

COMPUTER PROGRAM MANUAL  
(SURVEY DATA REDUCTION MANUAL)

# DAT38-4

Version 1.27

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# 1. Introduction

The survey data reduction program DAT38-4 is designed for use with Geonics EM38-4 ground conductivity meter data and operates on MS Windows 10, 11, and later versions. DAT38-4 supports EM38-4 data files, including Global Positioning System (GPS) data recorded directly on the Mesa2, Mesa3, Mesa4, or similar MS Windows 11/10-based field computer logger, under the control of the EM38-4 program.

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## 1.1 About DAT38-4

The DAT38-4 program is designed to process data collected on the field computer using the EM38-4 data acquisition program. It allows users to display, edit, recalculate inversions, and print data files. Data can be plotted on any Windows printer. Additionally, the program includes an option to create XYZ files that can be used as input for GEOSOFT, SURFER, or other contouring software. The format [X, Y, data1, data2, data3, ...] is suitable if three or more columns are required.

This Windows-based version of DAT38-4 provides an intuitive interface with on-screen information. The number of readings is limited only by the capacity of the computer's hard drive. It supports any printer or plotter compatible with Windows.

EM38-4 readings are organized into profile lines. Each profile line can consist of an unlimited number of readings and may contain up to 11 separate profiles, including:

- Eight Quadrature (Conductivity) and In-phase components for each of the EM38-4 coil separations (0.5 m, 0.75 m, 0.88 m, and 1.0 m) labeled as Coil #1, Coil #2, Coil #3, and Coil #4.
- Three optional real-time or recalculated inversion results (Thickness, Conductivity for Layer #1, and Conductivity for Layer #2).

*Note: The Quadrature component is generally referred to as "Conductivity" in this manual.*

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## 1.2 Contents of the DAT38-4 Distribution Disk

The DAT38-4 program is supplied on a USB memory module or CD, or it can be downloaded from the Geonics website. The USB/CD contains the following files and directories:

- SetupDAT38-4.exe: Setup program for DAT38-4.
- Documentation: Directory containing manuals in PDF format.
- SetupEM38-4.exe: Setup program for the data acquisition software for the field computer.

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## 1.3 DAT38-4 Software Installation

To install DAT38-4, exit all Windows applications before beginning the process.

1. Use Windows Explorer to locate the SetupDAT38-4.exe file in the USB/CD folder or the download location (Figure 1.1). Double-click the file to launch the setup program.

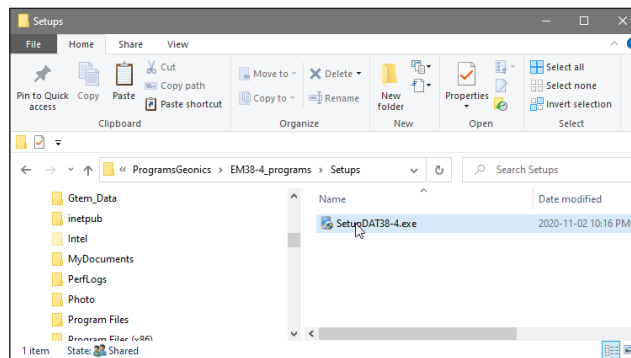


Figure 1.1 Starting setup program

2. The Welcome window will appear After determining your computer's configuration (Figure 1.2). Click Next to proceed.

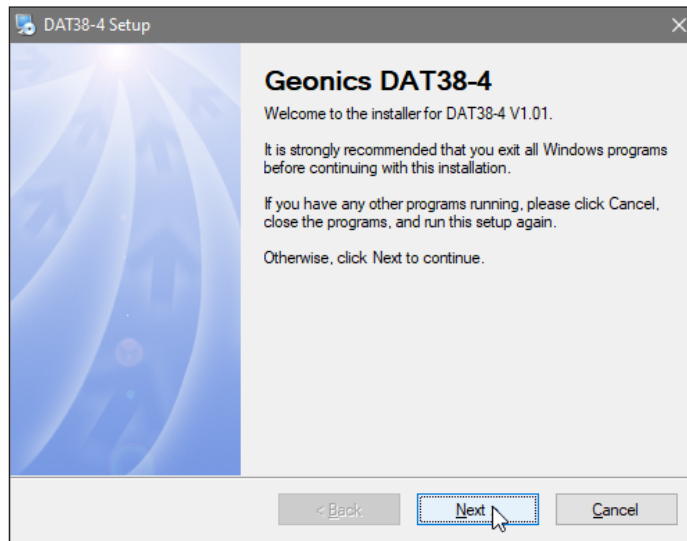


Figure 1.2 Welcome window

3. Enter the serial number in the Serial Number window (Figure 1.3) and click Next.

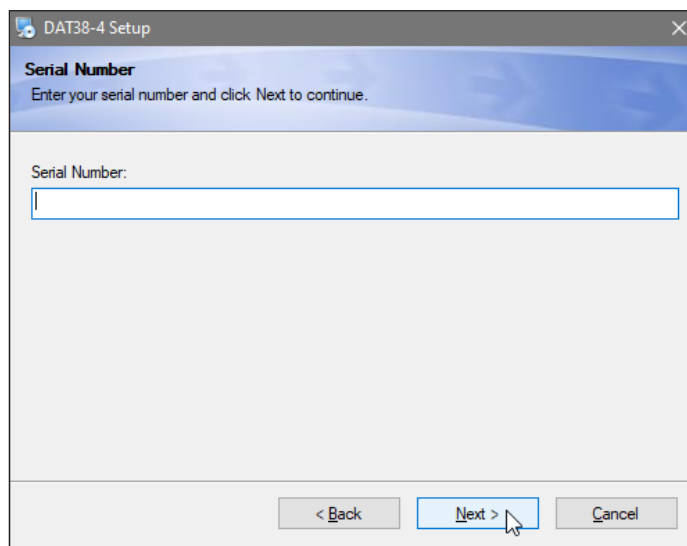


Figure 1.3 Serial Number Entry window

4. The Installation Folder window will appear (Figure 1.4). The program will default install in C:\Program Files (x86)\DAT38-4. Click Next to confirm, or use the Browse button to select a different directory (Figure 1.5).

