting. With the same settings of the track accumulation and the printout it is possible to print echo plots scaled in the same way for different profiles from a whole survey area.

How to overlay a sediment probe to an echo plot

Keywords:

Sediment Probe, Data Base

For some applications, like the soil investigation, it is essential to compare the echo data with real sediment data. If in a survey area sediment probes, e.g. borings, were taken, they can be combined with the echo data for a better interpretation and for an easier layer definition. Moreover, the calibration of the real sediment layer thickness becomes possible. Keep in mind that an echo plot is always a time slice and the sound velocity in the sediment is unknown. A layer thickness on the plot may be different from the layer thickness in reality.

The first step is to put the sediment probe information into a data base. Open the data base editor with the menu command "Probes | Sediment Probes". A data base can contain a number of single probes. Each probe can contain a number of layers. The whole data base can be stored to a disk. Add the probes with a name, the position information and the ground level. The position data must have the same coordinate system as the echo data. Edit the layer structure for each probe within this editor. Please see more details in the appropriate chapter of the manual. Finally, you should save the whole data base to a file. Once a data base is loaded or edited, it is available for the ISE application. Only one data base can be active at the same time and each loaded echo data file has access to this data base.

Load the wanted echo data files with the "File | Directory Browser" or "File | Load Echo Data" command. With the menu "Probes | Overlay Sediment Probes" a dialog appears in which you can adjust some settings for the probe view. The most important setting is the distance value. This value has no unit and accords with the unit of the echo data position information. The value defines which probes should be drawn, depending on their distance from the survey line. The smaller the value is, the more accurate the position of the probe near the line must be. If the sediment conditions do not change so quickly in an area, you can select larger values for the distance. The calculated distance can be plotted on top of the vertical probe line, together with the ground level and the complete soil strata. The echo plots can be printed out together with the probe information on a printer with the menu command "File | Print".

How to apply a different speed of sound to an echo plot

Keywords:

Speed of Sound Profile, Thickness

The online software of the SES-96/SES-2000 systems accepts the input of a single value of the speed of sound. This value is valid for the whole echo data traces, meaning both for the water column and the sediment part. The recorded signal travel time is converted to depth values on the echo plot based on that given speed of sound value. Of course this reflects not the real situation, where sediment layers and the water column will have different speed of sound values. Usually two ways of setting up the online software are used. First an average value of the speed of sound of the water column can be given, so the resulting echo plots will have an online determination of the water depth. If the water depth is determined by other systems anyway, like with a MBES, then a speed of sound value for the sediment body would be preferred to adjust, e.g. 1600m/s, which is widely used when working in sandy areas. The result will be an echo plot with better representation of the sediment thickness, but incorrect water depth.

Several possibilities are existing now with the ISE software to correct for different speed of sound values. To correct the digitised output of the seabed depth in X,Y,Z files a correction factor may be applied directly during the writing of files with the Export Layer function. If not only a single factor can be used or if the whole speed of sound profile exists for a survey and should be applied, then the echo plot can be corrected at all in advance of the export of the digitised seabed layer. The same two

main methods are existing for sub-seabed layers. Once a layer and the seabed or an upper layer are digitised and saved to X,Y,Z files, they can be combined with the layer combination tool. This tool has a depth difference or a thickness as an output and if known, a correction factor may be applied directly as well. For example the data were collected with 1500m/s for the speed of sound in the water column and we know about the top layer property of sand with about 1600m/s of sound travel speed, we may apply a correction factor of 1.0666 to the exported layer thickness values, since the real thickness would be more, than shown on the echo plot. Optionally the whole echo plot can be corrected by applying a new speed of sound value for the sediment body. Please note, the speed of sound value for the sediment body is valid for the total sediment part on the echo plot, not for an individual layer inside.

Both functions, the correction of the water column with a sound velocity profile and the speed of sound correction for the sediment body, are requiring the digitisation of the seabed layer in advance. Please refer to the section of this handbook how to digitise the water depth or the seabed layer with the ISE software. Assuming, this layer exists already, for example at layer number one, we may continue in editing or importing a speed of sound profile for the water column first. This is done via the menu Probes | Sound Velocity Profile…. The left side of the dialog contains an editable table for the sound speed values for every metre of the water column. A graphical representation with adjustable depth ranges is also given. After editing the values manually or importing an ASCII file with the speed of sound table, the whole profile must be activated for the ISE application and will then be valid for all open data windows, until it will be modified within this dialog again. To activate the speed of sound profile in a single data window, the menu Probes | Correct Echo Plot with Sound Velocity Profile… must be selected. Within this dialog it is necessary to give the layer number with the previously edited seabed information. Additionally it can be wise to keep this originally edited layer on a backup layer, since the correction itself is not stored within the data file. This means, whenever a data file is reloaded, the correction must be applied again and then it becomes necessary to use the edited seabed again. When the water depth layer is changed together with the echo plot, it is possible to export this layer directly as a X,Y,Z file with the correct bathymetry information without any need to apply further correction factors. The same dialog contains the checkbox to enable a different speed of sound for the sediment body. The border between water and sediment is a defined by the same digitised layer with the seabed information, so all data contents below this layer will be corrected with the given value. As a result of the procedure above, we get a corrected echo plot, where all given depth values are not related to a constant speed of sound anymore, but reflecting a true depth related to sea level or transducer surface, depending on an applied transducer draft.

