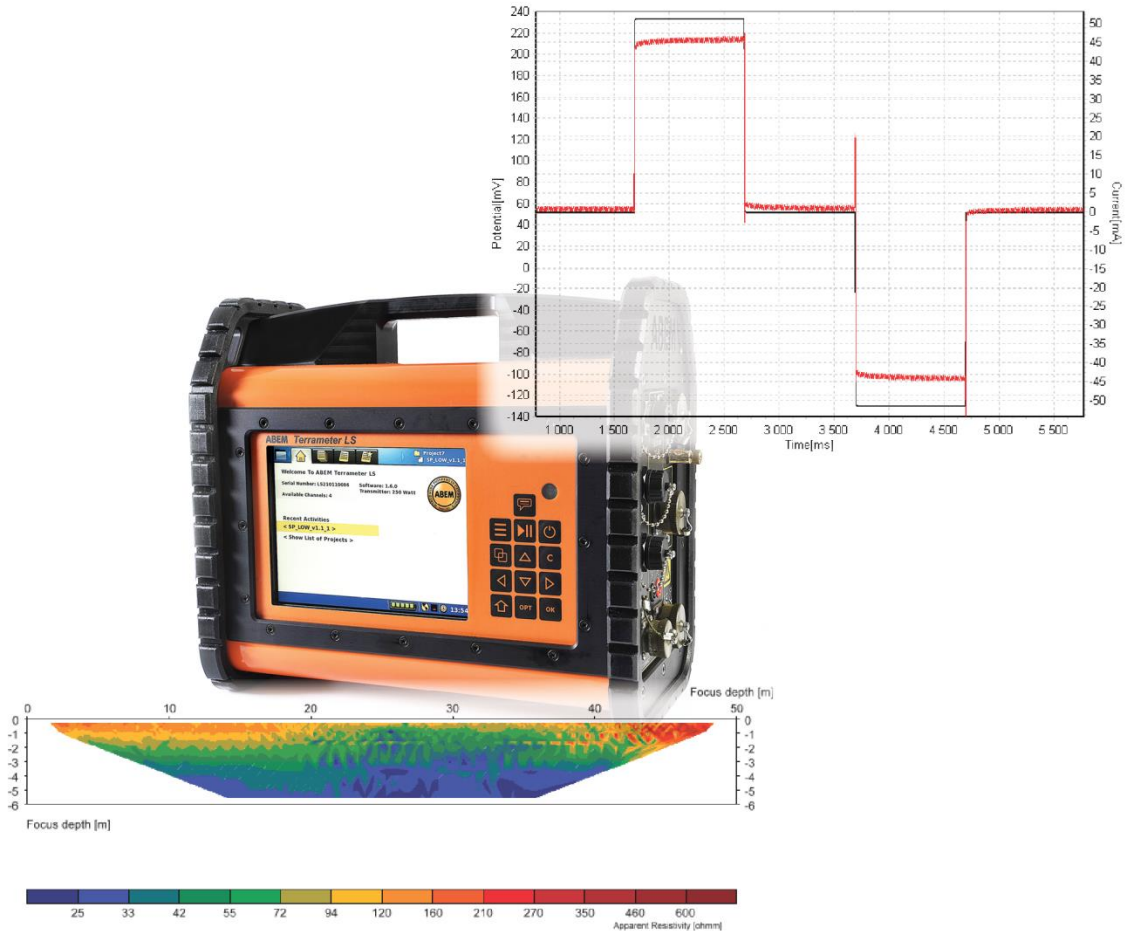
ABEM

User Manual



Terrameter LS Toolbox

ABEM Product Number 33 3100 08

ABEM 2016-12-07, based on release 2.0.1 of Terrameter LS Toolbox

Thank you for choosing ABEM Terrameter LS Toolbox

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ABEM will be pleased to receive occasional reports from you concerning the use and experience of the equipment and software. We also welcome your comments on the contents and usefulness of this manual. In all communication with ABEM be sure to include the instrument types and serial numbers and software versions.

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Table of Contents

Section **Page**

1 Introduction 1

2 Installation 2

3 Overview 6

4 Instrument Communication and Management 8

4.1 Initiating Communication 8

4.2 Importing Data 10

4.3 Spread and Protocol Transfer 11

4.4 Firmware Update 14

4.4.1 Updating the application software 14

4.4.2 Updating the current transmitter firmware 15

4.5 Setting Timezone and Time 17

5 Data Management and Post-Processing 20

5.1 Project Management 20

5.2 Task Data Post-Processing 22

5.2.1 Table 24

5.2.2 Export 26

5.2.3 View Electrode Contact Test 26

5.2.4 Show on Map 27

5.2.5 View Pseudosection 28

5.2.6 Full Waveform 31

5.2.7 View IP Decay Curves 33

5.2.8 Edit Electrode Coordinates 34

6 Main Menu 36

6.1 Conversion of ADR to XML Spread File 37

6.2 Conversion of ORG to XML Protocol file 39

6.3 View Spread and Protocol ..... **Error! Bookmark not defined.**

6.4 Windows Display 41

1 Introduction

Terrameter LS Toolbox is a revised replacement for the Terrameter LS Utility Software. The Terrameter LS Toolbox can be found and downloaded from *www.guidelinegeo.com* .

The following functions are included:

- Transfer of data files Terrameter LS => PC
- Viewing, culling and export of data file contents via table
- Listing contents of project data base files
- Export of data files in different formats
- Plotting of electrode contact resistances
- Viewing the location of the survey on map
- Plotting data as pseudo sections
- Plotting of IP decay curves
- Plotting of full waveform data sweeps
- Export of full waveform data to TXT files
- Transfer of spread and protocol files PC <=> Terrameter LS
- Conversion of address files from the SAS4000 system into XML format
- Conversion of protocol files from the SAS4000 system into XML format
- Update of instrument software

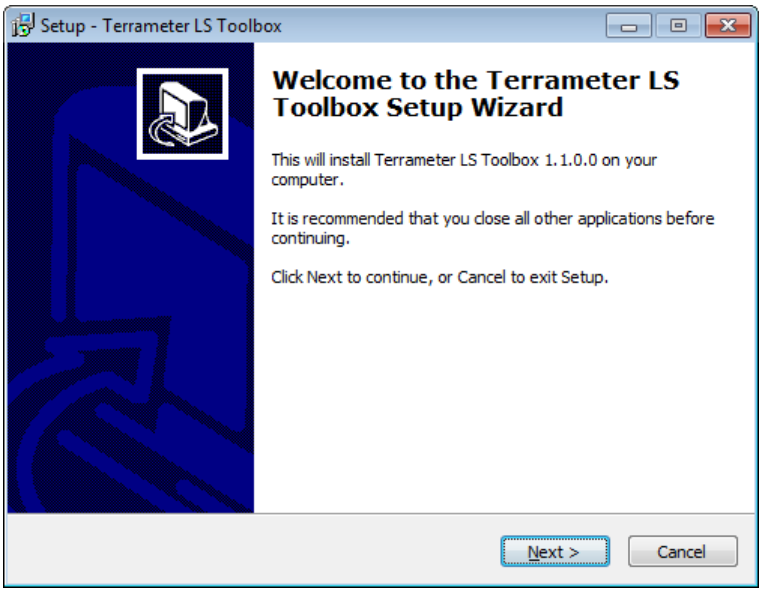
Essentially everything is based around the tree structure on the left side and the functions are accessed via a popup menu that appears when right clicking on an item.

2 Installation

Note! Operating systems such as Windows 7, 8, 8.1 and 10 might have limited access and permission to the "C:\Program Files" and "C:\Program Files (x86)" folders, which might cause errors. To avoid issues it could be recommended to install the Terrameter LS Toolbox in another folder, e.g. "C:\ABEM\Terrameter\"

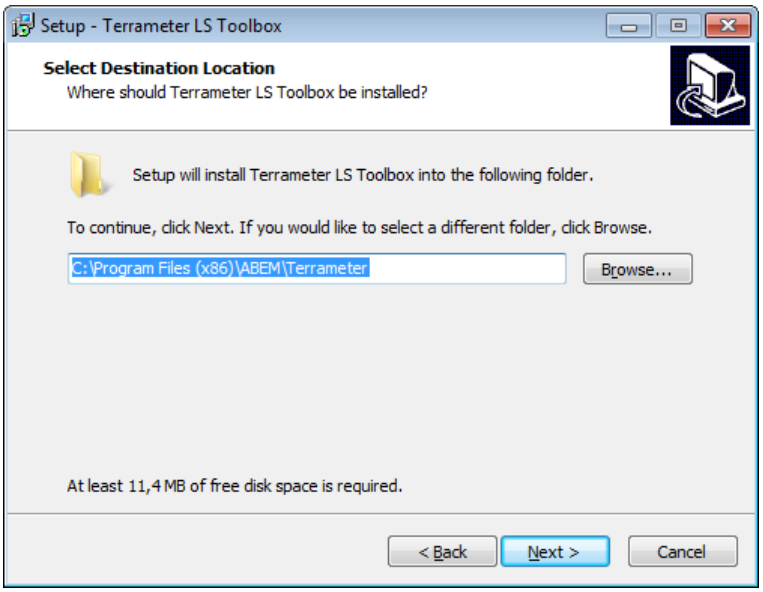
The Terrameter LS Toolbox installer is available for download from www.abem.se. The installation process is a matter of following a few simple steps.

When the installation program is run, the following dialog first appears:



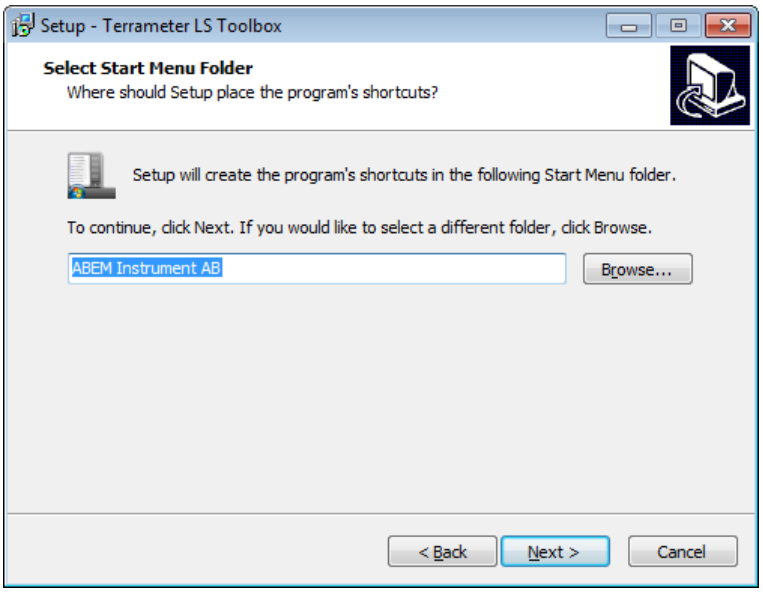
Click *Next*.

The default installation folder can be accepted or changed. To change click *Browse…* or type directly in the text field.



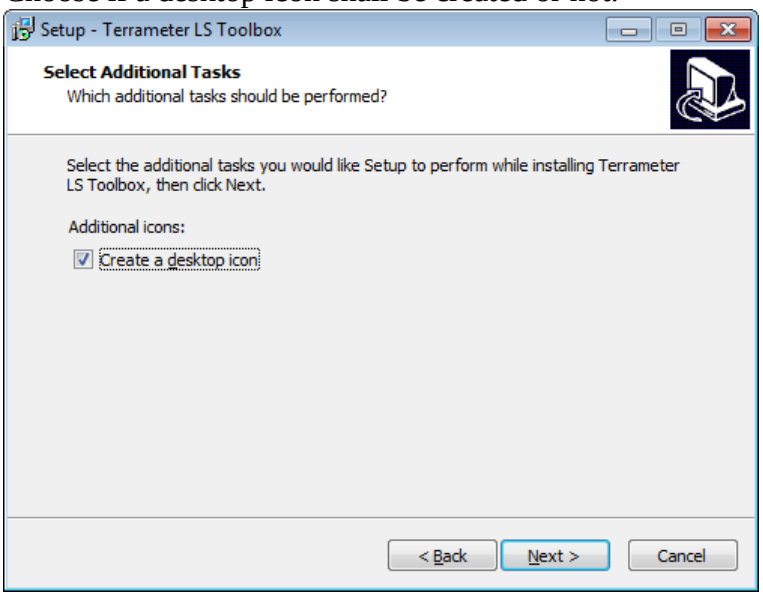
Click *Next*.

The default Start Menu shortcut can be accepted or changed. To change click *Browse…* or type directly in the text field.



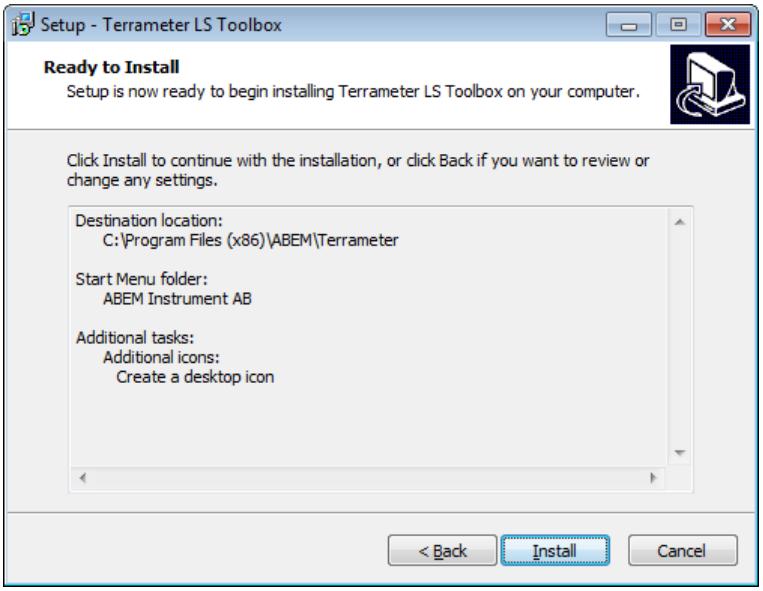
Click *Next*.

Choose if a desktop icon shall be created or not.



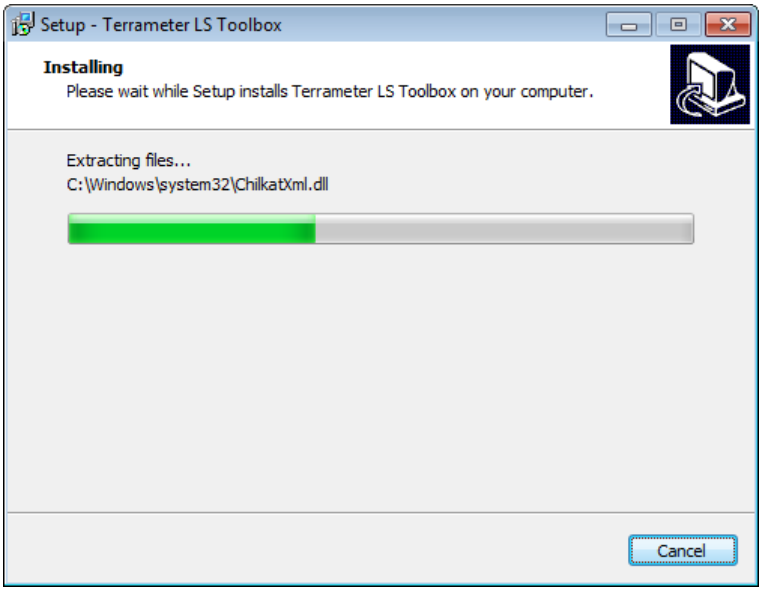
Click *Next*.

The installation process is now ready to start.

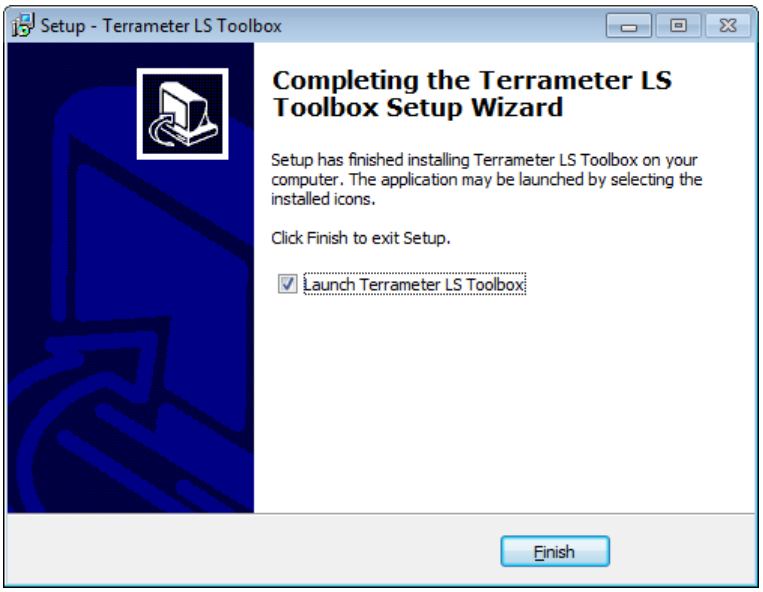


Click *Install*.