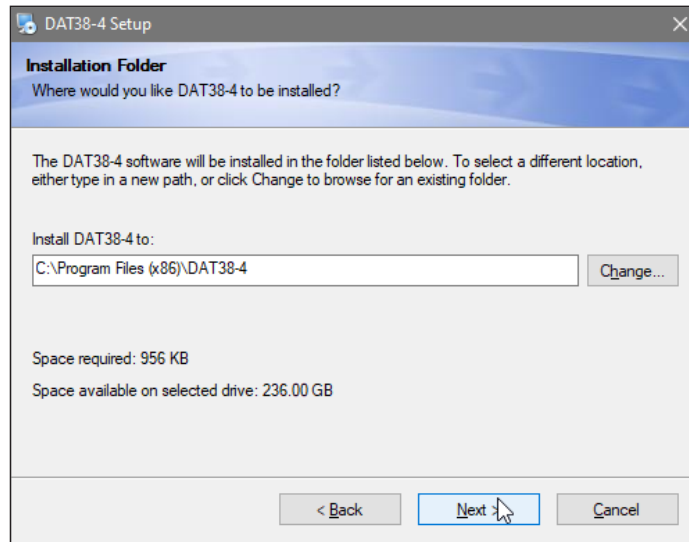


Figure 1.4 Installation directory window

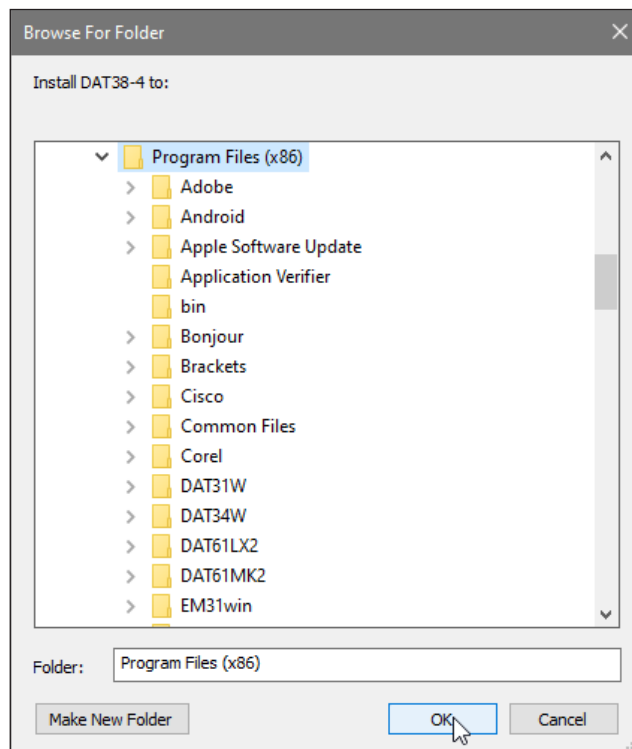


Figure 1.5 Select Shortcut Folder window

5. Once the directory is confirmed, click Next. The Select Shortcut Folder window will open (Figure 1.6). Customize or accept the default folder for the program menu. Click Next.

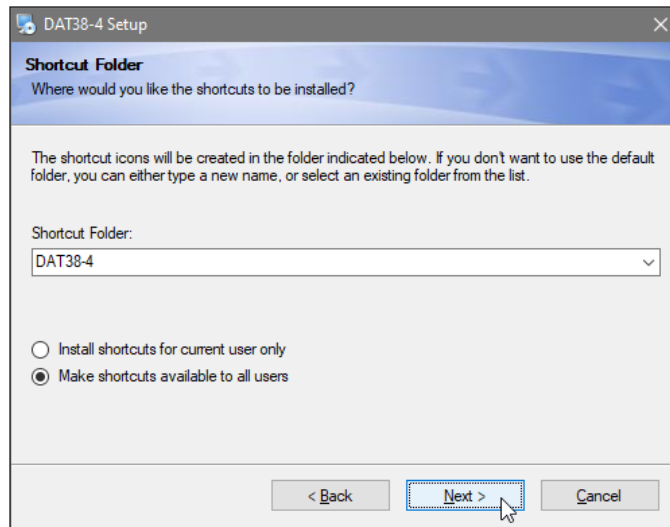


Figure 1.6 Select Shortcut Folder window

6. In the Ready to Install window (Figure 1.7), click Finish to begin the installation. A progress bar will display the status (Figure 1.8).

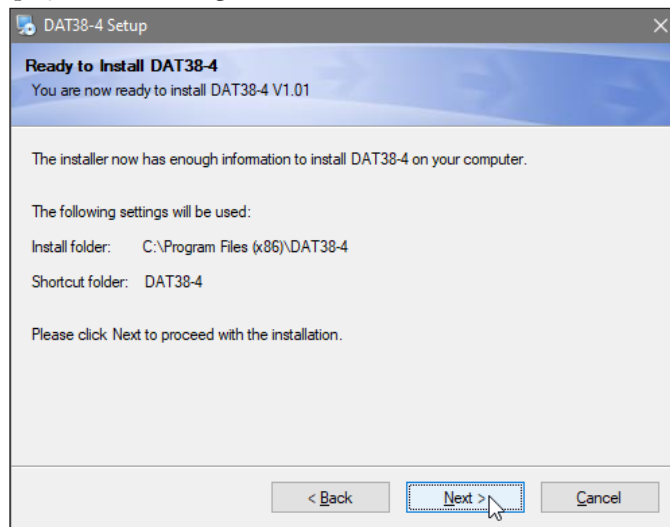


Figure 1.7 Ready to Install window

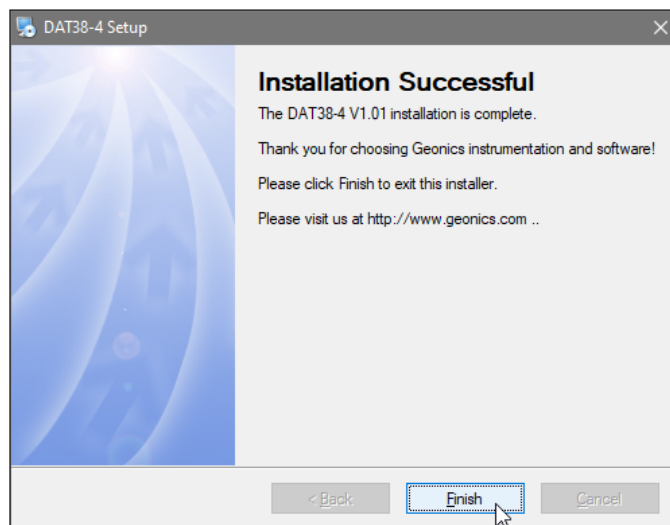


Figure 1.8 Finished window

7. The End of Installation window will appear when the installation is complete. Click Finish. The setup program will create a DAT38-4 program group and shortcuts in the Start menu. Restarting the system may be required.