Appendix A File Formats

During the work with the ISE software different file formats are used. The SES-96 data format will be processed automatically and is not described here, but some other formats, e.g. the tide data file format, are important for the user of the software.

The SES-96/SES-2000 Data File Format

The SES-96/SES-2000 data format is a binary format which contains the digitised echo signals, the information from navigation systems, the data from motion sensors and different system parameter settings. Theoretically, the file size is not limited, but to work efficiently one file should not exceed 100 MB. The file size which is generated by the SES for Windows software is limited to about 60 MB. The standard file extension is "ses".

- Do not edit SES-96/SES-2000 data files manually. This can cause errors during further processing and operation with the files.

The DAR File Format

This file format is a binary format which can be created from every SES-96/SES-2000 data file with the ISE software. The file is a picture of the actual data window appearance. The space on the disk which is required will be much less than for the original SES-96/SES-2000 data file. All processing tasks which were done with the data are not accessible or changeable after the conversion to a DAR file. The position information is included in the DAR file, so it is possible to load DAR files and digitise layers in the data. During the load operation only the colour palette for the echo plot can be selected.

- Do not edit DAR files manually. This can cause errors during further processing and operation with the files.

The Tide Data File Format

Tide data files can be imported by the ISE software. These files have to be ASCII files with the following structure:

Column	Description
1	The date as a string in the form 01.01.1999
2	The time as a string in the form 12:05
3	The tide level as a number in cm like 315.0

Every minute must be defined in the file. If no tide data are available for specific times of the day, the tide level value can be set to zero. The columns have to be separated by space characters. Common file extensions are “asc” and “tid”.

The Layer Data File Format

This is also a binary format. The file size depends on the size of the layer information included in the file. Layer files can also be loaded into data windows with different data files than the ones they were created from. Layer files contain information about the digitised features, the colours and the manually added annotation.

- Do not edit layer data files manually. This can cause errors during further processing and operation with the files.

The standard file extension is “sch”.

The Layer Definition File Format

This binary format contains all preferences from the layer editing. It is useful to save the selected pen colours and pen widths into a file. So these preferences can be reloaded to other files for easy editing set up. The standard file extension is "sdd".

The SIS File Format

This file format will be used within the SIS Replace function. If the SIS data strings were exported and recalculated with external software, they can be inserted into the data files again. The number and sorting order of the columns are variable. The SIS files are text files with the following typical structure:

Column	Description
1	The time as a string in the form 10:05:20
2	The X position as a floating point number
3	The Y position as a floating point number
4	The Z value as a floating point number

The Sound Velocity Profile File Format

This ASCII file format contains a list with all speed of sound values and the regarding depth. The depth can be positive or negative, depending on the given option during the saving operation. Both formats will be loaded by the ISE software. The standard file extension is "svp".

Column	Description
1	The depth in metres as a integer number
2	The speed of sound in metre per second as a floating point number

The Numerical Profile File Format

This is a binary format. The file size depends on the number and size of the included density profiles. The standard file extension is "den". Each numerical profile data base consists of one or more numerical profiles. To add a single profile, the user has to import ASCII files with the following structure:

Row	Description
1	The unique profile ID as an integer number
2	The X and Y coordinate values separated by a space character
3	The number N of the following numerical values
4 to (3+N)	The list of numerical values, where each row contains a depth and a floating point number, separated by a space character (N stands for the value of row 3)

- Do not edit density profile files manually. This can cause errors during further processing and operation with the files.

The Sediment Probe File Format

This is a binary format. The file size depends on the size of the probe and layer information included in the file. The standard file extension is "sed".

- Do not edit sediment probe files manually. This can cause errors during further processing and operation with the files.

The Bitmap File Format

This is a standard binary Windows Bitmap format. It is palette orientated and contains 256 different colours. In the exported bitmaps the echo plot from the screen as well as the header and the coordinates are included. It is the same appearance as in the printed echo plots. The standard file extension is "bmp".

- Instead of using Bitmap files it can be more efficient to export the graphic into GIF files. These GIF files are created with a compression algorithm without any loss of quality, based on 256 colours and high compression rates.

The GIF File Format

This is a standard binary GIF format. It is palette orientated and contains 256 different colours. In the exported graphic the echo plot from the screen as well as the header and the coordinates are included. It is the same appearance as in the printed echo plots. The standard file extension is "gif".