The installation is executed.



When installation is complete, choose if you want to launch the Terrameter LS Toolbox immediately or not:



Click *Finish*.

The installation process is now complete and Terrameter LS Toolbox is ready to be used.

Terrameter LS Toolbox can be started either from the desktop icon or the start menu.

3 Overview

The user interface is based on a tree structure holding one or more project groups as well as any number of Terrameter LS instruments (Figure 1). A project group can contain any number of projects. These projects are taken from one or more Terrameter LS instruments. This is useful if the data from a site or client project for practical reasons have been saved to more than one project in an instrument, or if more than one instrument has been used.

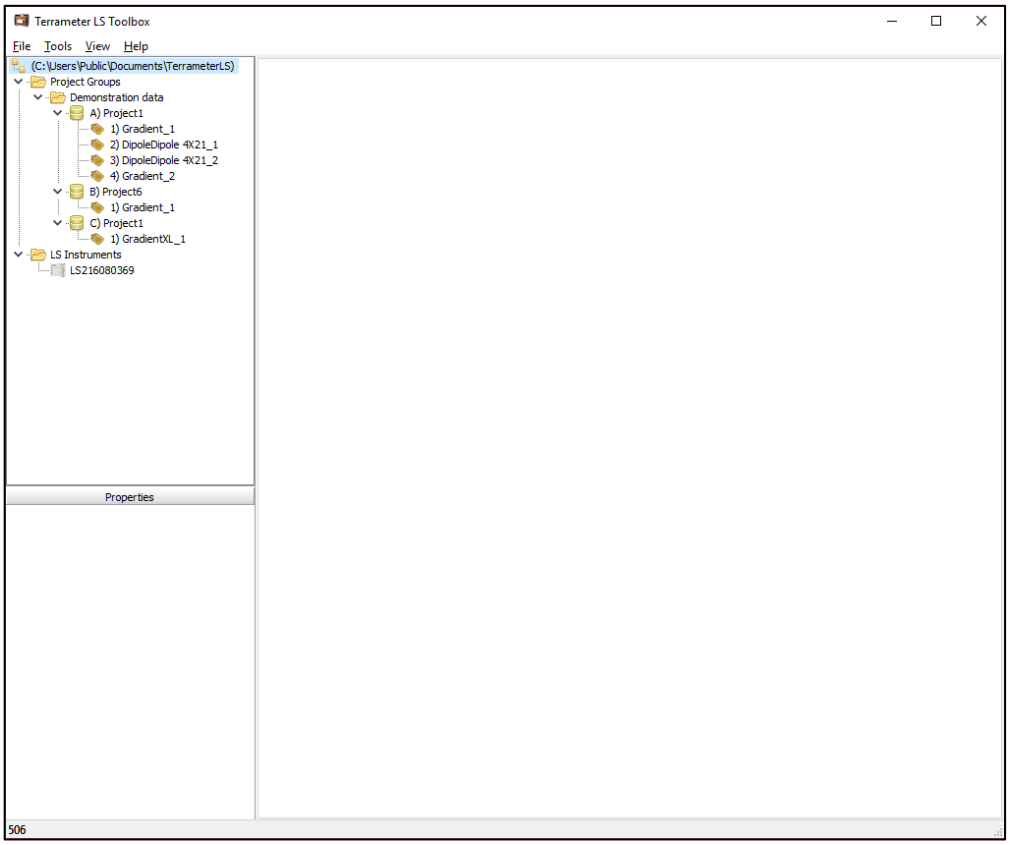


Figure 1. Example tree structure

By default the tree structure information is saved under “Shared documents”. The location of the tree structure information can be changed (Figure 2). If a tree structure is created and saved under “Shared documents” it will be accessible by anyone who uses the computer, but the projects under the project groups must of course be saved in a location that can be accessed by all users and not under e.g. “Personal documents”. It is also possible to save several tree structures under arbitrary directories to have separate trees for e.g. different geographical areas or clients. Furthermore it is possible to choose a directory on a network drive in a corporate network to make it possible to access a tree structure from different computers.

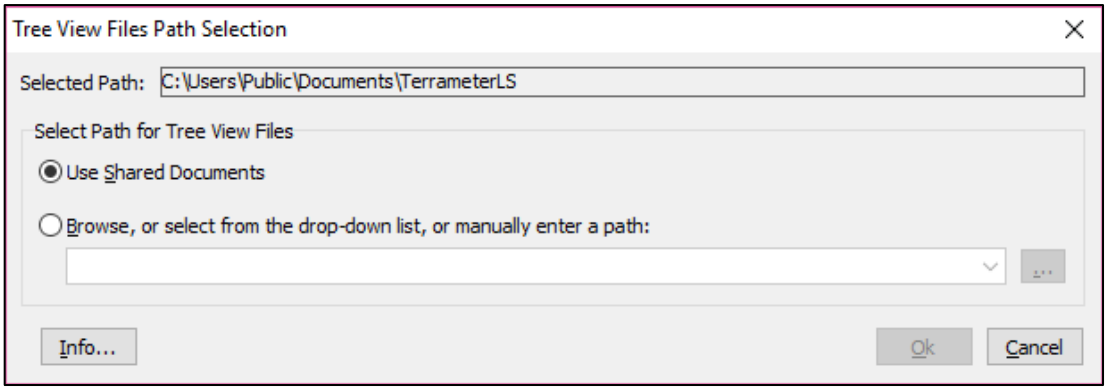


Figure 2. Tree structure location setup dialog

A tree structure can eventually become very large as more and more project groups, projects and instruments are added. If a project group is removed from the tree the data will not be deleted, but it may be desirable to keep the Terrameter LS projects organised in project groups e.g. for possible future re-processing of the data. Instead of removing the project groups it is possible to start a new tree structure in a different directory of the computer, in this way it is possible to go back to an old tree structure view at a later point.

Warning!	The software is not designed to handle more than one user of a tree structure at a time! The Terrameter LS Toolbox functionality cannot be guaranteed and tree structure information can be lost if users from two or more computers attempt to access a common tree structure at the same time.

4 Instrument Communication and Management

4.1 Initiating Communication

Transfer of measured data, spreads and protocols can conveniently be done between the Terrameter LS and a PC with LS Toolbox using a network connection. Instrument software upgrading is also carried out this way. First the instrument must be connected to the same network as the PC. Alternatively the built-in DHCP server can be activated in the Terrameter LS and the PC connected directly to it. Please read section "The Network" in the instruction manual for Terrameter LS for details on how to do that.

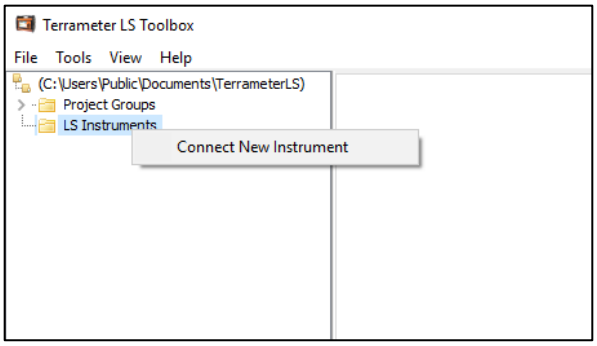


Figure 3. LS Instruments context menu

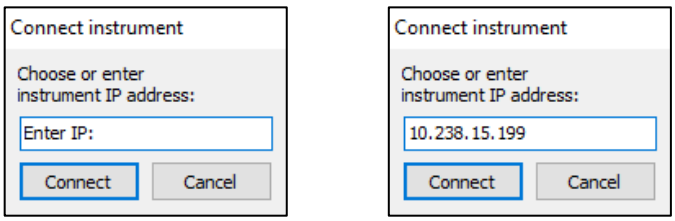


Figure 4. Dialog for choosing an IP number and activating the connection

Right-click on the "LS Instruments" tree node (Figure 3) and select *Connect New Instrument* to add an instrument. Enter the IP address of the instrument in the opened dialog (Figure 4) and press *Connect*. Connection to a previously used instrument is done by right clicking on its tree node and selecting *Connect* from the context menu (Figure 5). Either enter a new IP address or select between previously used IP addresses and then press *Connect* (Figure 4).

When the instrument has been connected all context menu items except *Connect* becomes enabled (*Figure 6*).

The Properties section shows locally stored information about the instrument (Figure 7).

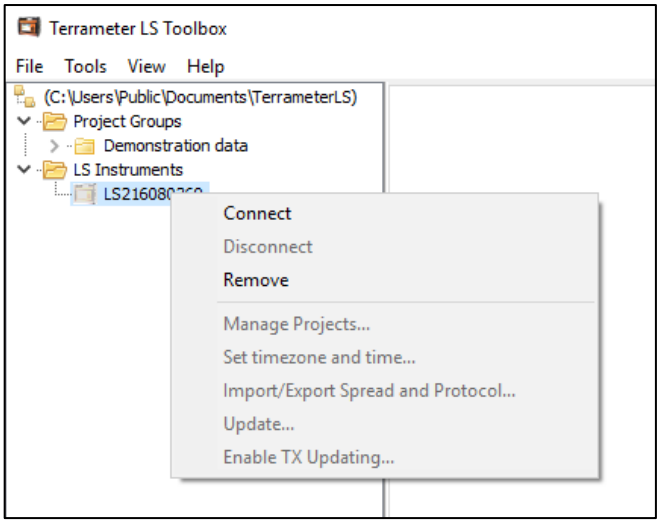


Figure 5. Context menu for an unconnected instrument

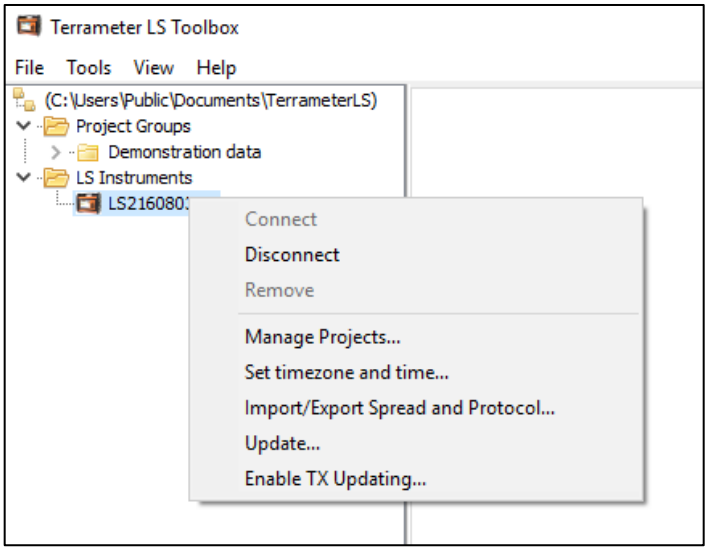


Figure 6. Context menu for a connected instrument

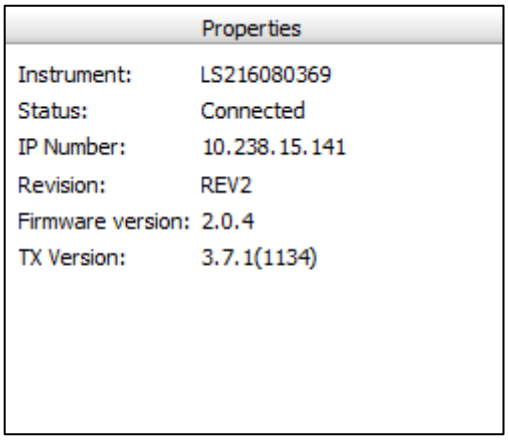


Figure 7. Properties section

4.2 Importing Data

To import data from a Terrameter LS, right click on the instrument tree node and choose *Manage Projects* (*Figure 6*). The Manage Projects dialog (Figure 8) is shown with a list of the projects on the instrument. Use the checkboxes on the left side (Figure 9) to select the project(s) to import to the PC. Before the data transfer is started, a start destination folder must be specified.

If the checkbox "Use Start Destination for All Projects" is checked, all projects will be stored in the Start Destination folder. If left unchecked a dialog will ask where the selected project(s) is to be stored. The checkbox "Include full waveform data" must be checked to transfer such data. This is of course only relevant if full waveform data were recorded. By checking the checkbox "Add to Project Group" a project can directly be added to a Project Group. If left unchecked the project(s) must be manually added.

Press "Download" to start the data transfer. Before data is saved the destination must be confirmed, and there is an opportunity to modify the destination and/or the name of the three structure file, if so desired.

Note!	Please observe that it can take considerable time to transfer full waveform data, even over a direct cable link. Hence it may be convenient to transfer only the project database in the first step, for example for on-site data quality checks in the field, and transfer the full waveform data at the end of the day.

Note!	If hovering the mouse over the question mark bubbles, help and tips are displayed.