## 1.4 Data File Transfer

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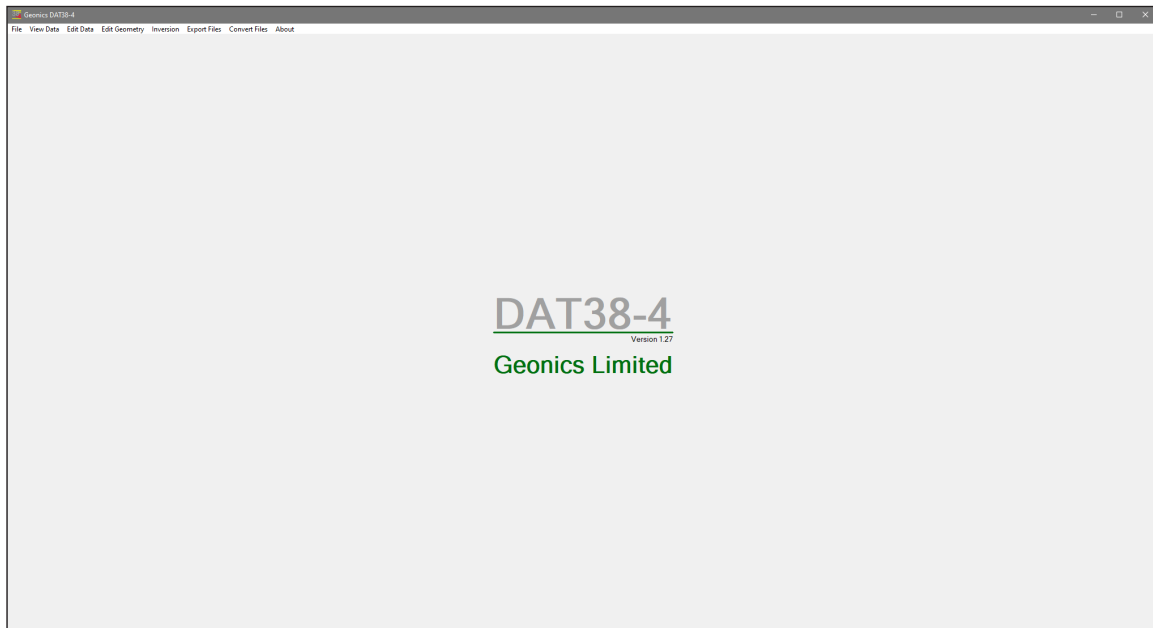
Data files with the extension .384 are saved in the logging computer. They can be transferred to a desktop PC using a USB module, network connection, or other methods.

- Binary .384 files are raw data files and must be converted to the DAT38-4 format (F38) using the "Convert" option in DAT38-4. Files in F38 format can then be loaded and processed in DAT38-4.
- Avoid opening binary .384 files in a text editor, as accidental saves may corrupt the file. If viewing is necessary, make a copy of the file first.
- Retain raw binary files until the end of the project. They contain all the necessary information for troubleshooting potential issues

## 1.5 Program Overview

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You can start DAT38-4 by double-clicking its icon in the Start menu, Windows Explorer, or a desktop shortcut. Upon launch, the program occupies 80% of the screen (Figure 1.9) but can be resized, maximized, or minimized to access other applications.



*Figure 1.9 DAT38-4 Initial window*

Initially, most menu items are disabled until a profile data file (F38) is loaded. The user can:

- Convert single or multiple raw binary .384 files to F38 format (In-phase units in ppt or mS/m).
- Convert multiple .384 files to XYZ format.

- Load DAT38-4 profile files (F38) and display them as stacked profiles.
- Exit the program.

When a profile file (F38) is loaded, all menu options become available. The program supports a single-document interface, but users can display additional data files in new windows or add them to the current data set using the "Add DAT38-4 Profile File" option.

The DAT38-4 data can be displayed as stacked profile (Figure 1.10), and if inversion results are available data presentation can be also viewed as vertical cross-section (Figure 1.11) or combined stacked profiles with associated vertical cross-section (Figure 1.12).