- The GIF file format is the recommended format to be used for graphics export. It has the best compression rate without a loss of data and detail. Bitmap files are very big and JPEG files create artefacts within the echo plot due to the compression algorithm

The JPEG File Format

This is a standard binary Windows JPEG format. It is true colour orientated and uses data compression techniques to save space on a storage medium. In the exported JPEG files the echo plot from the screen as well as the header and the coordinates are included. It is the nearly the same appearance as in the printed echo plots, only due to the data compression some pixel artefacts may appear. The standard file extension is "jpg".

- Instead of using a JPEG file it can be more efficient to export the graphic files into GIF files. These GIF files are created with a compression algorithm without any loss of quality, based on 256 colours and high compression rates.

The SVG File Format

This is an ASCII file format following the XML specification to describe scaleable vector graphics. SVG files can be created during the export of layer data. One or more edited and visible layers are exported with relative coordinates to the upper left corner. Additionally a link to the background echo plot may be part of the SVG file if selected during the export. SVG files can be opened and edited by several graphic programs. The standard file extension is "svg".

The CODA File Format (Custom Format)

This is a user specific ASCII file format following the scheme of the CODA processing suite. CODA files can be created during the export of layer data. One or more layers can be written into a single output file. The layers are divided into segments with Start

(S), Intermittent (I) and Stop (E) indicators. Position information and other data, e.g. Time and KP values are exported too, if available. The following table shows the column structure and one small segment as an example. Each row in the CODA file represents a single coordinate and one segment must have at least two rows (with S and E indicator). Some columns are not used and set to zero. Delimiter is per default a Tabulator character.

Date	Time	Layer	KP	X value	Y value	Z value	No Use	ID
15.06.2006	081218.0	Layer2	0.010	4526.66	0415.42	36.46	0.0000	S
15.06.2006	081219.0	Layer2	0.012	4526.65	0415.35	36.47	0.0000	I
15.06.2006	081220.0	Layer2	0.015	4526.65	0415.29	36.48	0.0000	I
15.06.2006	081221.0	Layer2	0.017	4526.64	0415.24	36.46	0.0000	E

The PIPE File Format (Custom Format)

This is a user specific ASCII file format following the same scheme as for the CODA file format. PIPE files can be created during the export of layer data, especially when pipeline reflectors are digitised. The seabed and the top of the pipeline can be written into a single output file or separate files may be exported. The layers are divided into segments with Start (S), Intermittent (I) and Stop (E) indicators. Position information and other data, e.g. Time and KP values are exported too, if available. The following table shows the column structure and one small segment as an example. Each row in the PIPE file represents a single coordinate and one segment must have at least two rows (with S and E indicator). Some columns are not used and set to zero. Delimiter is per default a Tabulator character.

In contrast to the CODA file format the Layer description is fixed to the strings "seabed" and "topofpipe".

Date	Time	Layer	KP	X value	Y value	Z value	No Use	ID
15.06.2006	081218.0	topofpipe	0.010	4526.66	0415.42	36.46	0.0000	S
15.06.2006	081219.0	topofpipe	0.012	4526.65	0415.35	36.47	0.0000	I
15.06.2006	081220.0	topofpipe	0.015	4526.65	0415.29	36.48	0.0000	I
15.06.2006	081221.0	topofpipe	0.017	4526.64	0415.24	36.46	0.0000	E

The ASCII Convert & Export File Format

This is an ASCII file format which is used during the ASCII conversion of SES-96/SES-2000 data and during the export of signal traces. The table below shows the structure of the file. The converter will create files containing several pings, during the export of signal traces individually files for each ping will be written.

The default file extensions are "asc" and "txt".

Row Number	ASCII Data Description
1	Time
2	SIS Field No. 1
3	SIS Field No. 2
4	SIS Field No. 3
5	SIS Field No. 4
6	SIS Field No. 5
7	SIS Field No. 6
8	SIS Field No. 7
9	SIS Field No. 8
10	Range Start [m]
11	Range Length [m]
12	Frequency [kHz]
13	Pulse Length [µs]
14	Sample Frequency [Hz]
15	Number of following samples [n]
16	Sample No. 1
...	...
16 + (n – 1)	Sample No. n