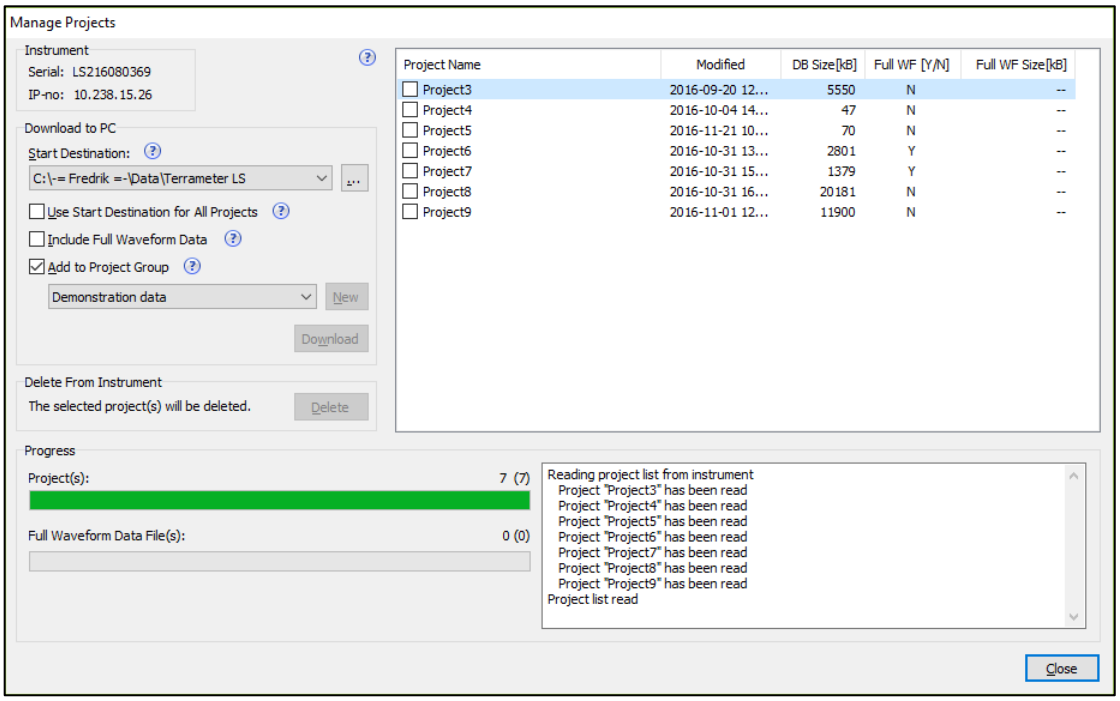


Figure 8. Data transfer dialog

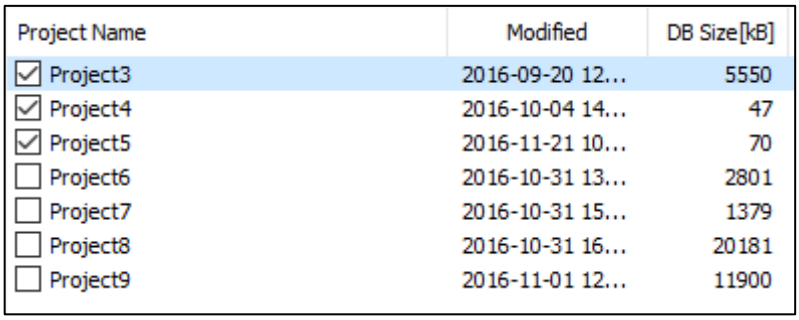


Figure 9. Three Projects selected for transfer

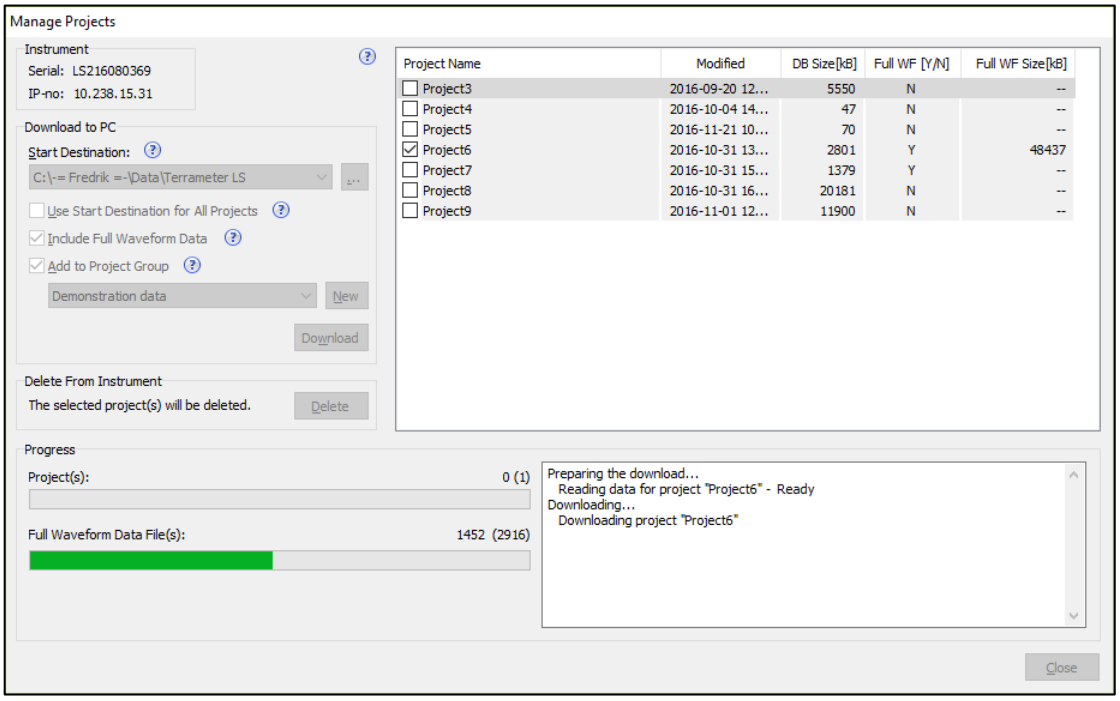


Figure 10. Transfer is ongoing

4.3 Spread and Protocol Transfer

The *Spread and Protocol Transfer* dialog (Figure 11) is opened by right clicking on the tree node of the instrument and choosing *Import/Export spread and protocol*. The two lists on the dialog are populated with spreads and protocols for the PC and the instrument respectively, the PC to the left and the instrument to the right. Use the checkboxes on either list (Figure 12) to select the spread(s) and protocol(s) to transfer.

Note!	The protocols required for the selected spreads are not automatically transferred. They must be explicitly selected (Figure 12).

Press the respective arrow button to transfer from the PC to the instrument or vice versa. The default directory in the PC is dependent on the Windows version *Terrameter LS Toolbox* is run on. The current directory is shown, bottom-left, and it is

possible to change to this by pressing the *Browse* button or entering text into the text box. If a spread or protocol in the Terrameter LS is to be replaced by a new improved or corrected version *Allow overwrite* must be checked.

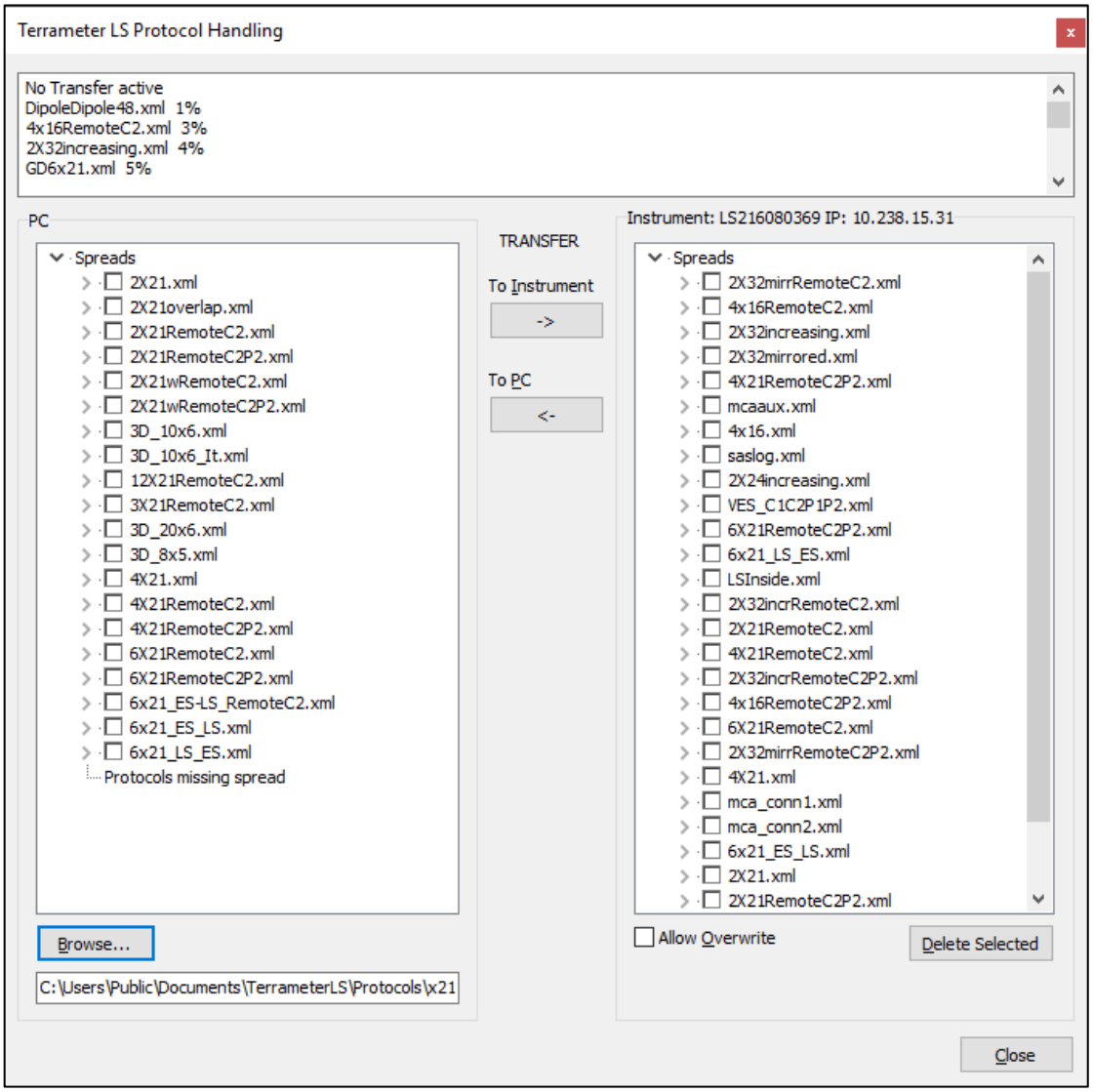


Figure 11. Spread and protocol transfer dialog

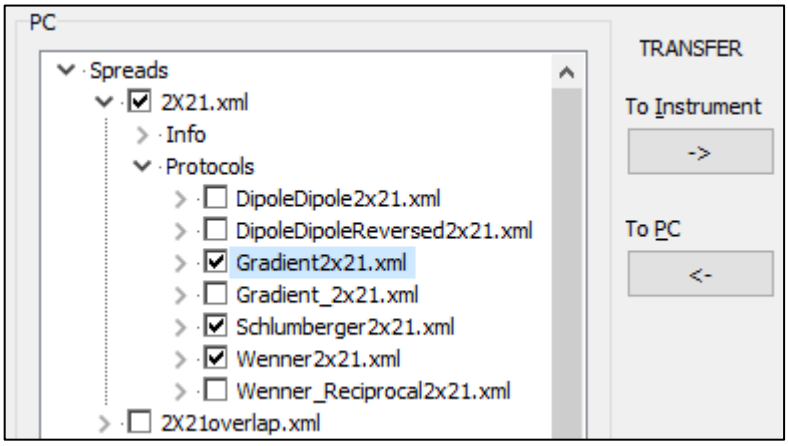


Figure 12. Spreads and protocols are selected for transfer

All protocols that can be used with a spread are listed under that spread in the tree lists. A protocol can in some cases be used in combination with two or more spreads, and as a result the same protocol can be present under more than one spread in the tree view.

Summary information about the spreads and protocols can be viewed by opening the *Info* node in the tree list (Figure 13), or by right-clicking on the item in question (Figure 14). It is also possible to delete items via this context menu.

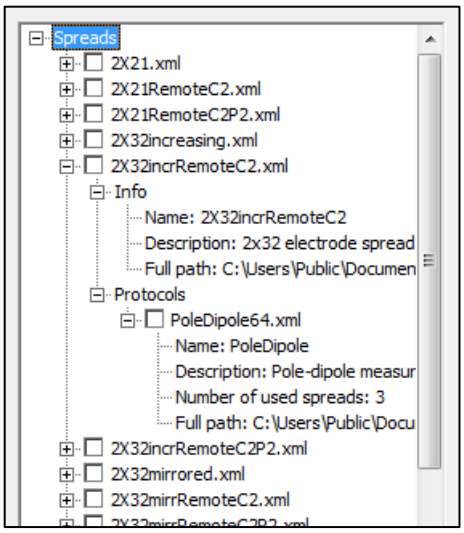


Figure 13. Info for spreads and protocols have been opened

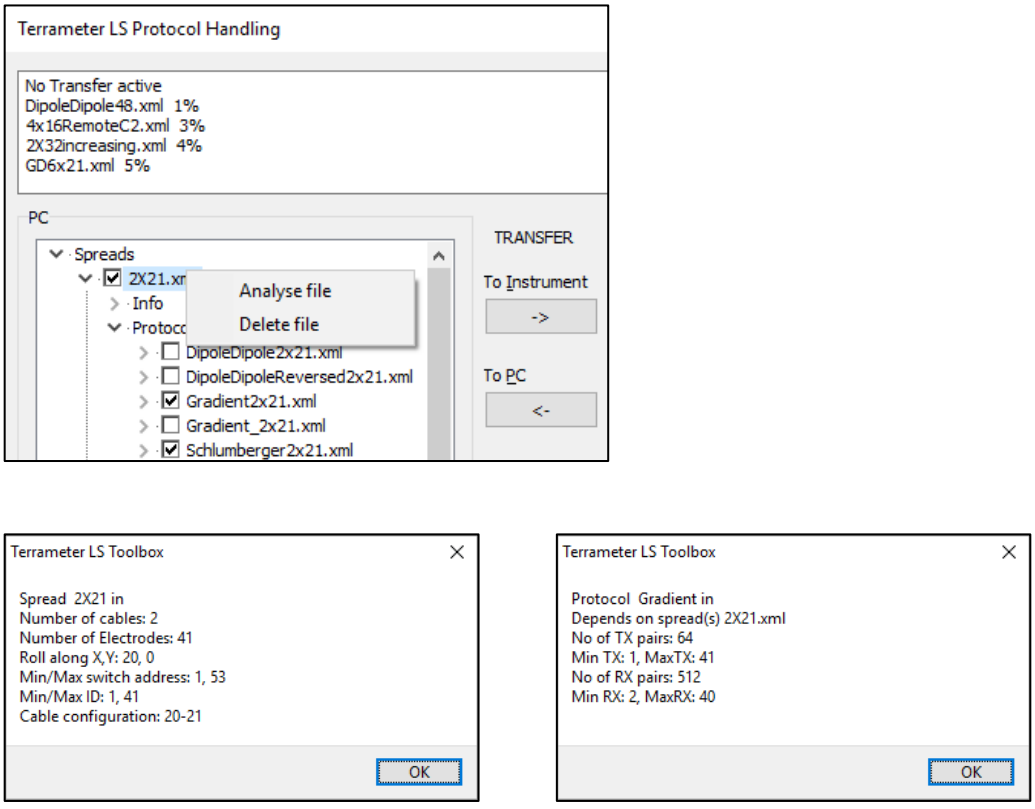


Figure 14. Spread and protocol file summary information.

4.4 Firmware Update

For the Terrameter LS there are two software that can be updates. The first is the application software, which is the graphical user interface and the data acquisition software. The second is the current transmitter software, also called current transmitter firmware, which controls the behaviour of the current transmitter.

Both software can be downloaded from Guideline Geo's web page. Go to the *Resource Center* section under *www.guidelinegeo.com* and download the files containing the latest versions.

4.4.1 Updating the application software

Open the *Update Instrument* dialog (Figure 15) by right-clicking on the tree node of the instrument and choosing *Update* from the context menu. Now press the "*...*" button to select the downloaded update package file, and then press *Update* to start the installation process. The outcome of the installation process will be echoed in the text box of the dialog (Figure 16). If the process was successful the Terrameter LS will automatically re-boot, after which the new instrument software version is running and the text box will say "Process completed" (Figure 17). Please verify that the new version is shown on the "Welcome" page in the Terrameter LS.

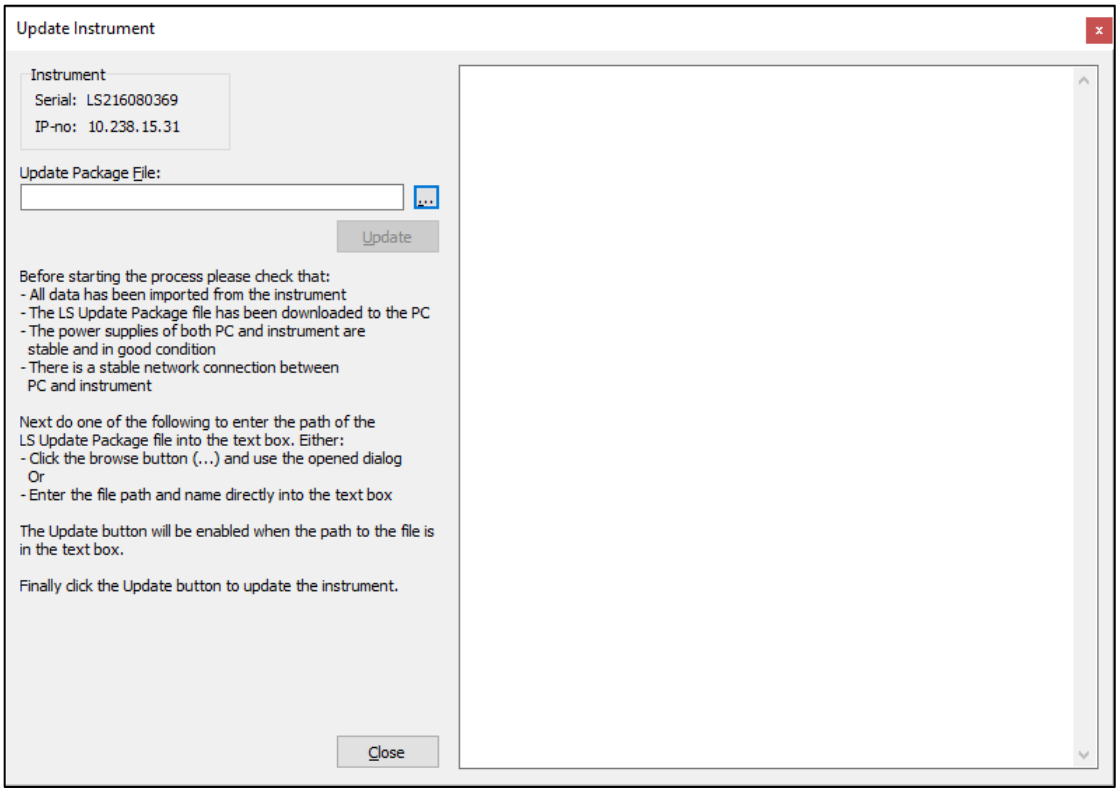


Figure 15. Instrument firmware update dialog

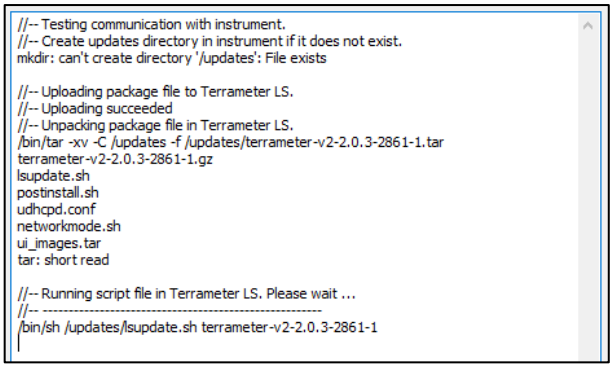


Figure 16. Update is ongoing

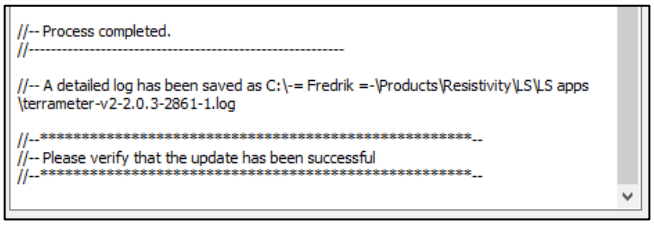


Figure 17. Update completed

4.4.2 Updating the current transmitter firmware

To update the current transmitter firmware the current transmitter needs to be set to programming mode, then it can be programmed using a separate software (SAM-BA). The entire process is described in a separate guide that can be found on Guideline Geo's website in the *Resource Center*.