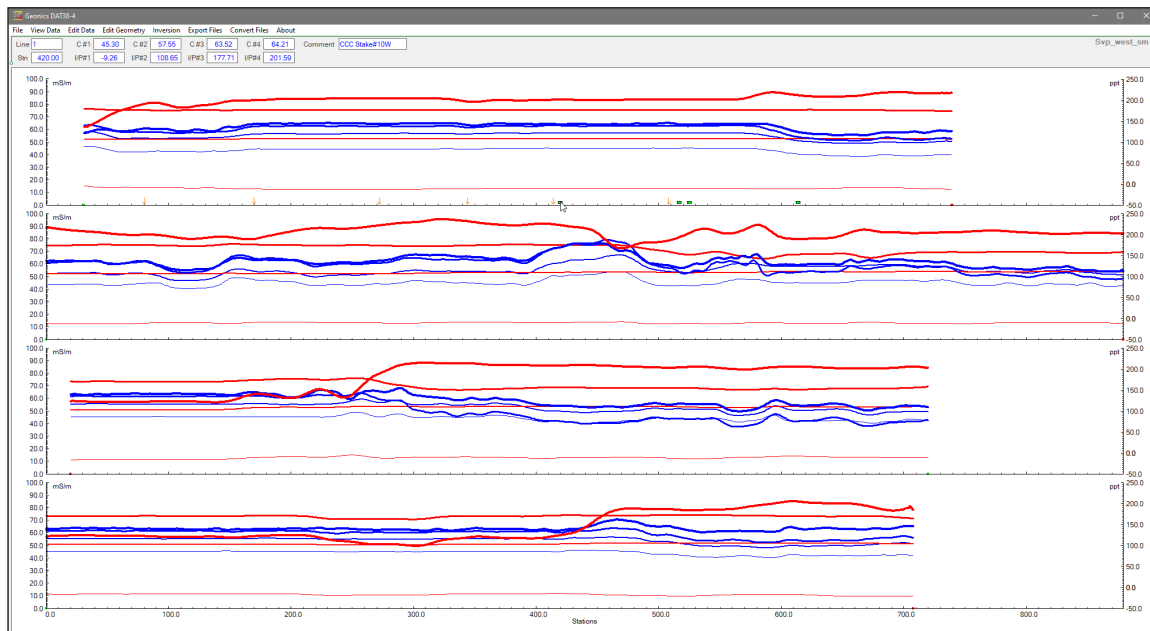


Figure 1.10 DAT38-4 screen after profile file is loaded

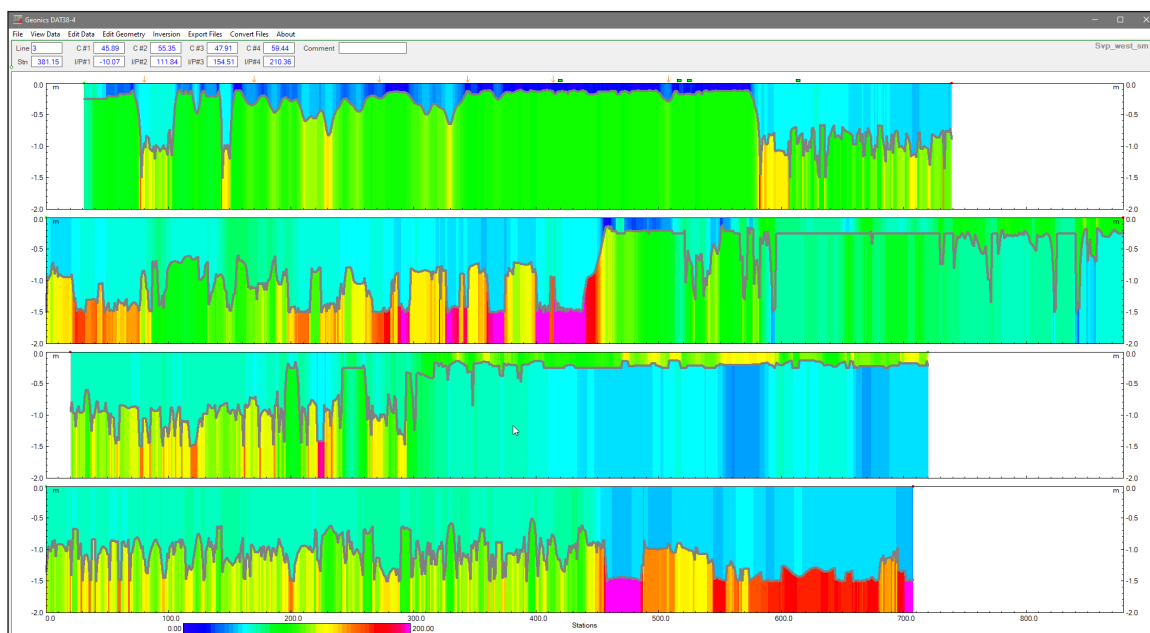


Figure 1.11 DAT38-4 screen with vertical sections after profile file is loaded

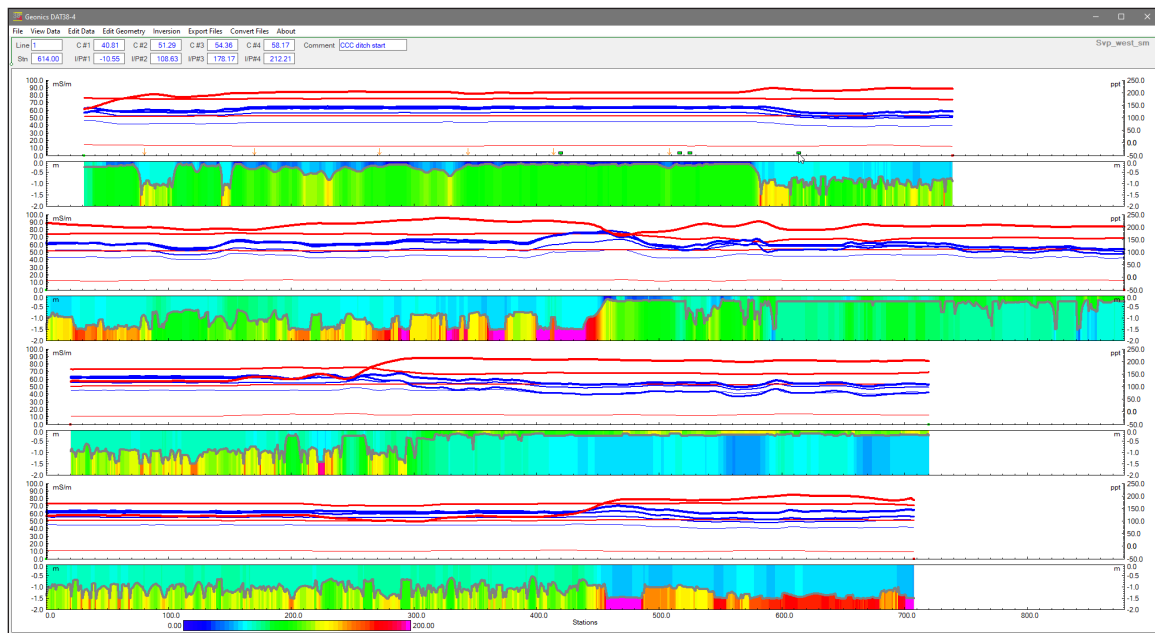


Figure 1.12 DAT38-4 screen with profiles and vertical sections after profile file is loaded

In the profile view, users can:

- Save or "Save As" files after editing.
- Print profiles using any Windows-supported printer.
- Manage survey lines (select, rename, or delete lines).
- Display profiles with specific parameters (e.g., component, coil separation).
- Specify value ranges and axis ticks for stations and components.
- Customize grid lines and line colors.
- Shift data sets up or down in user-specified steps.
- Correct data drift (if the Drift Control Procedure was used during data collection).
- Edit survey geometry (set limits, shift lines, position markers).
- Perform inversion using original or edited data sets.
- Export data to XYZ format (grid-based or GPS-based coordinates).
- Export data for the EM4Soil-G inversion program.
- Convert up to 50 .384 files simultaneously to F38 or XYZ format.