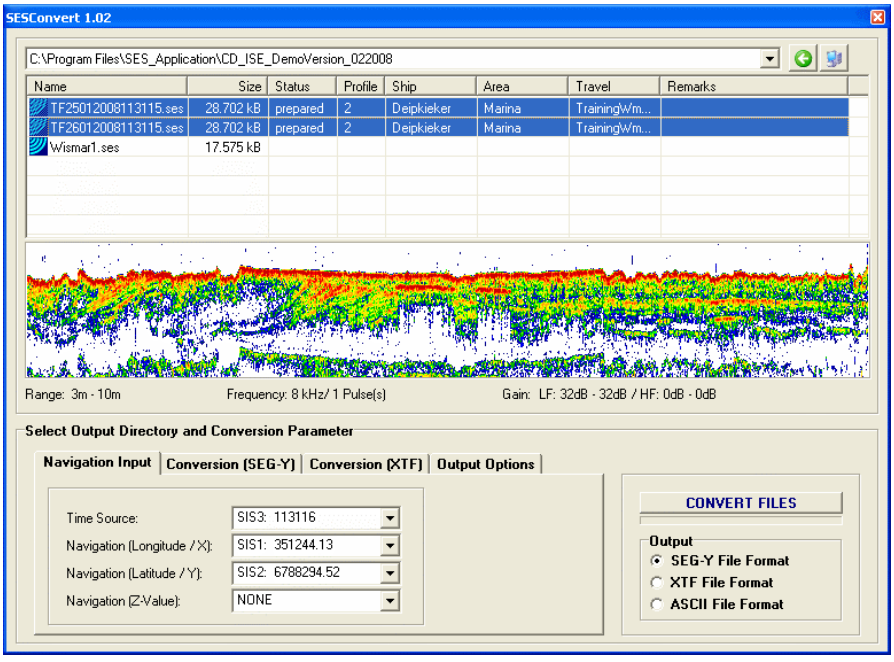
Appendix B SES Converter (Option)

To use different post processing software packages than the ISE software, an additional program is available to convert the SES-96/SES-2000 data files into SEG-Y, XTF or ASCII data files. There are numerous SEG-Y format modifications available, so this converter generates only a basic version of the SEG-Y format, e.g. leaving user fields set to zero.

The software consists of a single executable file, which can be run from any directory on the hard disk. It requires no installation procedure, except copying it to the destination directory.

- The original SES-96/SES-2000 data files are not affected during the conversion.
- Please note, there are separate documents available from Innomar with the description of the implementation of the different formats.

The main dialogue of the converter is divided into an upper part with a directory browser and a lower part with the converter settings. The file browser will list all files within the selected directory, including some file parameters and line description. Special modes, like the multi-frequency mode are given in the column 'Remarks'. Single files or multiple files are selectable for conversion. A graphical preview of the selected file is given below the browser. On the right side the conversion method (i.e. the file format) must be selected.

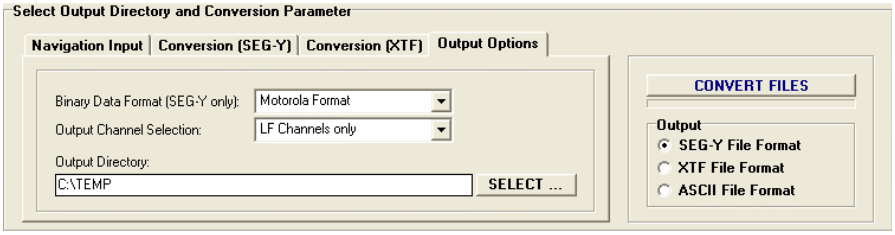


The first task is to define the source for the navigation data. Time and coordinates are selectable from individual SIS fields. If no position is available, the entry "none" should be used. Optionally a Z value can be selected, but will used for SEG-Y files only.

The conversion will start by clicking on the 'Convert Files' Button. A progress bar shows the status of the conversion process. Additionally the file list contains a status field indicating the conversion process for each file. The new generated files are named like the original SES-96/SES-2000 data file plus a suffix depending on the channel. Multi frequency files, beam steering files and Side Scan files are also supported. In these cases the suffix contains some more information about it. The standard file extension for the SEG-Y files is "sgy", for the XTF files "xtf" and for the ASCII files "asc".

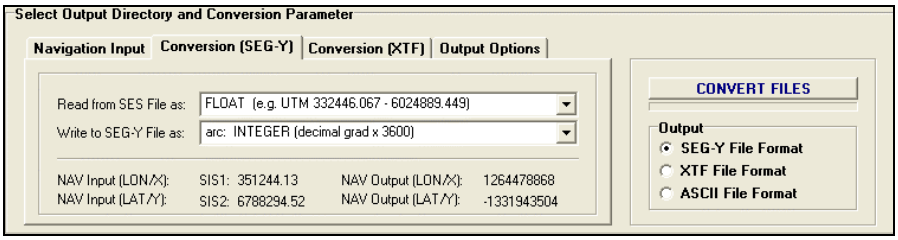
Original file name	**Converted file name**
31102002205500.ses	31102002205500_LF.sgy 31102002205500_HF.sgy
01112002130950.ses (Multi frequency file)	01112002130950_6kHz_LF.sgy 01112002130950_12kHz_LF.sgy 01112002130950_6kHz_HF.sgy
23102001205736.ses (Beam steering file with 3 beams)	23102001205736_-16_HF.sgy 23102001205736_-16_LF.sgy 23102001205736_0_HF.sgy 23102001205736_0_LF.sgy 23102001205736_8_HF.sgy 23102001205736_8_LF.sgy

Some general options for all format conversion are available on the tab 'Output Options'. An output directory is required, where all converted files will be written to. This can be a different directory or the same directory as where the source files are located. Since the SES-96/SES-2000 data files contain multiple channels (at least HF and LF), the user can select, which channels should be converted. The file names of the exported files will be labelled accordingly. The binary data format for the SEG-Y conversion depends on the processing platform for the SEG-Y files. This can be either Intel or Motorola format (Unix/Linux or MSWindows operating system).