With the Terrameter LS Toolbox the current transmitter can be set to programming mode. Open the *Enable TX Update on Instrument* dialogue (Figure 18**)** by right-clicking on the tree node of the instrument and choosing *Enable TX Updating* from the context menu. If everything is working as it should, the software will pre-load the script file that is needed, and the next step is to press the *Execute* button as in Figure 18.

When the *Execute* button has been pressed the outcome of the installation process will be echoed in the text box of the dialog. The entire process of setting the current transmitter in programming mode can take up to 1 minute. When completed it will say "Process completed" at the end of the log file if the script was performed successfully (Figure 19).

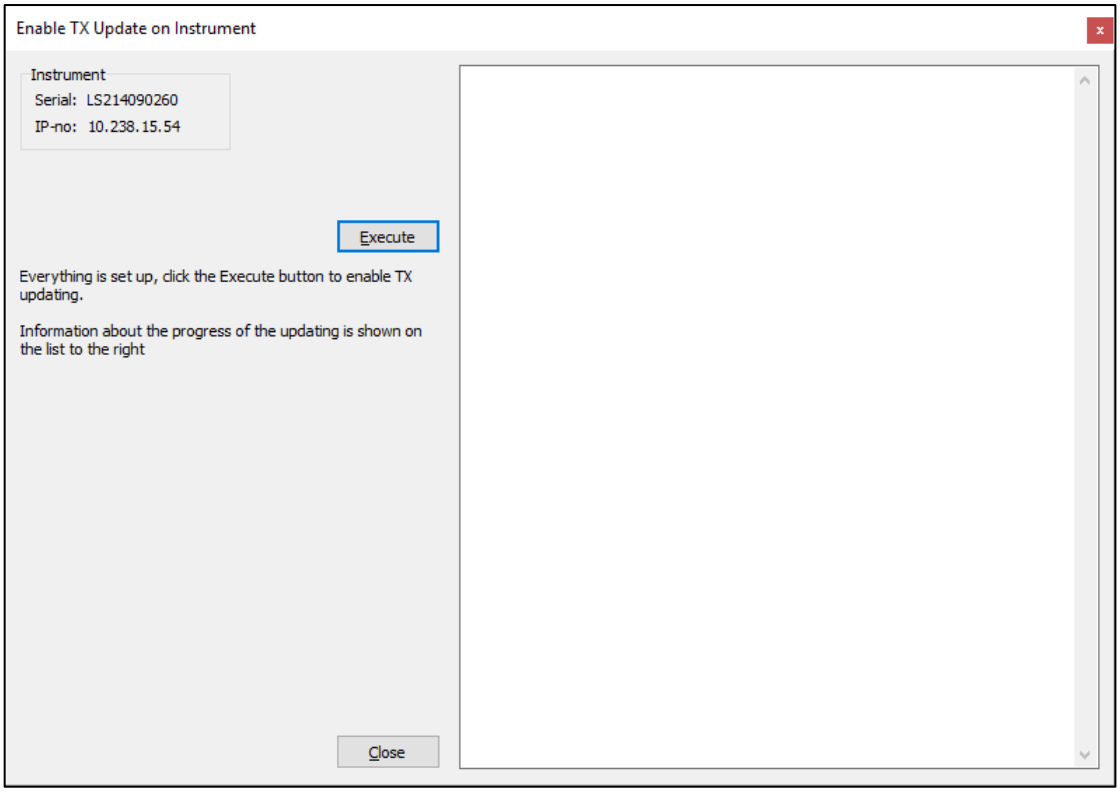
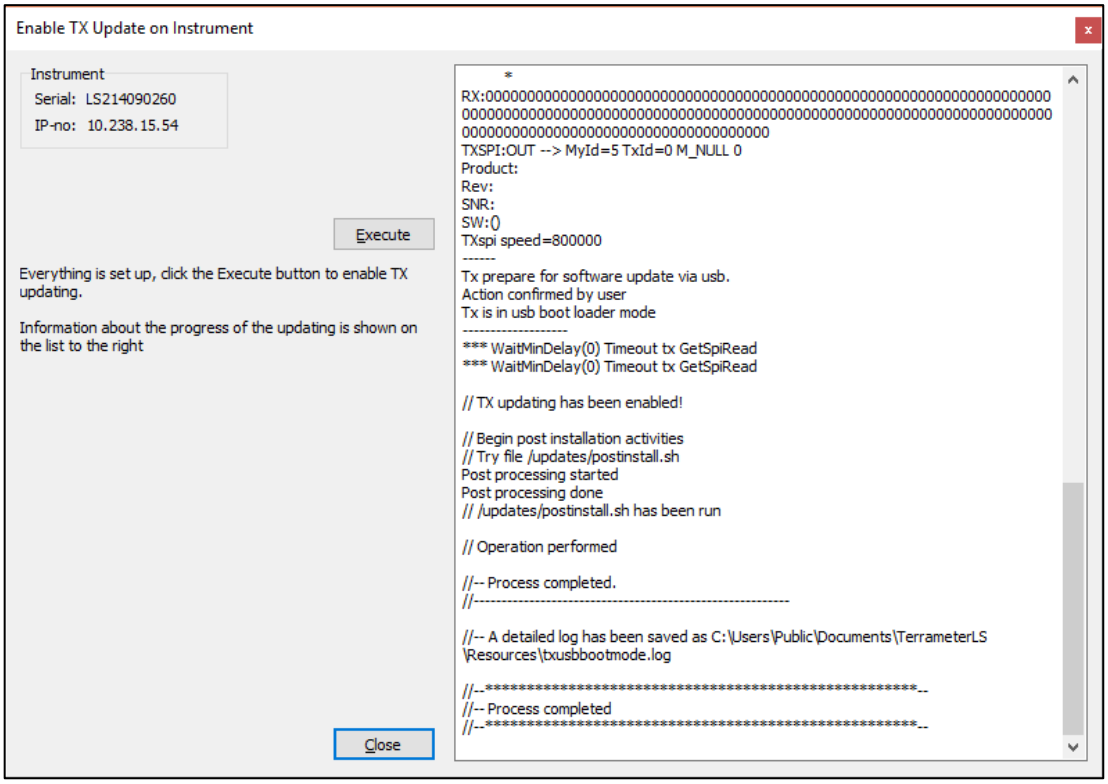


Figure 18. Enable TX Update on Instrument

Once the current transmitter is in programming mode, it can be programmed using a separate software called SAM-BA. See separate update guide for instructions.


Enable TX Update on Instrument
Instrument
Serial: LS214090260
IP-no: 10.238.15.54
Execute
Everything is set up, click the Execute button to enable TX updating.
Information about the progress of the updating is shown on the list to the right
Close
*
RX:0000000000

If the script file is not automatically found the LS Toolbox will open a different dialogue (Figure 20) that allows the user to manually select the script file by pressing the *"..."* button. If LS Toolbox has been installed correctly, a script file called "*txusbbootmode.tar*" should be found in the folder "*C:\Users\Public\Documents\TerrameterLS\Resources*". Once the script file has been selected the *Execute* button can be pressed for setting the current transmitter in programming mode.

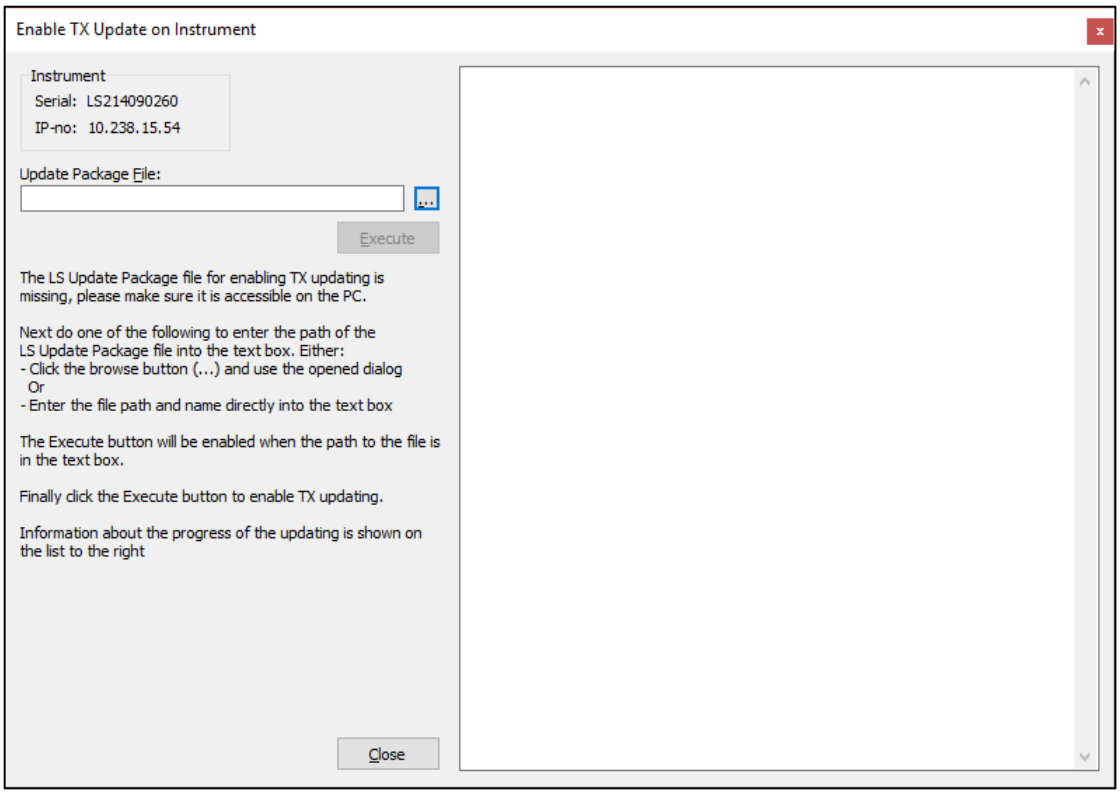


Figure 20. Manually select TX Update script file

4.5 Setting Timezone and Time

The Terrameter LS will upon delivery be pre-set to a time and timezone according to the known information about the end user. If this information was not correct or if the time needs to be changed the *Change Timezone & Time* dialog (Figure 21) can be used. The dialog is opened by right-clicking on the tree node of the instrument and selecting *Set timezone and time*. The time and timezone information installed on the instrument will be read and depending on how many time zones are installed this can take a little while.

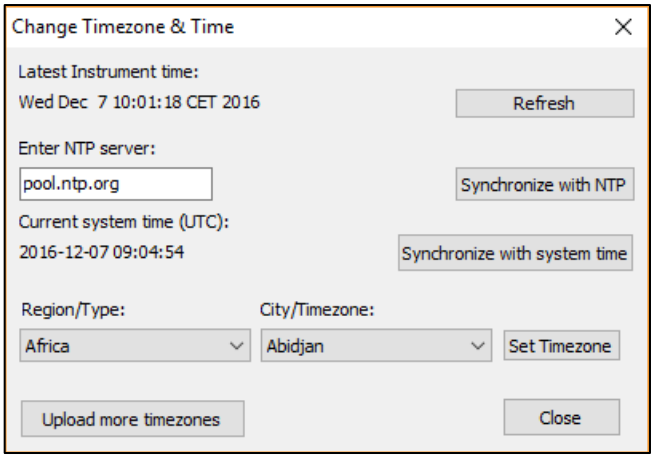


Figure 21. Change Timezone & Time dialog

The time is set by pressing one of the two *Synchronize* buttons. To change the timezone start by selecting a *Region/Type* and then select a *City/Timezone*. Finally press the *Set Timezone* button. The *Refresh* button will read the clock from the instrument and update the *Latest Instrument time* to the left.

Note!	Only the larger cities will be present in the list. If you can't find the exact one you are located in, select the closest one.

Note!	If there are very few Regions or Cities available in the drop down list this may be because not all timezone packages have been installed in the Terrameter LS. To install all current timezone packages press the button *Upload more time zones*. This will take a little while so please be patient. Once installed it is necessary to close and reopen the *Change Timezone & Time* dialog.

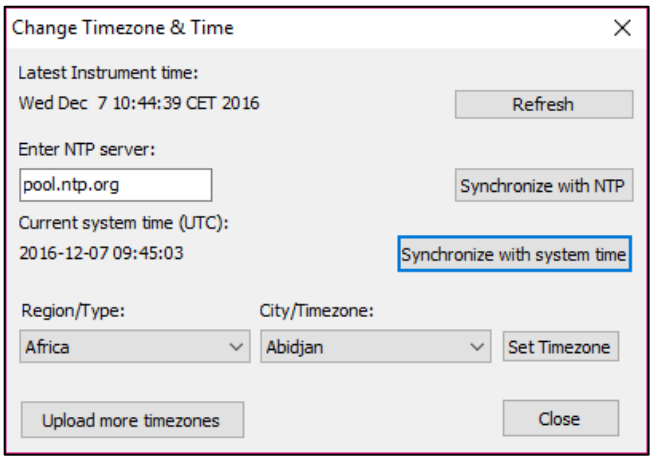


Figure 22. Synchronizing with system time

Figure 23. Synchronizing completed

5 Data Management and Post-Processing

5.1 Project Management

In order to open data in Terrameter LS Toolbox the data must first be added to a project group. A project group can contain one or several Terrameter LS projects. It is possible to combine projects from different instruments in a project group. Start by right-clicking on *Project Groups* and select *Create Project Group* (Figure 24). Now give the new project group a descriptive name, e.g. the name of the investigation site (Figure 24).

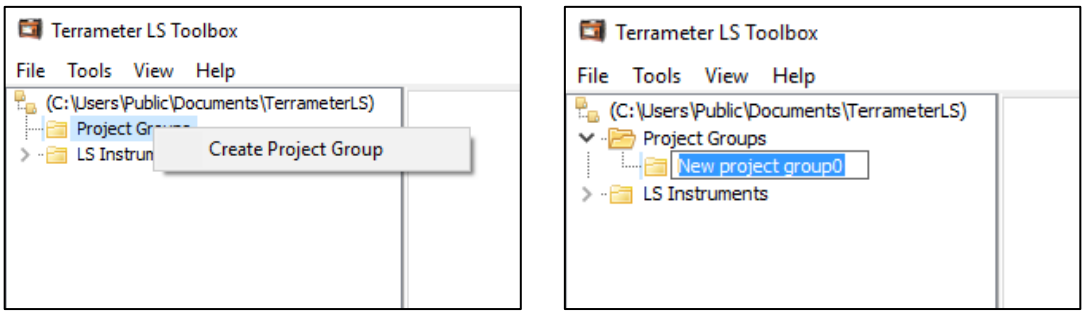


Figure 24. Project Groups context menu (left) and a newly created project group

Projects imported from LS instruments (see chapter 4.2) are then added to the project group by selecting *Add Project* from the context menu (Figure 25).

Note!	A database can also be imported directly from an instrument into a project group (see chapter 4.2)

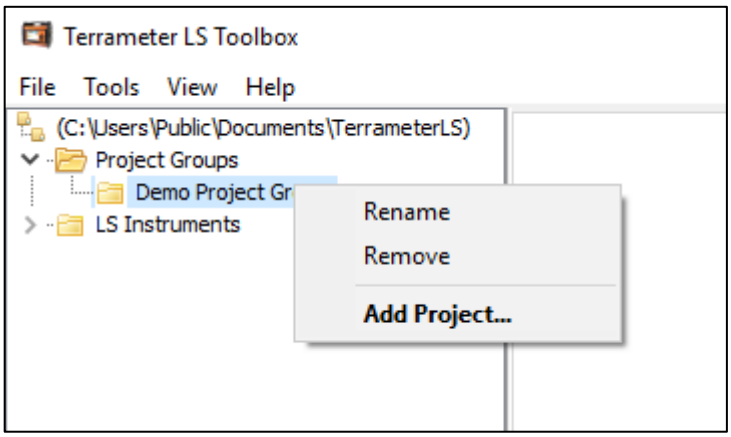


Figure 25. Context menu of a project group

Once this is done the project and its tasks will be displayed in the tree structure. Added projects will automatically be expanded, but can be collapsed by pressing the down arrow in front of the Project (Figure 26). The project context menu (Figure 27) has a *Summary* item that opens a summary page to the right (Figure 28). When a project is selected the properties section in the lower left corner of LS Toolbox shows a short summary of the project (Figure 29).