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## 2. Quick Start

This 'Quick Start' section is designed to provide a streamlined guide for downloading and editing an EM38-4 survey. It serves as a starting point for users who want to quickly get familiar with the basic functions of the program. Later sections will delve into more detailed explanations of all program functions.

### 2.1 Converting Binary Instrument Files to DAT38-4 and XYZ Formats

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The data acquisition program EM38-4, running on the field computer, saves readings in a raw binary file format with the extension .384. These raw files must be transferred from the Mesa3 (or another data logger) to a desktop PC using a USB memory module, network connection, or other transfer methods.

The DAT38-4 program utilizes ASCII-formatted data files with the extension .F38. Since the raw binary files (.384) are not directly compatible, they must first be converted to the DAT38-4 (F38) format. The program's Convert Files menu allows users to convert raw data files (.384) into ASCII files (.F38).

To convert .384 files, navigate to the **Convert Files** menu and select one of the following options:

1. **Convert EM38-4 File (.384) to DAT38-4 (.F38) Format** – This option allows for the conversion of a single data file (Figure 2.1).

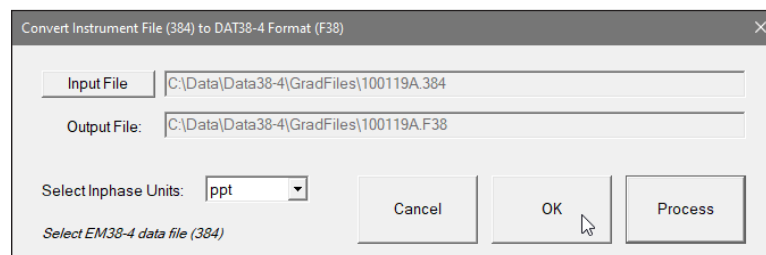


Figure 2.1 Convert EM38-4 Files to F38 Format dialog (Inphase units in ppt)

2. **Convert Multiple EM38-4 Files (.384) to DAT38-4 (.F38) Format** – This option simultaneously enables batch conversion of up to 50 files. After clicking the **Process** button, all selected files will be converted to the F38 format (Figure 2.2). The converted file names are not specified in the dialog; however, each file name is displayed during processing (Figure 2.3).

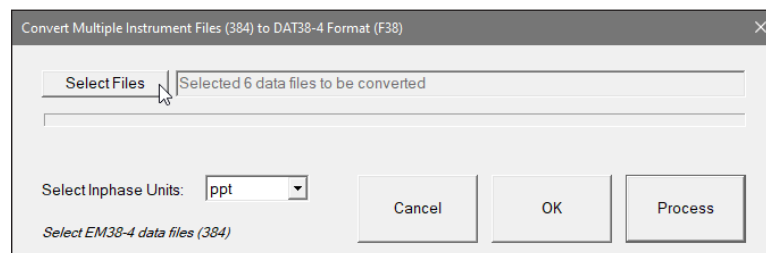


Figure 2.2 Convert Multiple EM38-4 Files to F38 Format dialog (selected Inphase units in ppt)

Conversion to the selected Inphase units is independent of those used during data collection.

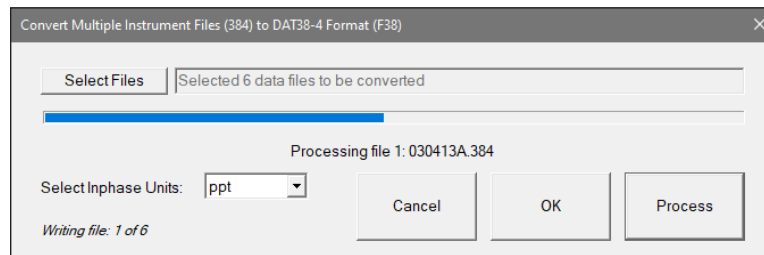


Figure 2.3 Convert Multiple EM38-4 Files to F38 Format dialog during conversion procedure

To select files for conversion:

- Click the **Select Files** button to open a file selection window displaying available .384 files.
- Choose one or multiple files (in the Multiple Files dialog).
- Once files are selected, the **Process** button will become active.
- Click **Process** to initiate the conversion. The converted files (.F38) can then be loaded into the program as Profile files.

A third option in the Convert Files menu allows for conversion to XYZ format:

3. **Convert Multiple EM38-4 Files (.384) to XYZ File Format** - This option opens a dialog window (Figure 2.4). Chapter 7 (Export Data Files to XYZ Format) provides a detailed explanation of its parameters. Users can select up to 50 files for conversion.

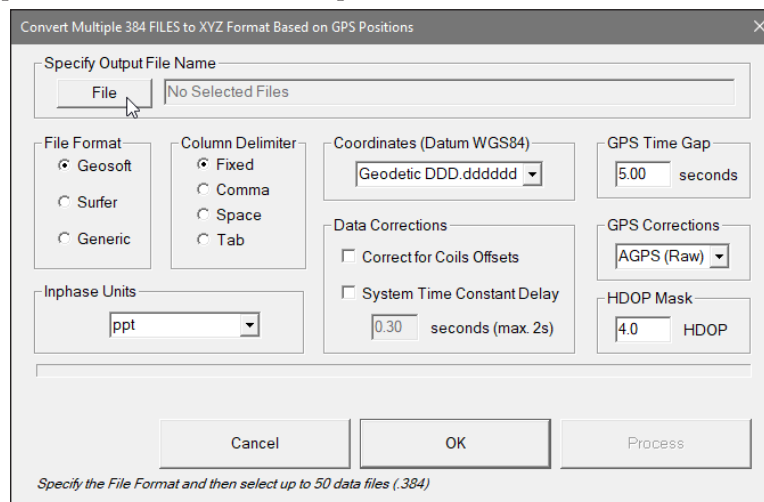


Figure 2.4 Convert Multiple EM38-4 Files to XYZ Format dialog

To proceed with the XYZ conversion:

- Click Select Files to open a file selection window displaying available .384 files.
- Choose the desired files.
- The **Process** button will become active.
- Click **Process** to convert the selected .384 files to XYZ format.