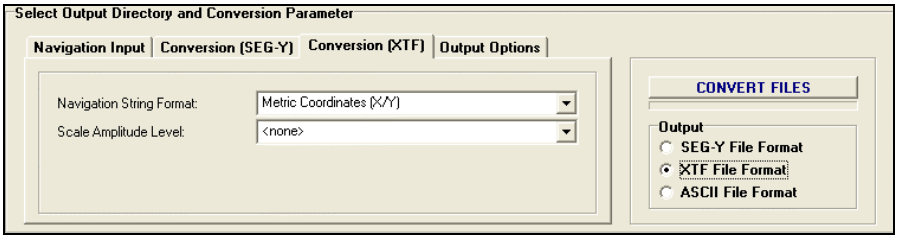
SEG-Y conversion

The following tab shows some conversion options for the SEG-Y format. For Lat/Lon coordinates the type of navigation strings within the SES data files is selectable. For the SEG-Y format a few methods exist to code the degrees as Integer Numbers. It depends on the processing system, which format needs to be selected. Examples of the coded coordinates are given below.



XTF conversion

The tab for the XTF conversion contains a selection for the type of navigation data. This can be of metric type or Lat/Lon type. Another option exists to scale the amplitude data by factor two. This is required, if the used processing software will read 16bit data as bipolar data only. A scaling factor of two will result in 15bit for the always positive amplitude values of the demodulated SES data and can be imported now without problems. This option is not required if RAW data files or Side Scan data files are converted.



ASCII conversion

No special options are necessary for the ASCII conversion.

Appendix C Simple Side Scan Processor (Option)

If a SES-96 or SES-2000 system is equipped with a side scan transducer and the relating software, it is possible to record 100kHz side scan data. The side scan data are stored within normal SES-96/SES-2000 data files. The online software allows the replay of these data files, but an extended processing might be helpful for a coordinate referenced digitisation of targets and structures. For this reason a special tool is provided, which allows the generation of Bitmap graphics containing a coordinate referenced chart of different side scan profiles, slant corrected and processed with some signal and picture processing methods. These referenced Bitmaps are usable for any chart as a base map for further digitisation or plotting with external software packages, for example Surfer from Golden Software or Arc View GIS from ESRI or others. The software is not a real Mosaic software, but it is a handy tool to get some mosaic like output of side scan profiles.

The Side Scan Processor Software

The Side Scan Processor has no real time display or preview of the generated Bitmap graphics, due to the possible big size of the files, which may overflow the graphics resources of older Windows versions. Therefore it is a dialog orientated tool, where to define the input data, to process the data and finally to generate and store the output data as a Bitmap file.

The following graphic shows a flow chart of all necessary steps to generate a useful output. Already during the recording and before using this tool it is necessary to fulfil some requirements.

- Side Scan data files must contain heading information in one SIS field, coordinates in a metric system and the coordinates have to be already interpolated for each ping (which can be done within the ISE software). The heading information will be interpolated and smoothed temporarily within the Side Scan Processor.

Use the Side Scan Transducer and record Side Scan Data with Coordinates and Heading stored to the SIS fields.

(Optionally a course may be calculated with ISE, but a true heading is preferred)

↓

Eventually convert the coordinates into a metric system, if not already recorded and calculate the heading from the coordinates, if not already recorded. The ISE software provides a SIS Extract and SIS Replace function, as well as a tool to calculate the heading from ASCII coordinate files.

↓

Interpolate the coordinates, so every ping has it's own coordinate. This step is necessary, because typically one position per second is available, but there are up to 30 pings per second generated with the echo sounder system. The ISE software has a tool for interpolating the coordinates within the SES data files.

↓

Optionally a digitisation of the bathymetry can be done with ISE and these depth data should be stored at one SIS field with the SIS replace tool. This procedure increases the quality of the near nadir region during mosaicing.

↓

Start the Side Scan Processor software and select the data files to be processed (multiple files are selectable and a graphical preview is available too).

↓

Define the input parameters, especially where to read the coordinate and heading information from the SES data files.

↓

Define the output size of the generated Bitmap and scale the input data depending on the area to be processed and visualized and depending on the survey speed and the achievable ping rate during the survey.

↓

Define some signal processing parameters to enhance the generated output, like TVG and heave correction. Additionally some picture processing parameters, like pixel smoothing and the overlay of grids are available.