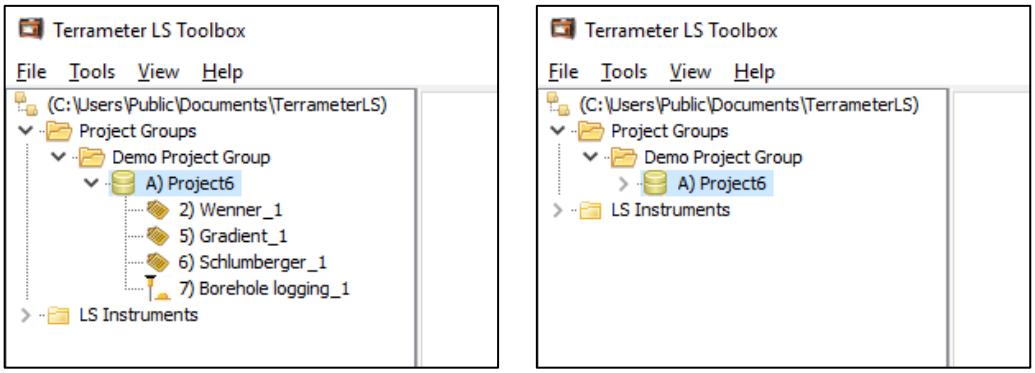


Figure 26. Expanded and collapsed Project

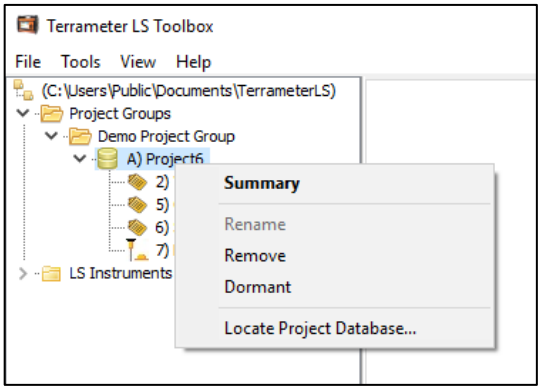


Figure 27. Project context menu

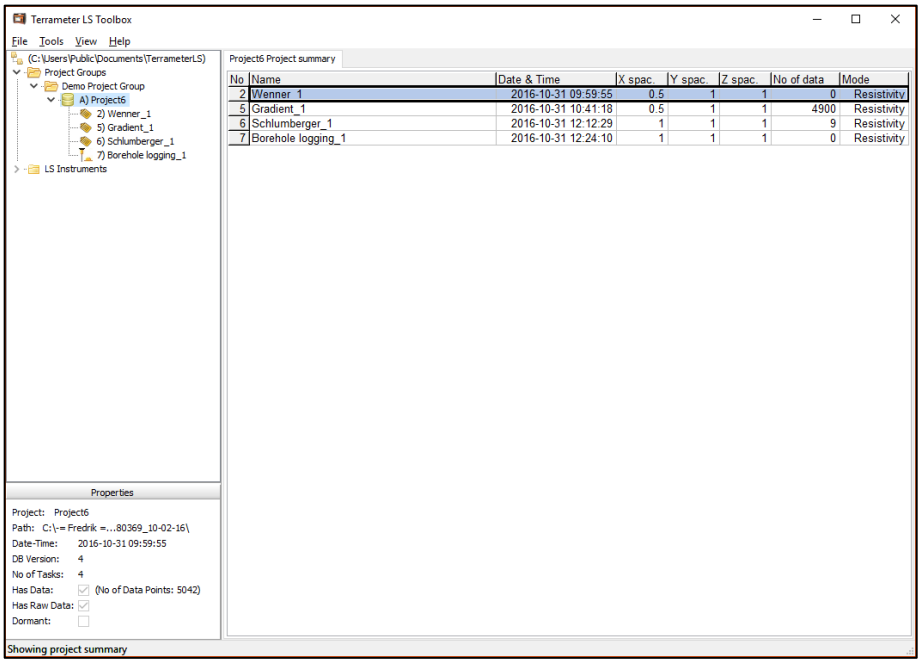


Figure 28. Project Summary page

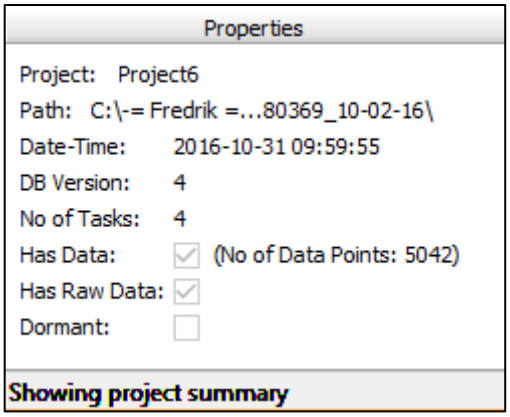


Figure 29. Properties section showing project summary

In the project context menu projects can also be removed from the project group, by selecting the option *Remove.* By selecting *Dormant* in the project context menu, projects can be marked as inactive (*Figure 30*).

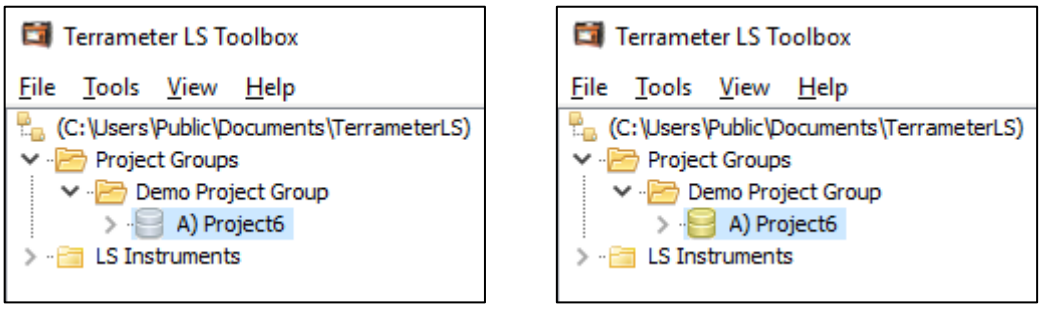


Figure 30. Dormant and active project

By clicking the project context menu option *Locate Project Database* the Windows File Explorer will be opened, showing the folder in which the project database is located.

5.2 Task Data Post-Processing

The data of a task can be displayed and acted upon in various ways. This is done by right clicking on the task node in the tree (Figure 31) and selecting a menu item on the displayed context menu.

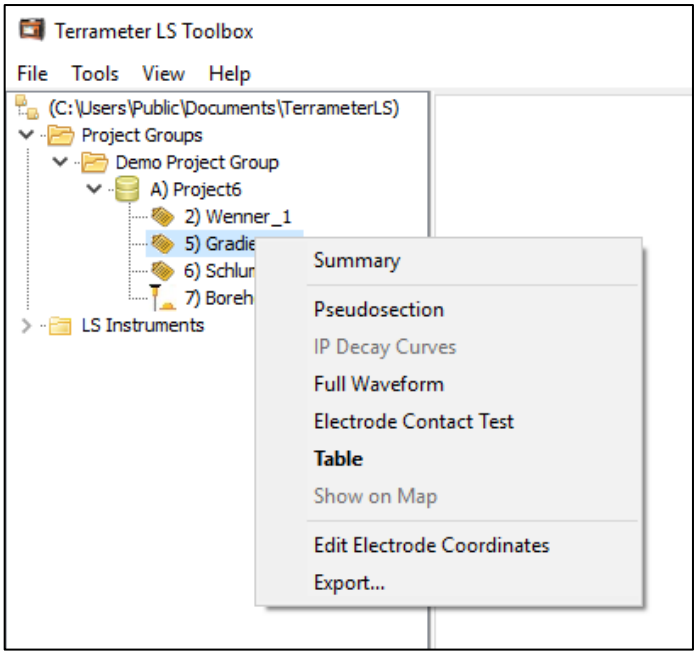


Figure 31. Right-click context menu of a task

Clicking on *Summary* will show a page similar to the one in Figure 32.

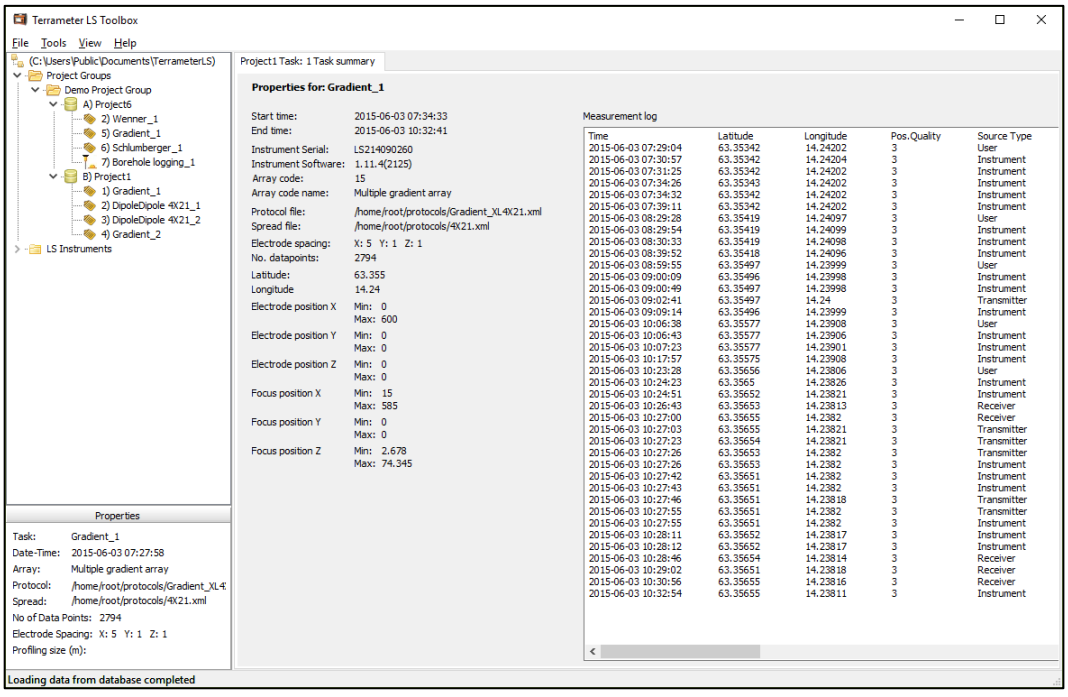


Figure 32. Task Summary page

Before viewing the task data, e.g. as a pseudo section, bad data points can be filtered away. Filtering is done via the *Table* context menu item (see chapter 5.2.1).

All task context menu items are explained in the following subchapters.

5.2.1 Table

The *Table* page (Figure 33) displays the data points of a task in a list. The checkboxes on the *Show data* panel on the right hand part of the page can be used to deselect or select which columns to show in the table. Any changes will be visible directly in the table. Besides the visible change this can also be used to decide which data point's values to export (see chapter 5.2.2). The *Show data* panel can be shown/hidden with the button at the top right corner (Figure 34).

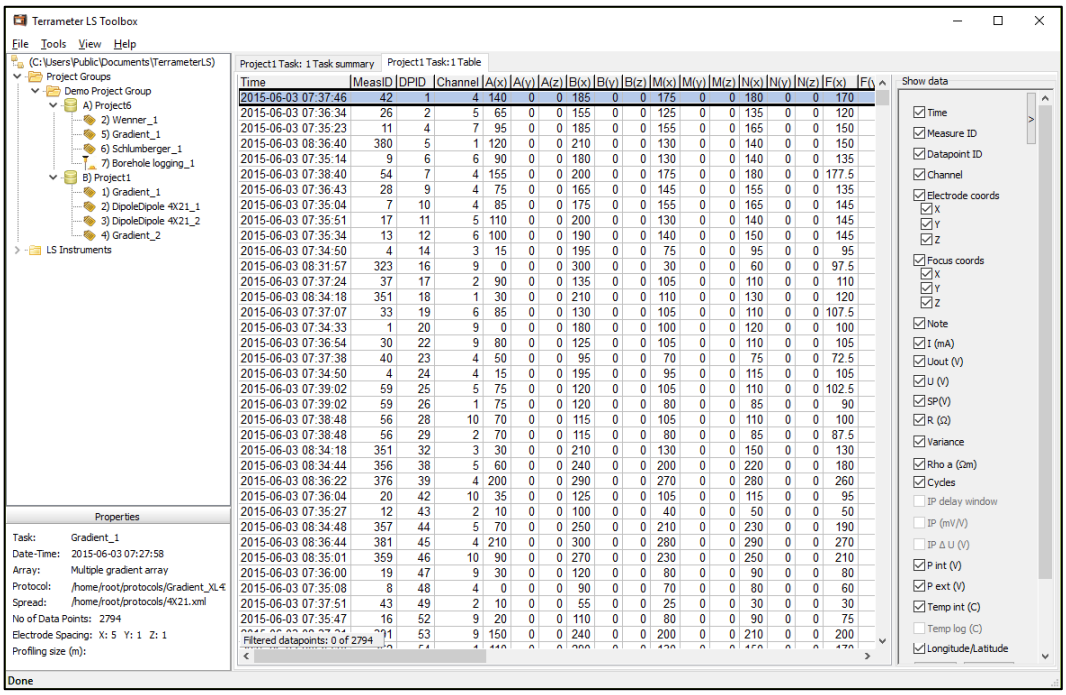


Figure 33. The View in Table page

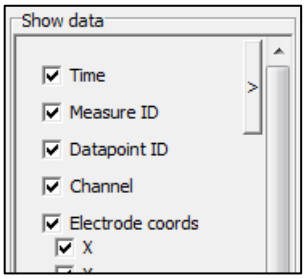


Figure 34. The show/hide button at the top right

The data can be sorted in increasing or decreasing order by left clicking on the table header of the column to sort on. This can, for example, be used to identify and filter away data points with anomalously high or low apparent resistivity or chargeability. Right-clicking anywhere in the table will show a context menu (Figure 35) with items to perform actions on the selected data points.

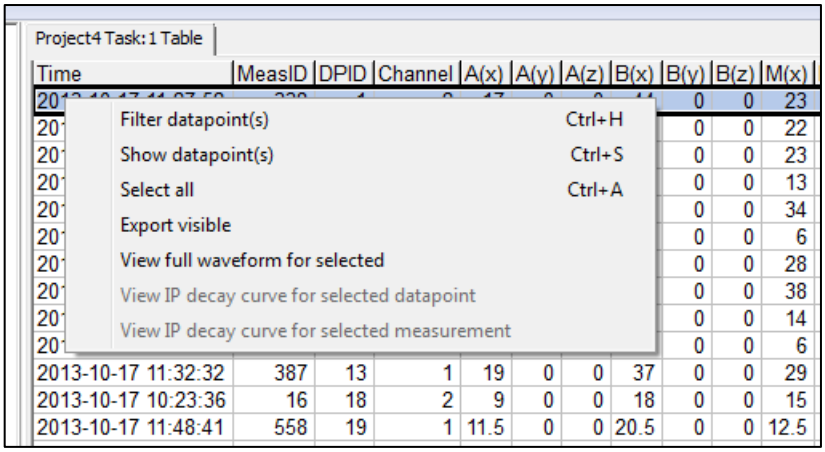


Figure 35. The right click context menu of the data table

Note!	One or more data points can be selected using the shift and control keys combined with mouse clicks in the standard Windows way (Figure 36).