As with the F38 conversion, the file names are not specified within the dialog, but each converted file's name is displayed during processing (Figure 2.5). The generated XYZ files contain unprocessed field data, preserving the raw values acquired during data collection. This option provides a quick way to convert field data into XYZ format for further analysis.

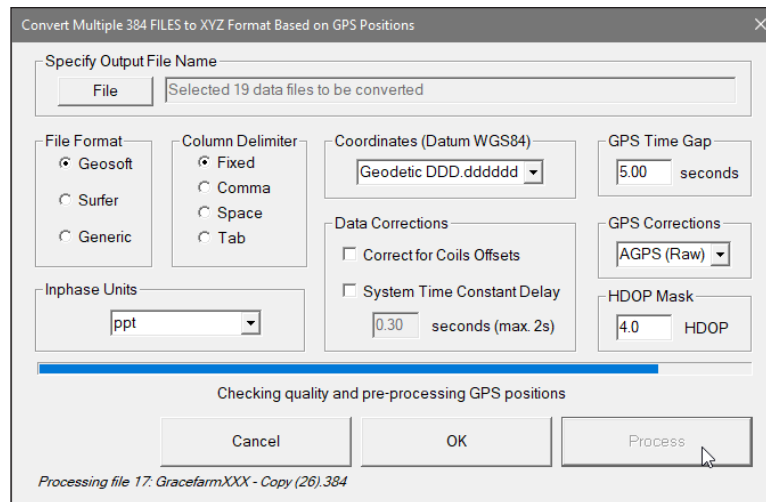


Figure 2.5 Convert Multiple EM38-4 Files to XYZ Format dialog during conversion procedure

## 2.2 Displaying Data as Profiles

### Loading and Displaying Data Files

To display data, navigate to **File | Open Profile File** in the DAT38-4 program menu. This action will open the Select Profile File window, which is the first step in the process of displaying data (Figure 2.6).

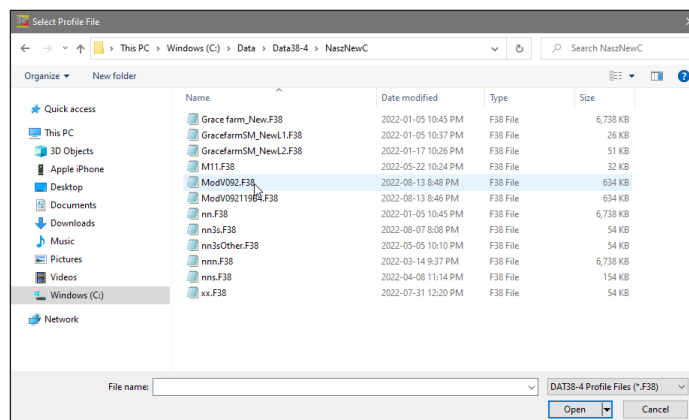


Figure 2.6 Open EM38-4 File window

1. Choose the desired directory and file name.
2. Click **Open** or double-click the file or press Alt + O on your keyboard.

The Select Profile File window displays available files with the .F38 extension. Once the file is loaded, the data is shown in a stacked profile format (Figure 2.7).

Survey lines are organized into panels, each containing recorded data. Generally, each survey line is assigned to a separate panel. However, if multiple survey lines share the same line name and instrument mode, they will be placed in individual panels.

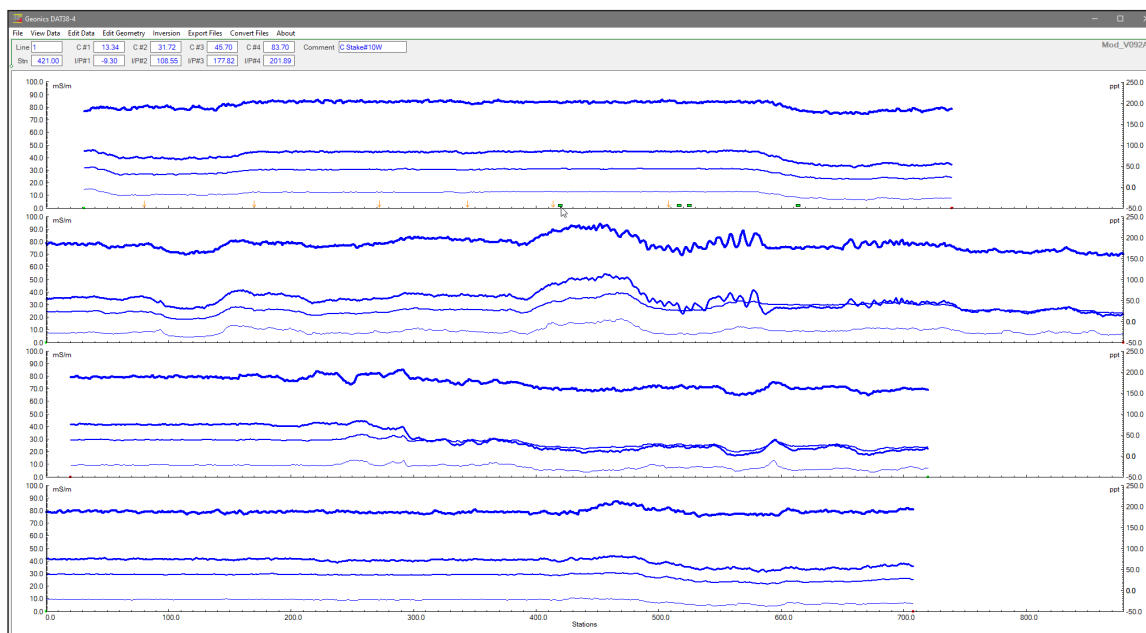


Figure 2.7 DAT38-4 screen with stacked profiles

Below the program menu, a set of small windows displays:

- Current Line Name
- Station
- Reading values for the survey line and station under the mouse cursor

The data file name (excluding the extension) is displayed in the top-right corner of the profile plot window.