↓

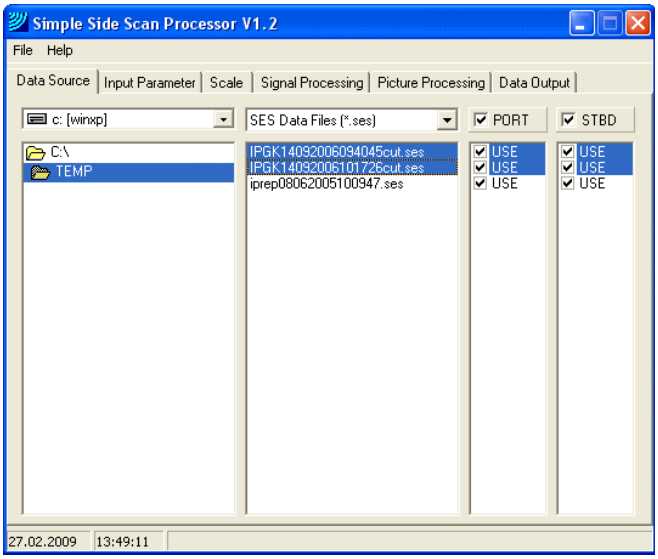
Define the output file and destination and start the processing which may take a while, if large data sets are processed.

↓

Use the generated output Bitmap file within third party software for charting, digitisation of structures and plotting. The Bitmap files are normal MS Windows bitmaps with 256 colours and compatible with all available picture processing and visualization and charting software.

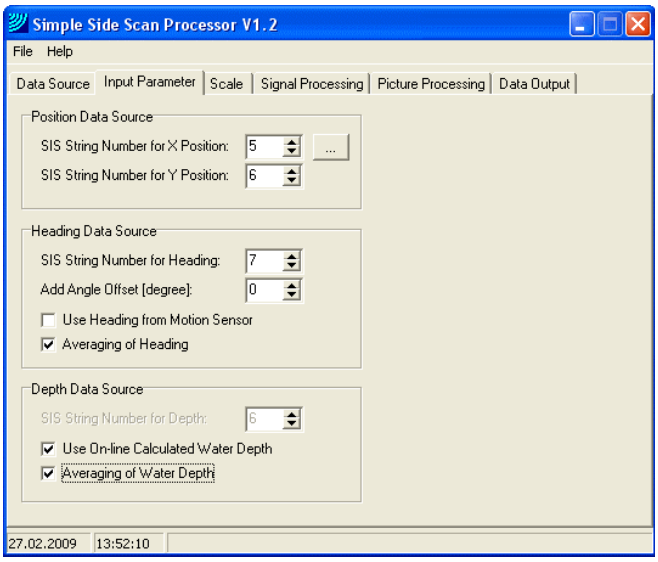
The Data Source Dialog

Within this dialog it is possible to select one or more SES data files for the processing. Browse to the source directory and select the files by marking them with the mouse. Also the port and starboard channel are selectable independently of each other. That might be useful in order to avoid to many overlaid Side Scan data within the mosaic. At least one file must be selected.



The Input Parameter Dialog

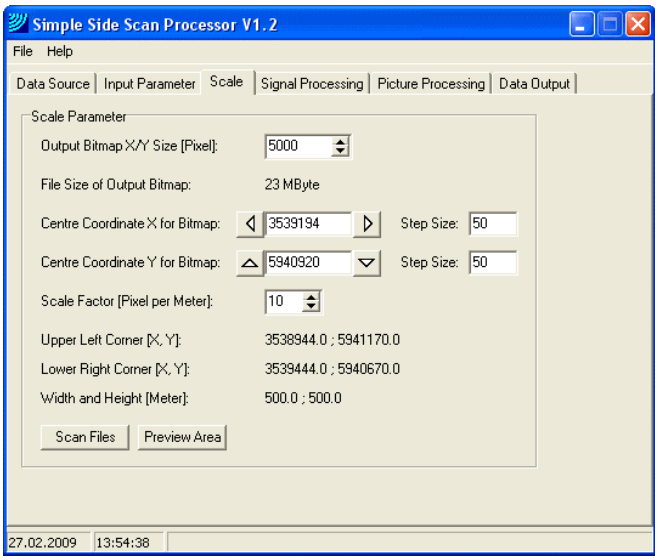
Select the SIS string number for the X and Y coordinates within the eight SIS field of the SES data files. Additionally one field must contain the Heading information. It is recommended to use the averaging of the heading data to improve the output quality of the processing. The heading data normally has too large steps compared to the number of pings between each heading value and the resulting smaller change of the heading from ping to ping in reality. For the depth data source either the on-line calculated depth or a depth value from one of the SIS field may be used. An averaging of the depth data may increase the quality of the near nadir region during the mosaic calculation.