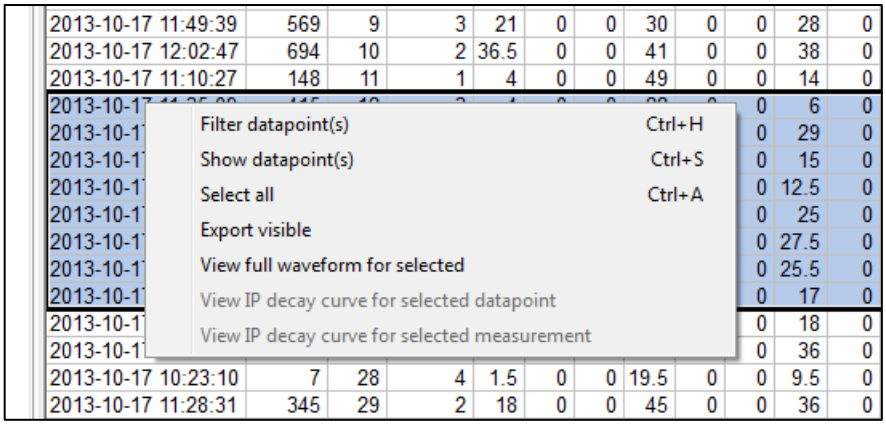


Figure 36. Several data points can be selected and filtered away at the same time

The context menu has the following items:

- *Filter datapoint(s):* will filter out the selected data point(s) from the handled data point set
- *Show datapoint(s):* will restore the selected data point(s) to the handled data point set
- *Select all:* selects all data points
- *Export visible:* will export the current data point set using the *Data Export* dialog (see chapter 5.2.2). The *Export only visible columns* checkbox will be checked.
- *View full waveform for selected:* will open the *Full Waveform* page for the first selected data point in the table
- *View IP decay curve for selected data point:* will open the *IP Decay Curve* page for the first selected data point in the table
- *View IP decay curve for selected measurement:* will open the *IP Decay Curve* page for the first selected measurement in the table

5.2.2 Export

The *Data Export* dialog can be invoked directly from the task in the project tree view or from the data point list (see chapter 5.2.1). In the *Data filter options* panel of the dialog it is possible to filter the exported data. E.g. according to type of electrode array and whether to include IP data or not (only enabled if the data set contains IP data). The export format is set in the *Filetype* panel.

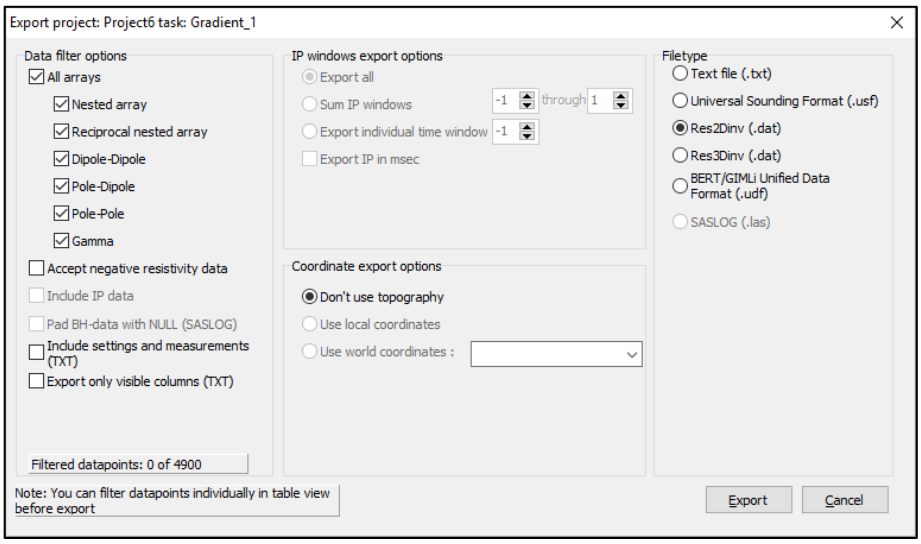


Figure 37. Data Export dialog

5.2.3 View Electrode Contact Test

The electrode contact test can be viewed as a diagram (Figure 38), with option to plot with linear or logarithmic resistance scale. Right click to bring up export options for the diagram as graphics or as the contact resistances in a text file (Figure 39).

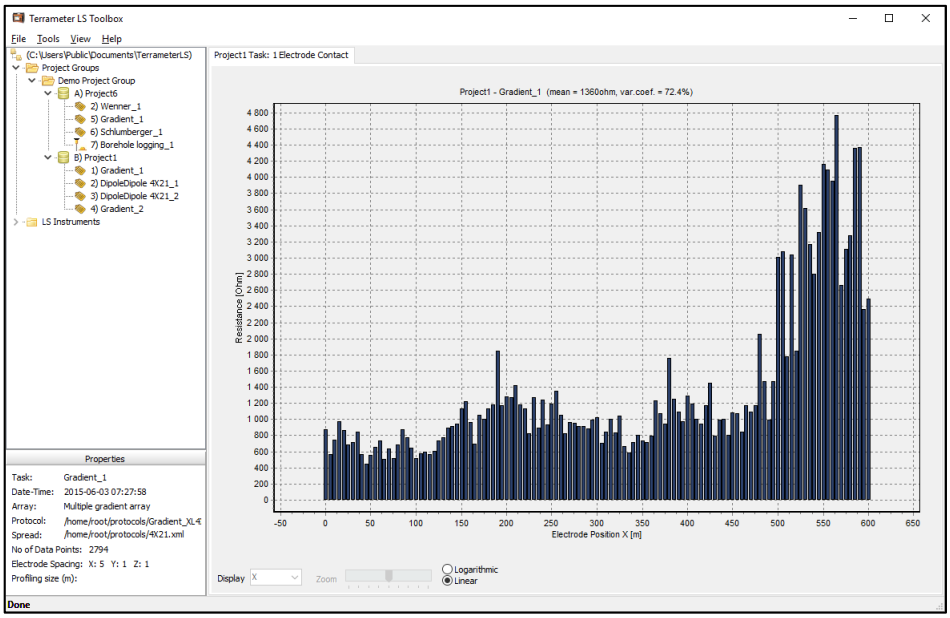


Figure 38. Electrode Contact diagram page

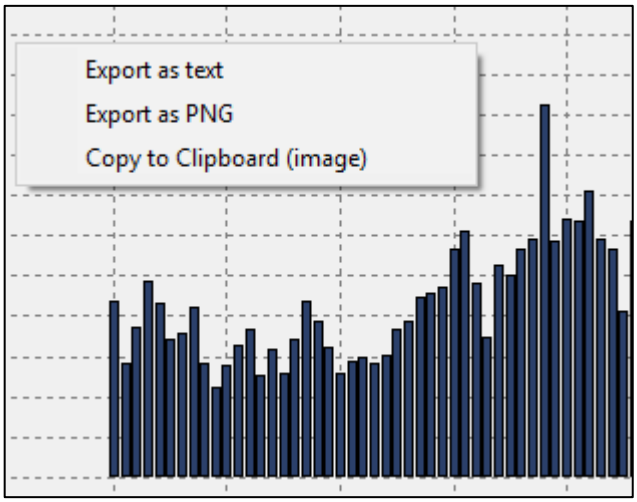


Figure 39. Right click to bring up export menu items

5.2.4 Show on Map

The geographical location of the measurement task can be plotted on a map using the *Show on Map* function (Figure 40). This menu item is accessible via a right-click on the tree node of the task. This function will only be available if it has been possible for the built-in GPS to read signals from GPS satellites, hence it will not work for data recorded indoors or for example under a tree canopy. This function also needs access to Google Maps via the Internet to work. It is possible to use the standard features in Google Maps such as zooming in the map and plotting as satellite image instead of map.

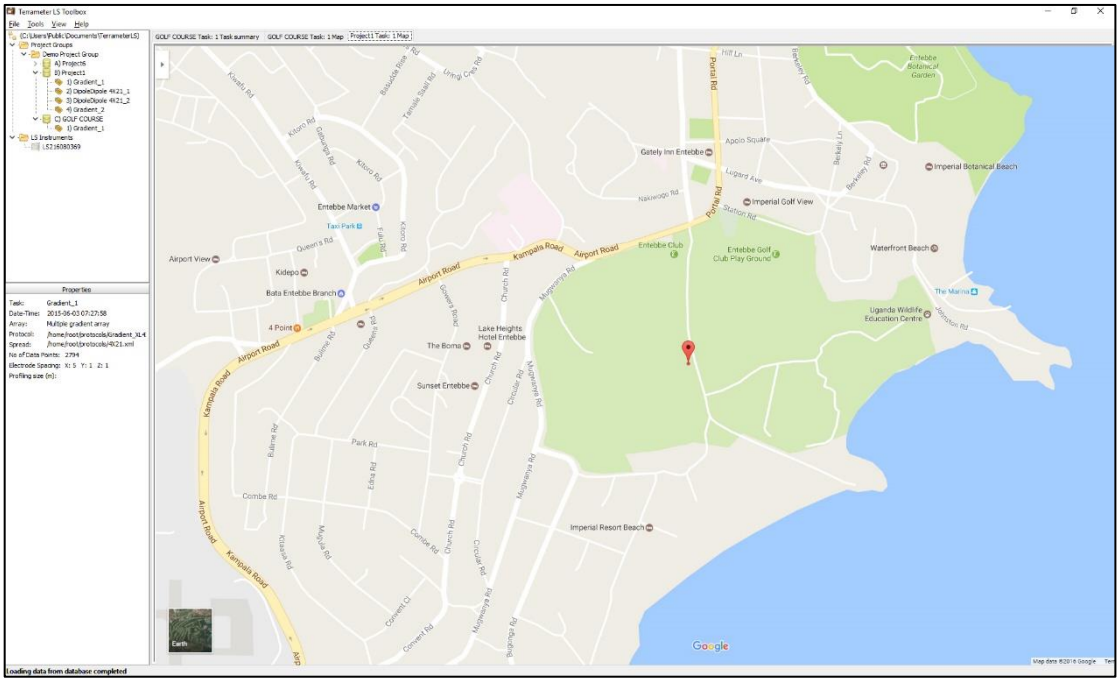


Figure 40. Map view of task location according to the built-in GPS

5.2.5 View Pseudosection

The pseudo section plot (Figure 41) function is also reached via right-click on the tree node of the task. On the right side of the plot window there is a menu for setting up plot options. E.g. the choice between plotting apparent resistivity (Figure 41) or apparent chargeability (Figure 42) is made here.

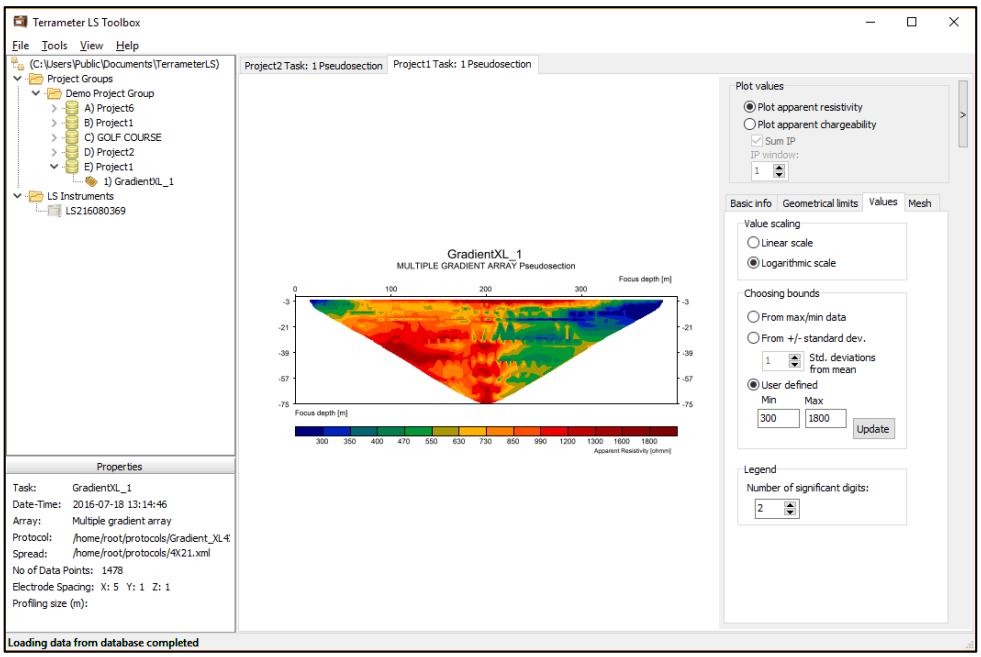


Figure 41. Pseudo section view of apparent resistivity with plot option menu visible.

Apparent chargeability (IP effect) can be plotted for individual IP time windows or the sum of all time windows.

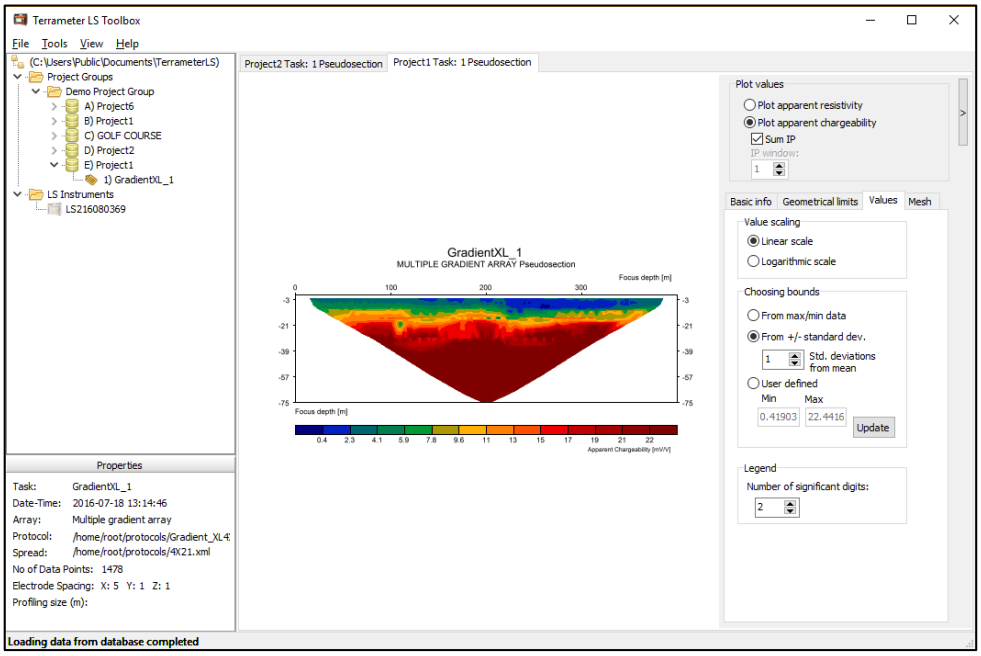


Figure 42. Pseudo section view of apparent chargeability (IP-effect) for sum of IP time windows

There are four tabs for setup of pseudo section plot options (Figure 43).

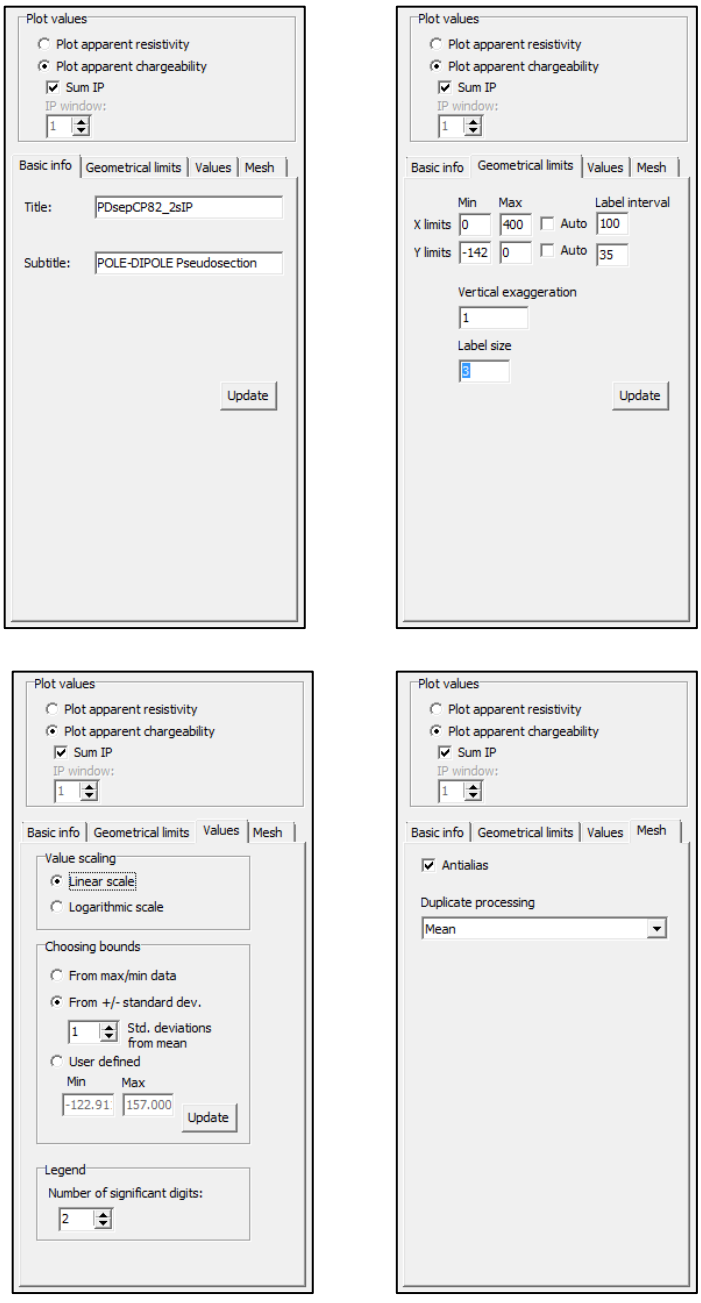


Figure 43. Plot option tabs for pseudosection view.