Each panel includes one or more data types (channels) defined by a combination of components, coil separation, and other parameters. Access the Select Data Type window via **Display | Select Data Type** to configure data types. (See the "Select Data Type" section below.)

### EM38-4 Data Type Descriptions

The program uses standard abbreviations for each data type (channel):

<b>C #1</b>	-	Conductivity,	Coil Separation <b>0.50</b> m
<b>I/P #1</b>	-	Inphase,	Coil Separation <b>0.50</b> m
<b>C #2</b>	-	Conductivity,	Coil Separation <b>0.75</b> m
<b>I/P #2</b>	-	Inphase,	Coil Separation <b>0.75</b> m
<b>C #3</b>	-	Conductivity,	Coil Separation <b>0.88</b> m
<b>I/P #3</b>	-	Inphase,,	Coil Separation <b>0.88</b> m
<b>C #4</b>	-	Conductivity,	Coil Separation <b>1.00</b> m
<b>I/P #4</b>	-	Inphase,	Coil Separation <b>1.00</b> m

In addition, if available, inversion results (such as first layer thickness, conductivity of layer #1, and conductivity of layer #2) can be plotted. However, numeric windows are not provided for these parameters.

All Conductivity and Inphase channels are displayed for all survey lines by default.

- The left vertical axis corresponds to apparent conductivity (Quad-phase component) and is labeled in millisiemens per meter (mS/m).

- The right vertical axis represents the Inphase response, labeled in parts per thousand (ppt) of the Primary Field or mS/m (depending on how the file was converted).
- If Inversion Results are selected, Inphase options are disabled. The right Inphase axis is replaced by a Thickness axis (in meters). Inversion Conductivity values are scaled according to the left Conductivity axis.

## Selecting and Managing Survey Lines

### Selecting Survey Lines

When a data file is loaded, all survey lines are displayed. To choose specific lines, navigate to **Display | Select Lines** in the program menu. This opens the Select Survey Lines window (Figure 2.8).

- Click on survey line names in the Available Lines list to select or deselect them.
- Use the Select All and Unselect All buttons for bulk selection.
- After finalizing your selection, click OK to update the display.

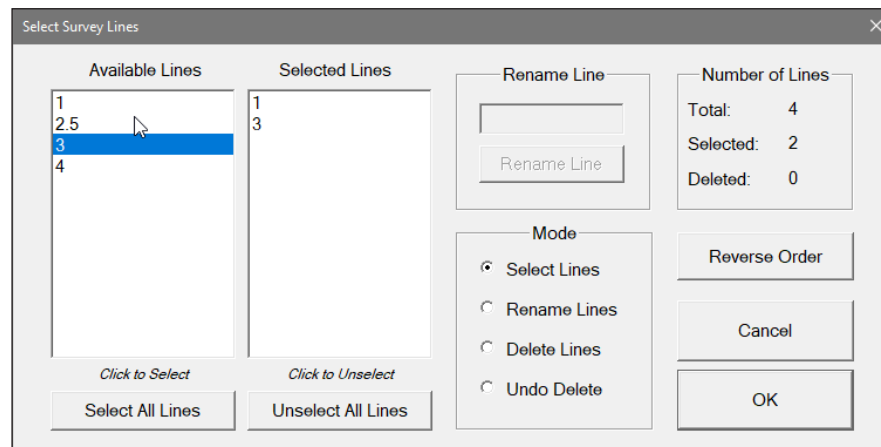


Figure 2.8 Select Survey Lines window

### Deleting and Renaming Survey Lines

To delete or rename survey lines, use the Select Lines window (Figure 2.8).

#### Deleting Lines

1. Click the **Delete Lines** radio button under Mode.
2. Select the line name in the Available Lines list. A D will appear next to it, indicating it will not be displayed or saved.

#### Renaming Lines

1. Click the **Rename Lines** radio button.
2. Select a line name in the Available Lines list.
3. Edit the name in the Rename Line text box and click **Rename Line**.

Note: Deleted and renamed lines remain valid only for the current session. To save changes permanently, use **Save** or **Save As**. You should use **Save As** to retain an unedited copy of the original data.

## Selecting Profile Data Type

---

Go to **Display | Select Data** Type in the program menu to specify which data types to display. This opens the Select Data Type window (Figure 2.9).

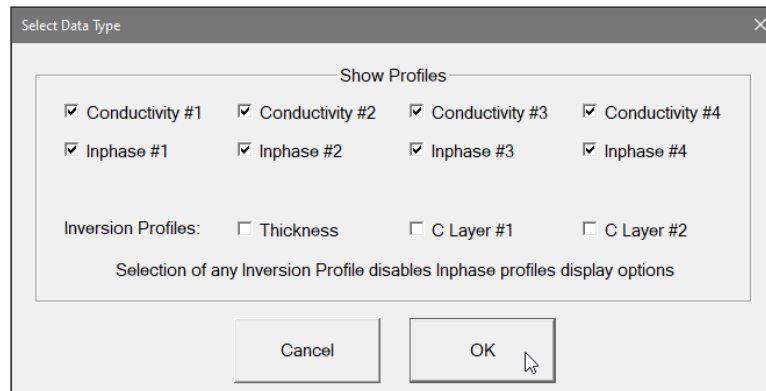


Figure 2.9 Select Data Type window

### EM38-4 Data Type Descriptions

<b>Conduct. #1</b>	-	Conductivity,	Coil Separation <b>0.50</b> m
<b>Conduct. #2</b>	-	Conductivity,	Coil Separation <b>0.75</b> m
<b>Conduct. #3</b>	-	Conductivity,	Coil Separation <b>0.88</b> m
<b>Conduct. #4</b>	-	Conductivity,	Coil Separation <b>1.00</b> m
<b>Inphase #1</b>	-	Inphase,	Coil Separation <b>0.50</b> m
<b>Inphase #2</b>	-	Inphase,	Coil Separation <b>0.75</b> m
<b>Inphase #3</b>	-	Inphase,	Coil Separation <b>0.88</b> m
<b>Inphase #4</b>	-	Inphase,	Coil Separation <b>1.00</b> m
<b>Thickness</b>	-	Inversion: Thickness of the first layer	
<b>C. Layer #1</b>	-	Inversion: Conductivity of the first layer	
<b>C. Layer #2</b>	-	Inversion: Conductivity of the second layer	

- Inversion profiles can only be displayed if inversion was applied.
- If an inversion profile is selected, Inphase profiles are automatically disabled.