The Scale Dialog

This dialog is responsible for all settings relating to the output size of the Bitmap and the area to be visualized within. The bitmap itself is always quadratic and can have a maximum size of 10000 x 10000 pixels (which results in a file size of 100 MByte). The resulting output file size is calculated and given. Use the Scan Button to get read through all selected files and to find the centre coordinate within the boundary rectangle of the side scan profiles. The centre coordinates can be changed and defined manually, if specific section from the selected data set is of primarily interest. The preview window gives an overview about the vessel's track. The red area displays the backboard side and the green area displays the starboard side and both together are representing the coverage of the side scan track. The area of interest can be selected directly by clicking the mouse into the preview chart. The buttons shown down on the preview window can be used to create a grid according to the size of the output bitmap. The arrow buttons are used to move the selected window to the area of interest. This is very useful if more the one bitmap is necessary to cover the area. It makes sure that bitmaps can be created without any gaps in between.

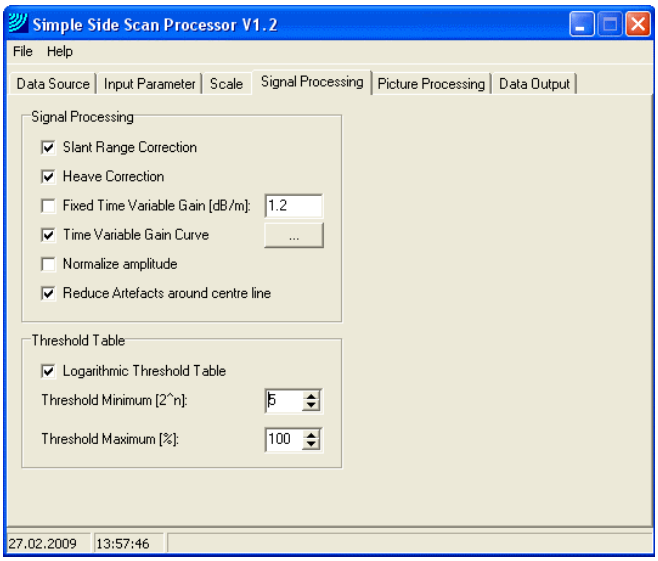
Furthermore the Scale factor is given in Pixel per Meter. Depending on the ping rate and the survey speed it might be necessary to decrease the number of pixels per metre, due to less coverage of the surveyed area with transmitted pings. On the other side the visualized area changes by changing the number of Pixel per metre relating to the output bitmap size. For this reason the processed boundary and size of the area is always recalculated and given on the lower part of the dialog.

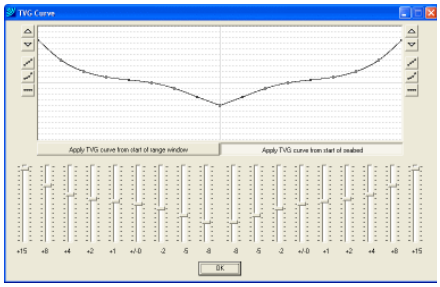


The Signal Processing Dialog

Several processing steps are available. If during the survey a motion sensor was attached to the SES system, the heave information can be used for a heave correction. The averaging of the water depth can decrease errors during the TVG and the slant correction, if the bottom was not flat below the transducer or stones were on the bottom. A fixed time variable gain can be adjusted in dB/m to correct the received signal for energy losses due to geometrical and normal attenuation. There is also a

possibility to create an own time variable gain curve. The gain curve can be adjusted for both sides separately. The amount of amplifying the received signal depends on the survey condition and must be found by manual trials. An automatic TVG calculation is not available at this time. The slant correction is necessary to get true distances of the reflectors from the survey line positions. Slant Range correction means the recalculation of the travel time to the true horizontal distance, when the height of the transducer over the bottom is known. The area near the centre of the survey line is not as detailed as with higher distance due to less data points per change of distance, but this is normal for this processing method. For this reason side scan data plots sometimes are better interpretable without slant range correction, but for really coordinate referenced plots it is necessary to do. One signal processing method is included to compensate the received signal for changes of the signal strength due to directivity and other influences. The amplitude normalization will produce an output with a normalized signal level over the whole received signal. Small variations due to reflections from objects and structures on the seabed are not affected, but if the size of such reflectors is to large or the seabed characteristic changes constantly, the normalization may produce wrong amplification levels on these areas. A special algorithm is selectable for the signal processing, which is able to reduce artefacts around the centre line of the profile (nadir region). Finally a threshold table can be applied to the processed signal to convert amplitude levels to a colour or grey scale value for the final picture. This threshold table can have linear or logarithmic steps. A logarithmic table will have more steps in the lower amplitude range and will therefore improve the visibility of small changes of the signal. The minimum value is used to remove the background noise from the generated picture. A higher value for the threshold minimum results in a bigger value for the starting point of the threshold table and all amplitudes below will be removed from the picture output. The maximum value for the threshold table is given in percent of the total dynamic range. A smaller value than 100 percent will decrease the total size of the threshold table and will result in more steps for the generated threshold table for the given signal amplitude range and therefore in better visible variations of the signal amplitude.