Note!	The software Erigraph is recommended for pseudosection plotting for reports and presentations. It is also useful for plotting inverted model sections from Res2dinv, in order to make consistent presentations in cases with more than one section from a site. Inverted models should be exported in Lund-format. Erigraph can be downloaded from *www.guidelinegeo.com* .

5.2.6 Full Waveform

Note!	Full waveform recordings of the data can only be plotted if the option for saving such data was enabled during the field data acquisition, and that the data was imported from the Terrameter LS.

The *Full Waveform* page (Figure 44) is opened either by right-clicking on the tree node of the task and selecting *Full Waveform* from the context menu or by right-clicking in the *Data Table* list (see chapter 5.2.1). In the latter case only the first selected data point or measurement is shown.

By default the diagram shows the transmitted current (black line) and the active input channels (curves in different colours), as shown in the legend on the right side of the diagram. It is possible to go to a particular measurement number via the combo box in the lower left side of the diagram, and it is possible to step up and down between the measurements of the task using the up and down arrows when the combo box has the focus.

If several measurement channels were used it may sometimes be useful to turn off plotting for one or several of the measuring channels to improve the clarity of the plot.

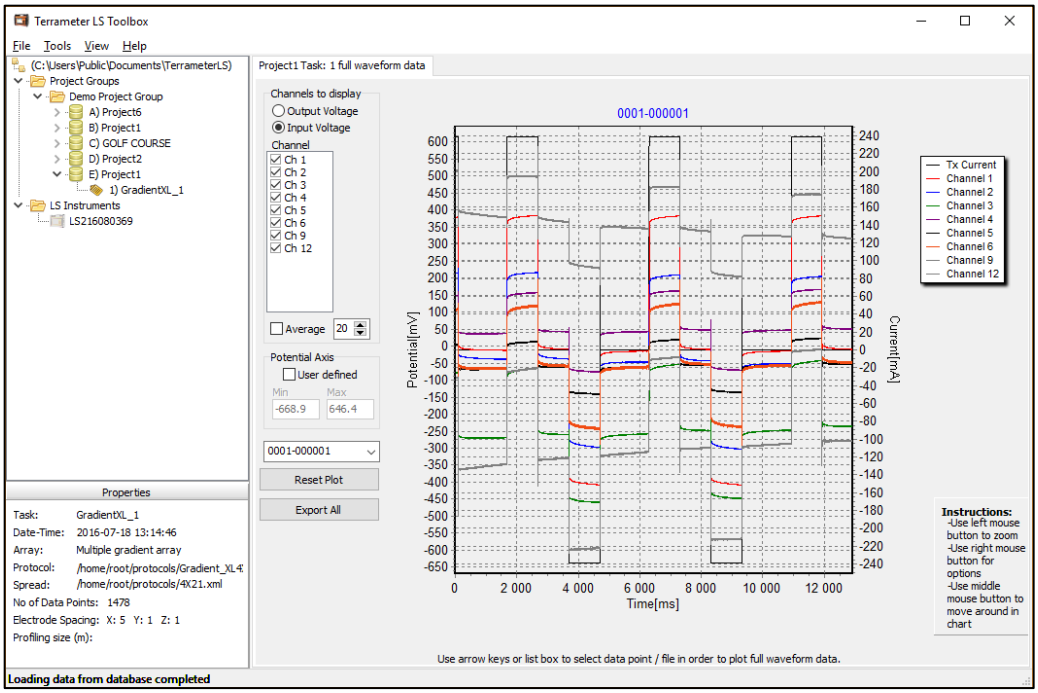


Figure 44. Full waveform plot showing transmitted current and received voltages for the active input channels.

It is possible to zoom in the diagram by using the mouse (Figure 45). Place the pointer and press down the left mouse button while selecting the area to zoom in on.

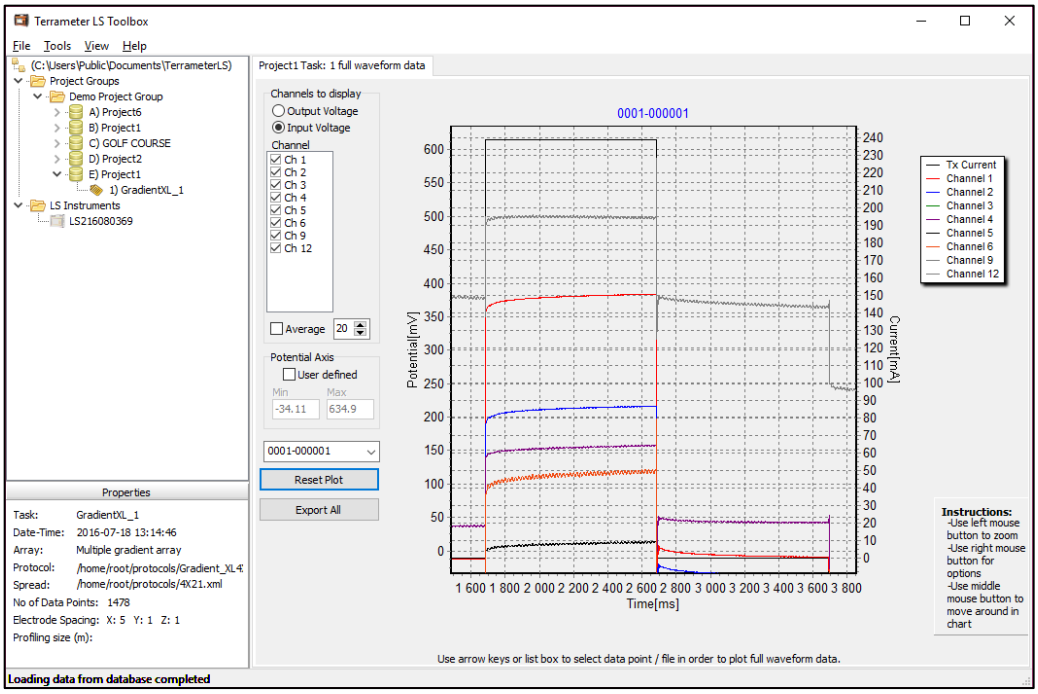


Figure 45. Zoom-in view of full waveform data. Zoom by selecting part of diagram with left mouse button pressed.

Instead of voltages measured by the input channels the output voltage from the transmitter can be plotted along with the transmitted current (Figure 46).

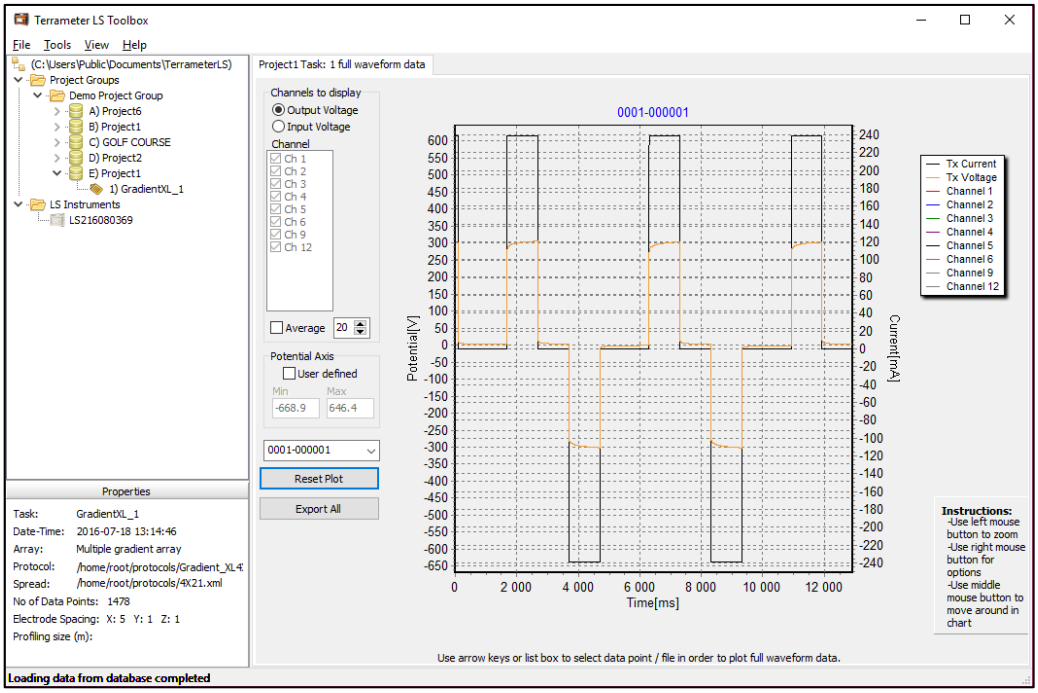


Figure 46. Full waveform plot showing transmitted current and output voltage for the transmitter.

By right clicking on the diagram a summary of the electrode geometry can be shown with the *Show Info* menu item (Figure 47). This is also the way to access export of the diagram to the clipboard or as graphic file, and to export the full waveform data as a text file.

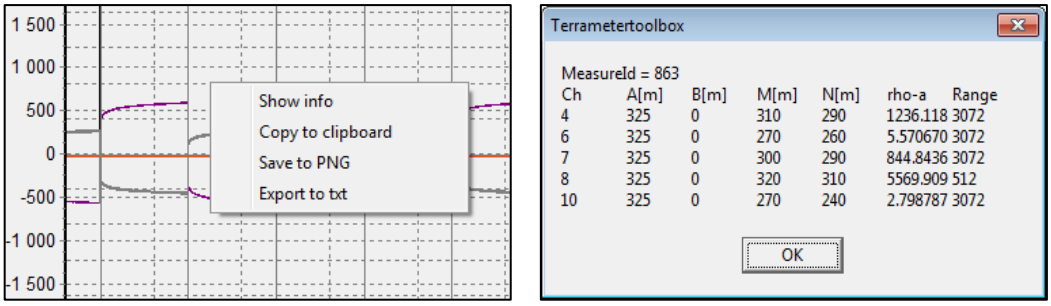


Figure 47. Electrode geometry information accessed via right click on full waveform diagram and clicking the Show Info menu item

5.2.7 View IP Decay Curves

The *IP Decay Curves* page (Figure 48) is opened either by right-clicking on the tree node of the task and selecting *View IP Decay Curves* from the context menu or by right-clicking in the *Data Table* list. In the latter case only the first selected data point is shown. It is possible to go to a particular measurement number via the combo box in the lower left side of the diagram, and it is possible to step up and down between the measurements of the task using the up and down arrows when the combo box has the focus.

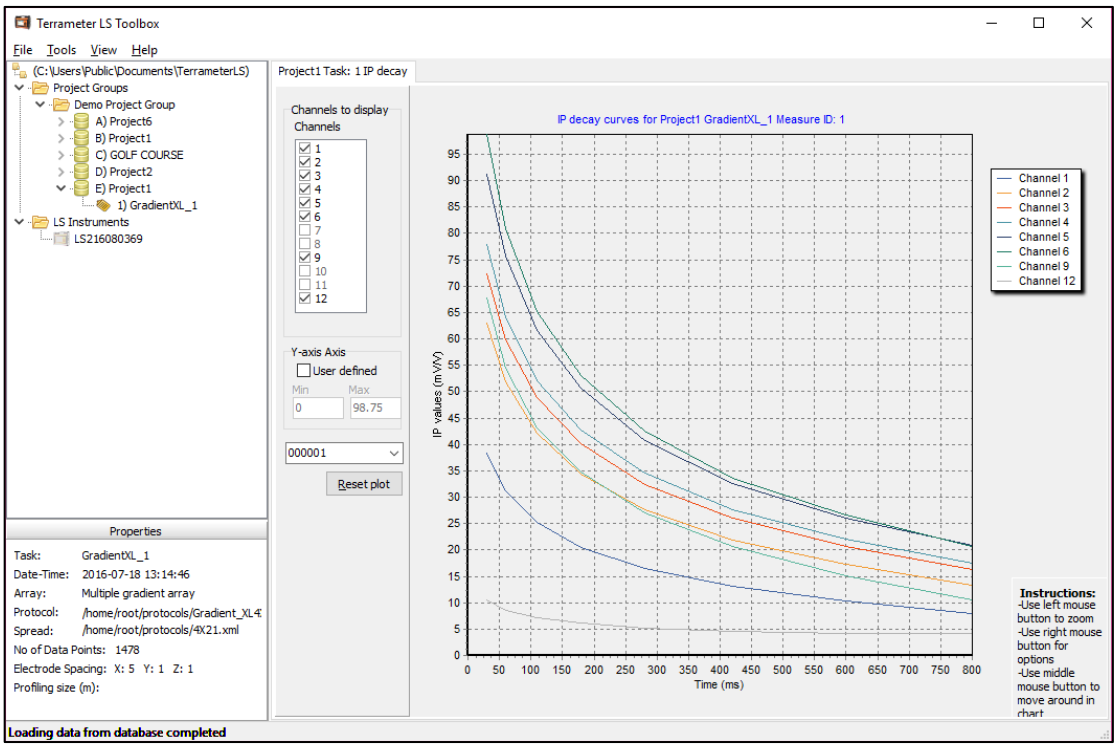


Figure 48. IP decay curves.

By right clicking on the diagram it can be exported to the clipboard or as a graphic file (Figure 49).

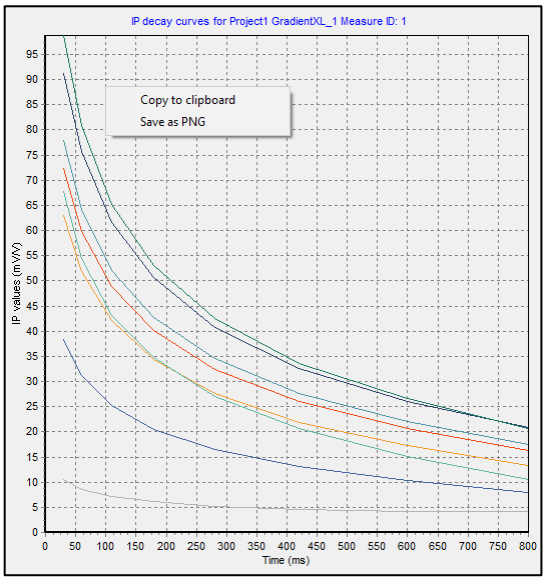


Figure 49. Context menu items

5.2.8 Edit Electrode Coordinates

The *Edit Electrode Coordinates* page (Figure 50) can be used to add additional coordinate information, such as topography, to tasks. This page is opened by right-clicking on the tree node of the task and selecting the *Edit Electrode Coordinates* menu item.

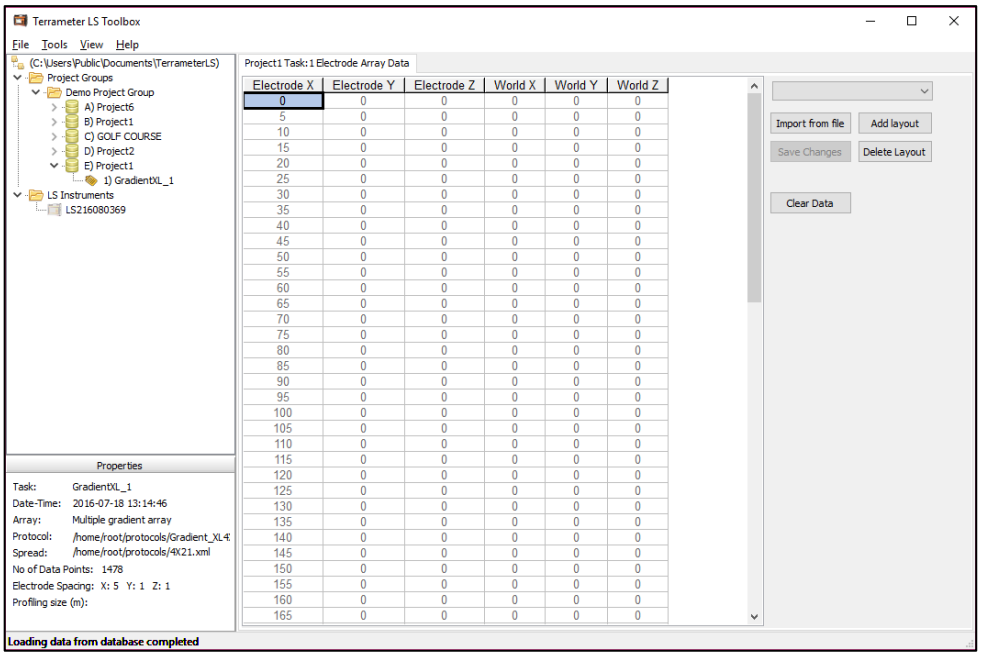


Figure 50. Edit Electrode Coordinates page

To add topography either import topography information from a file, or press the *Add layout* button to add the topography data directly into the list. To import topography information from a file press the *Import from file* button. In the open box select to open files of the type "Topography text files (*.txt)" and select the file with the topography information. When the data has been imported they will be shown in the columns "World X" and "World Z". The X values are assumed to be from the start of the cable spread. If needed to show the values from a horizontal view it can be changed in the drop list and the "World X" values will be recalculated.