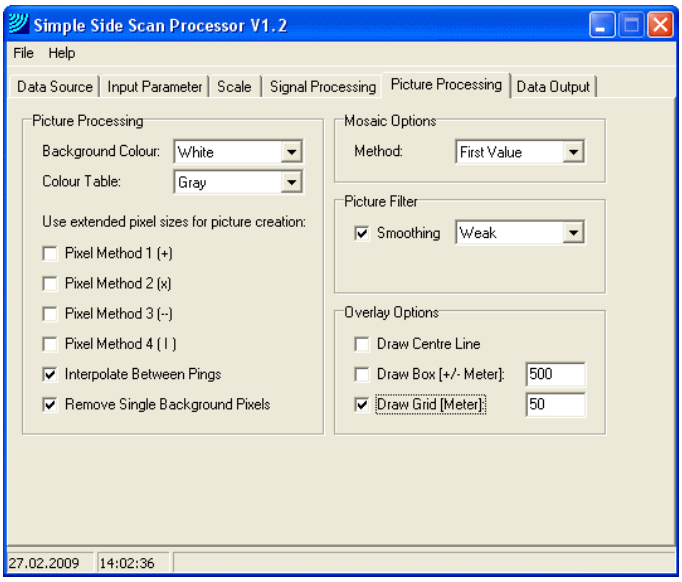
The Picture Processing Dialog

The picture processing is done after the signal processing. There are several options available for the improvement of the output pictures. A selection of different colour tables and background colours can produce positive or negative pictures (shadows are light or dark). Extended pixel sizes are used, to fill blank areas between pings, when the ping rate was to low or the survey speed to high for the selected scale factor. There are different and combinable options for the pixel extension, which may used depending also on the survey direction. For example a North / South profile may be filled with vertical pixel extensions only, to keep the originally resolution in East / West direction. There is a limit to use the pixel extension, if the blank areas between the pings are getting to big. For that reason a function for the interpolation of data between the pings is available. This is the preferred method to produce graphics without blanked parts between single pings. If the scale factor is selected too big it is possible that still some blank pixels are visible on the plot. A function to remove such single pixels is selectable for that reason.

The generation of mosaics means the combination of several single profiles within one output plot. A few different methods for the combination exist. When a pixel will be written to a position, where a pixel was already put before, they may be combined with the following options: the first pixel will be the final pixel, the last pixel will be the final pixel, the maximum amplitude will be used, the minimum amplitude will be used or an average of the amplitudes will be calculated.

The final picture can be smoothed with a gauss filter of a selectable strength to improve the signal to noise ratio and the quality of the output.

Three overlay functions are available, first the drawing of the centre line of the single profiles, second the drawing of a box with a fixed dimension around the centre coordinate and third the drawing of grid lines, where the centre coordinate is the centre for the grid. The line distance is adjustable depending on the processed area.

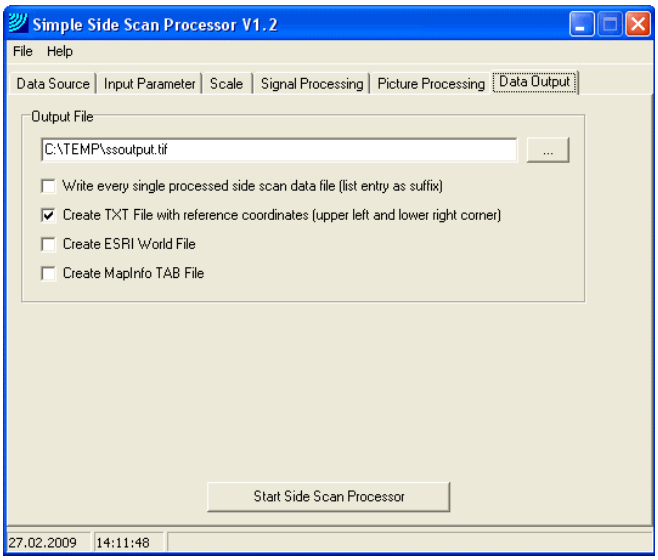


The Data Output Dialog

Finally the target directory, which is per default the data source directory, and the output file name have to be defined. To select another directory than the default a button to start a directory selection dialog is available.

Optionally a geo-referenced picture will be created for every single profile, which was selected and for the final mosaic, or the mosaic only will be written to disk. The generation of a text files with reference coordinates of the output pictures will make the import into third party charting software more comfortable.

By pressing the Button Start Side Scan Processor the processing will begin. The status bar of the software informs about the progress of the processing. Large data sets may require some time to finish. All of the dialogs are not accessible during the processing.



Example of Output Graphic

The following picture is a typical output of the Side Scan Processor Software. All options are enabled, like heading averaging, slant correction, TVG, pixel extension and smoothing. The grid line distance is 50 metres.