A topography text file uses the following format

```
0  0
5  0.5
10 1
15 1
20 1.5
25 2
```

The first column is the X value (meters along your cable spread) and the second column is the elevation value. The elevation value can be a relative value (starting at zero and changing up or down along the profile) or an absolute value (e.g. meters above sea level).

To use the LS Toolbox to add topography press the button *Add layout*. It is now possible to edit the columns "World X" and "World Z". The X value is the meters along your profile, and the Z value is the elevation value for that X coordinate.

Note!	The elevation value cannot change more than the distance between the current and previous X value, the inclination/declination cannot be more than 45 degrees. E.g. in the above example of a topography text file the elevation for the fourth row cannot be more than 6, as the delta X value is 5 and the previous elevation value was 1.

6 Main Menu

The main menu of *Terrameter LS Toolbox* has four top menus (Figure 51).

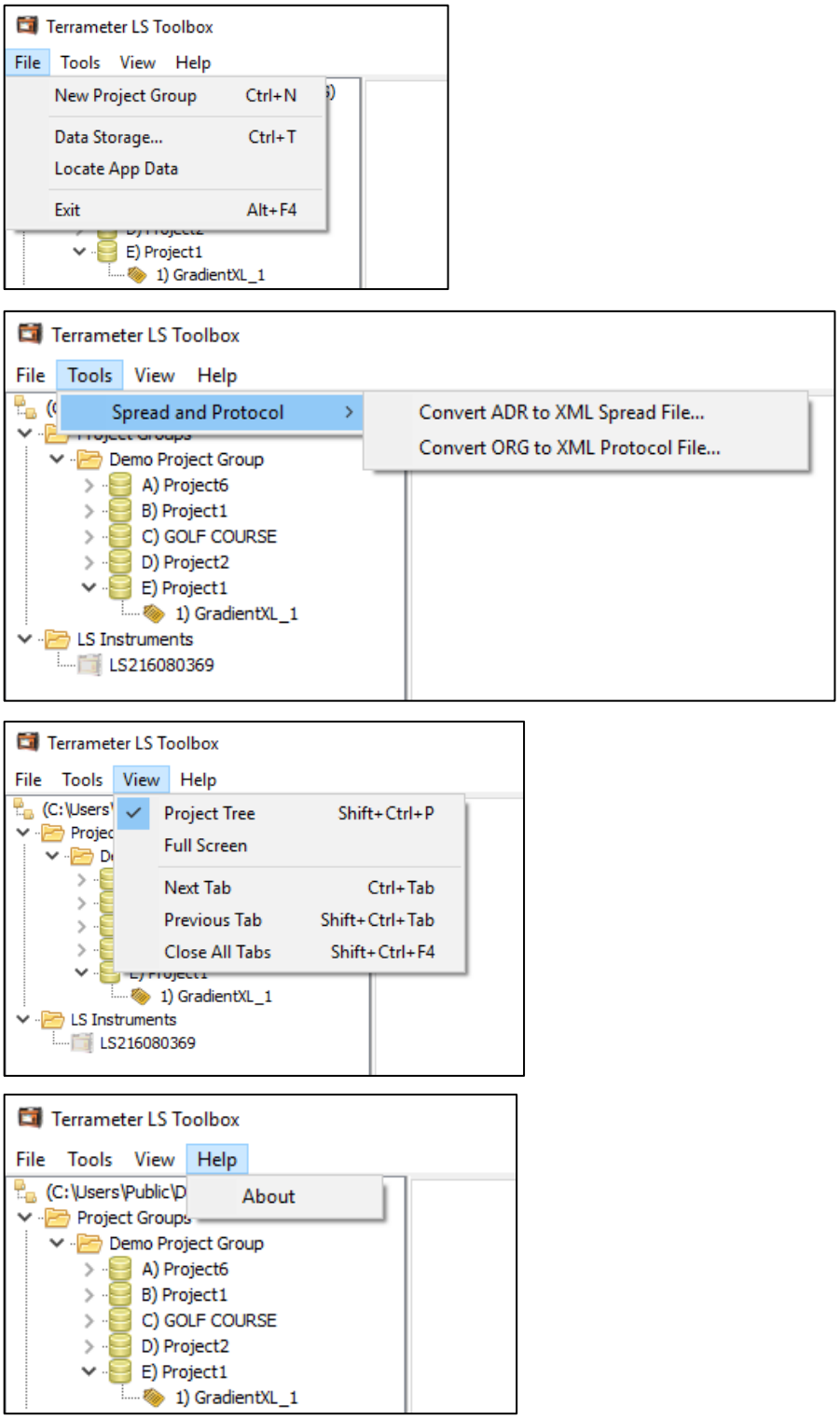


Figure 51. The Main Menu

File	Contains items for creating a new project group, opening the settings dialog for data storage, locating the application setting files and exiting the program
Tools	Contains items for converting ADR and ORG files and to view spreads and protocols residing on the PC (see chapters 6.1-**Error! Reference source not found.**)
View	Contains items for handling the tabs (navigating and closing) and to hide/show the tree.
Help	Contains information about the software

It is also possible to close and open the tree view, which may be useful in order to gain lager data views on small computer screens.

There are built-in tools for converting spreads and protocols into the XML format used by Terrameter LS. The input files for these conversion routines must be in the same format that is used by Terrameter SAS1000 / SAS4000.

6.1 Conversion of ADR to XML Spread File

The input files for this conversion routine must be in the ADR format that is used by the Lund Imaging System based on Terrameter SAS1000 / SAS4000. The format is described in Appendix C of the instruction manual for Terrameter LS. Please read this appendix carefully before attempting to create your own spread files.

The spread file is always the same for a specific cable configuration regardless of the electrode spacing. Hence this routine will only be needed if cable sets different than the types ones delivered by ABEM, or if a set of standard cables are configured in a different way than the standard spread. The spread file in ADR format can be created in a text editor or spread sheet, and it may be convenient to do it by modifying a copy of an existing spread file.

The conversion routine is activated via the Start button (Figure 52) and selecting the input file and the output file name and destination. Make sure that the output file is saved in the desired location.

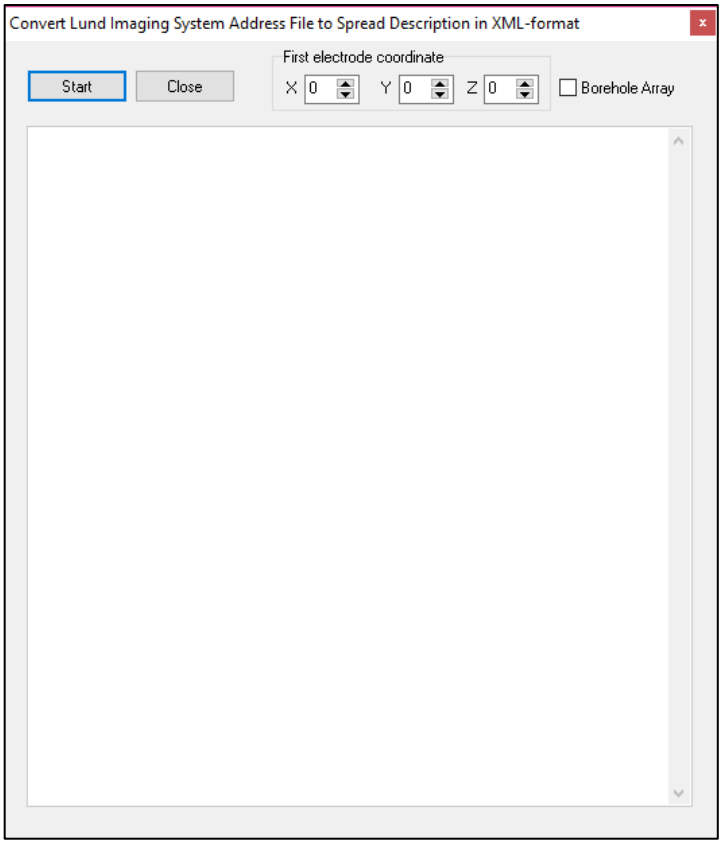


Figure 52. ADR to XML spread file conversion dialog before conversion

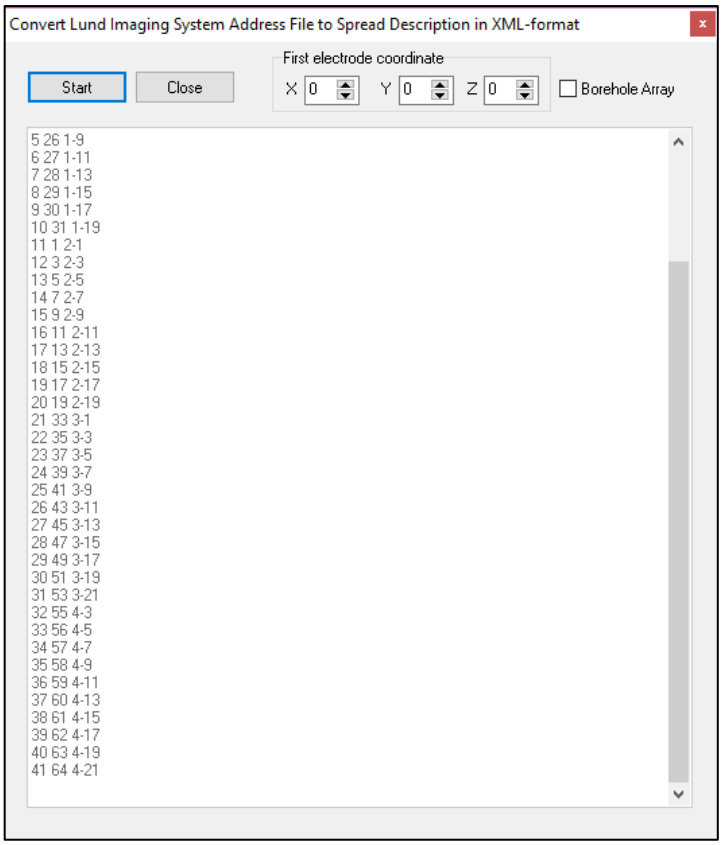


Figure 53. ADR to XML spread file conversion dialog after conversion

6.2 Conversion of ORG to XML Protocol file

The input files for this conversion routine must be in the ORG format that is used by the Lund Imaging System based on Terrameter SAS1000 / SAS4000. The format is described in Appendix C of the instruction manual for Terrameter LS. Please read this appendix carefully before attempting to create your own protocol files.

The protocol file is always the same for a specific measuring sequence cable configuration regardless of the electrode spacing. The protocol file in ORG format can be created in a text editor or spread sheet, and it is also possible to use the Terrameter SAS4000 Utility Software. If the latter is used it is recommend that the protocol is saved as a 4 channel protocol.

The sequence of the measurements is important for the possibility to make use of the multi-channel capability of the instrument. All measurements that use the same current electrode combination should follow immediately after each other in order for them to be measured during the same current transmission. If more measurement points are listed than the available measuring channels they will be measured in a sequence following after each other in a sequence optimised by the instrument software. It is also important to design the measuring sequence in order to avoid using an electrode as potential electrode immediately after using it for transmitting current. The electrodes are charged up when transmitting current through them and the decay is initially strongly exponential, which may affect data quality adversely even if SP compensation is automatically carried out.

The conversion routine is activated via the Start button (Figure *55*) and selecting the input file and the output file name and destination. Make sure that the output file is saved in the desired location. The measuring sequence will be echoed in the text window, and if there are errors these will be reported otherwise the number of data points in the protocol will be specified. If the ADR file corresponding to the ORG file is present in the same folder the protocol will be checked against the spread. Otherwise a warning message will be issued, but it does not mean that there is any error in the protocol file.

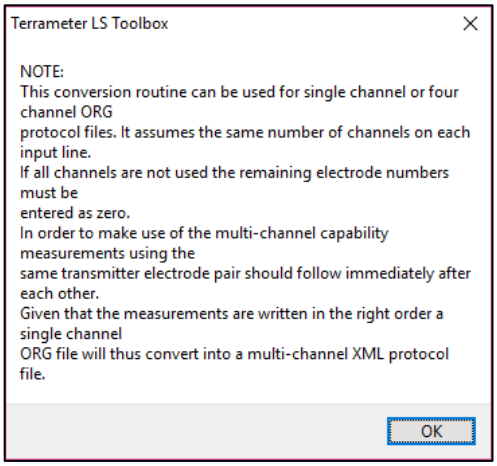


Figure 54. ORG conversion start dialog

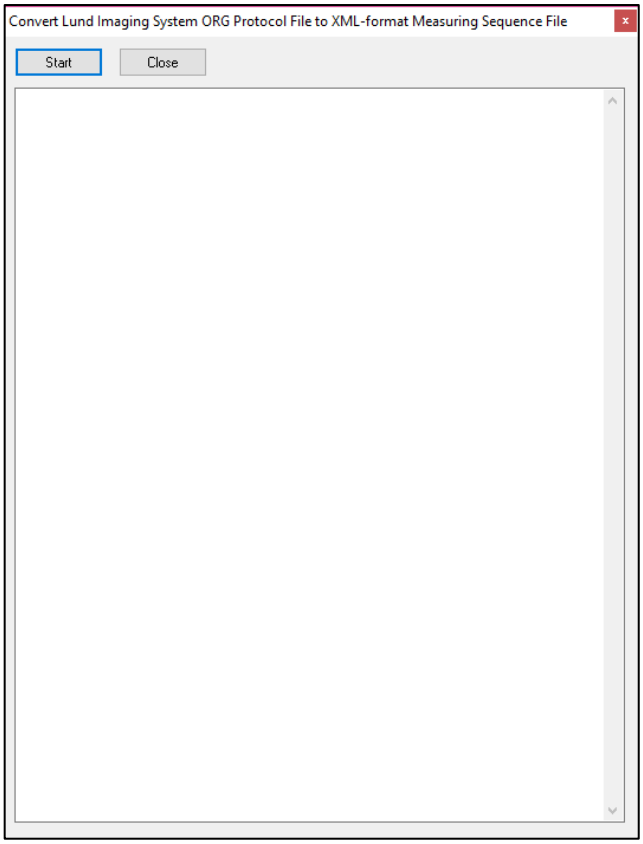


Figure 55. *ORG to XML protocol file conversion dialog before conversion*

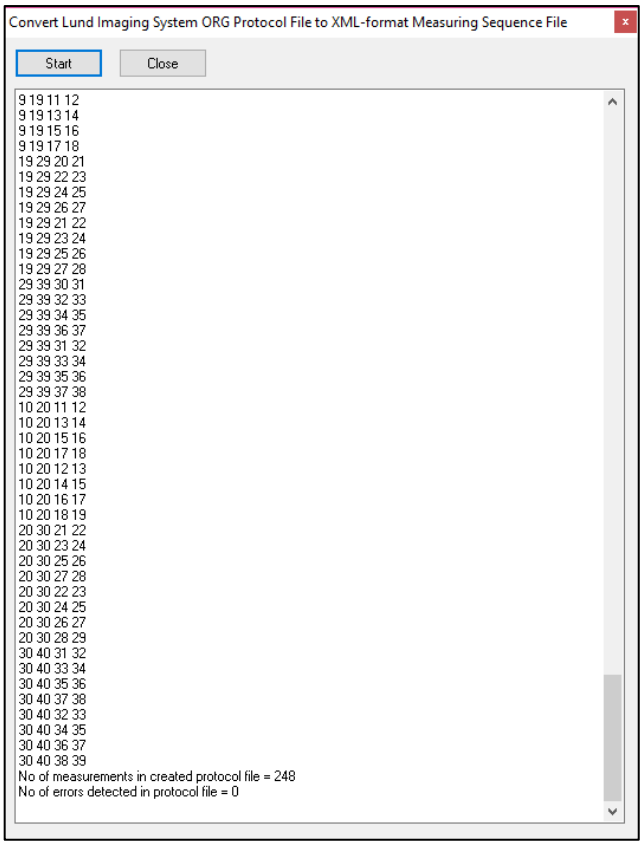


Figure 56. ORG to XML protocol file conversion dialog after conversion

6.3 Windows Display

The tree panel on the left side can be hidden or shown. This may be useful in order to see more of the tabs on the right side. There are three different ways to do this. Either use the View/Project Tree menu item, the Shift-Ctrl-P shortcut or use the mouse to drag the screen splitter between the two main parts of the program (the tree on the left and the tabs panel on the right).