## Setting Profiles Display Parameters

---

To adjust the display range of profile parameters, go to **Display | Set Profiles Display Parameters** (Figure 2.10).

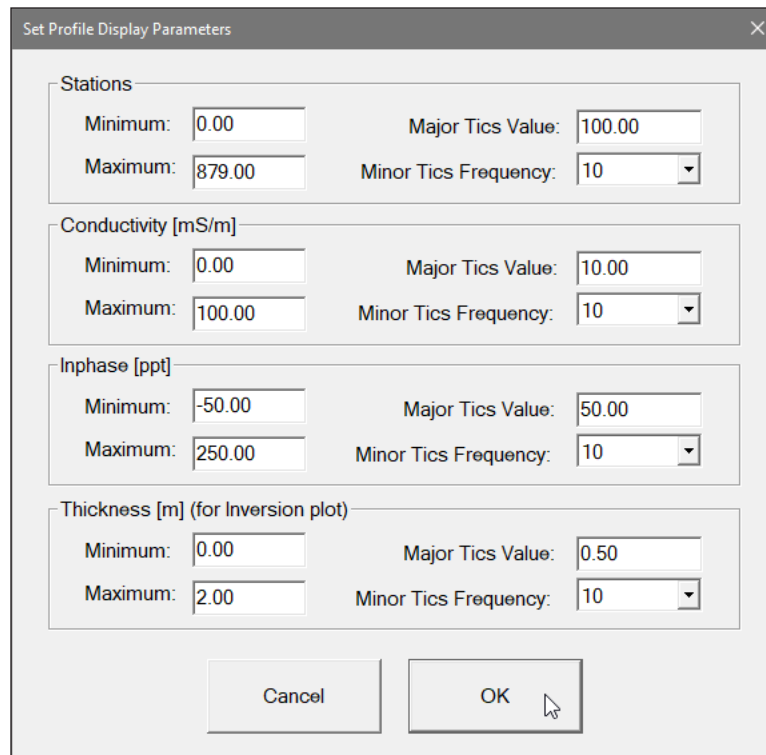
This allows you to modify:

- Survey line length (stations displayed)
- Amplitude scaling for Conductivity, Inphase, and Inversion results
- Major tick intervals and minor tick frequency (used for grid lines and labels)

## Set Vertical Section Parameters

---

To change the display mode and adjust vertical section settings, go to **Display | Set Vertical Section Parameters** (Figure 2.11).



The dialog box is titled "Set Profile Display Parameters" and contains four sections for configuring different data series:

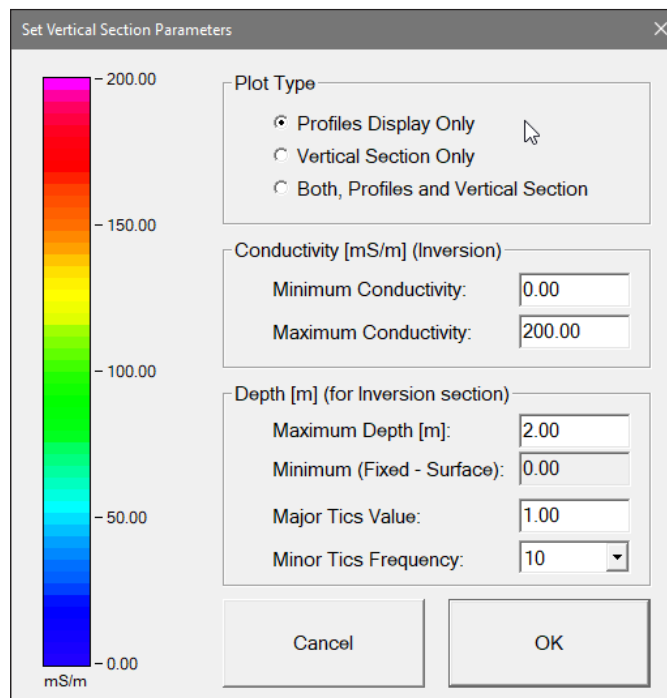
- Stations:** Minimum: 0.00, Maximum: 879.00, Major Tics Value: 100.00, Minor Tics Frequency: 10.
- Conductivity [mS/m]:** Minimum: 0.00, Maximum: 100.00, Major Tics Value: 10.00, Minor Tics Frequency: 10.
- Inphase [ppt]:** Minimum: -50.00, Maximum: 250.00, Major Tics Value: 50.00, Minor Tics Frequency: 10.
- Thickness [m] (for Inversion plot):** Minimum: 0.00, Maximum: 2.00, Major Tics Value: 0.50, Minor Tics Frequency: 10.

At the bottom are "Cancel" and "OK" buttons.

Figure 2.10 Set Profile Display Parameters dialog

This window contains:

1. Plot Type: Choose **Profiles Display Only** (Figure 2.7 above), **Vertical Section Only** (Figure 2.12), or **Both** (Figure 2.13).
2. Conductivity Range (mS/m): Adjust the color scale for the vertical section.
3. Depth Settings: Define maximum depth, major tick values, and minor tick frequency (minimum depth is fixed as zero - representing soil surface).



The dialog box is titled "Set Vertical Section Parameters" and includes a color scale on the left and configuration options on the right:

- Color Scale:** A vertical bar showing a gradient from blue (0.00 mS/m) to red (200.00 mS/m), with intermediate labels at 50.00, 100.00, and 150.00.
- Plot Type:** Three radio buttons: ☒ Profiles Display Only, ☐ Vertical Section Only, and ☐ Both, Profiles and Vertical Section.
- Conductivity [mS/m] (Inversion):** Minimum Conductivity: 0.00, Maximum Conductivity: 200.00.
- Depth [m] (for Inversion section):** Maximum Depth [m]: 2.00, Minimum (Fixed - Surface): 0.00, Major Tics Value: 1.00, Minor Tics Frequency: 10.

At the bottom are "Cancel" and "OK" buttons.

Figure 2.11 Set Vertical Section Parameters dialog

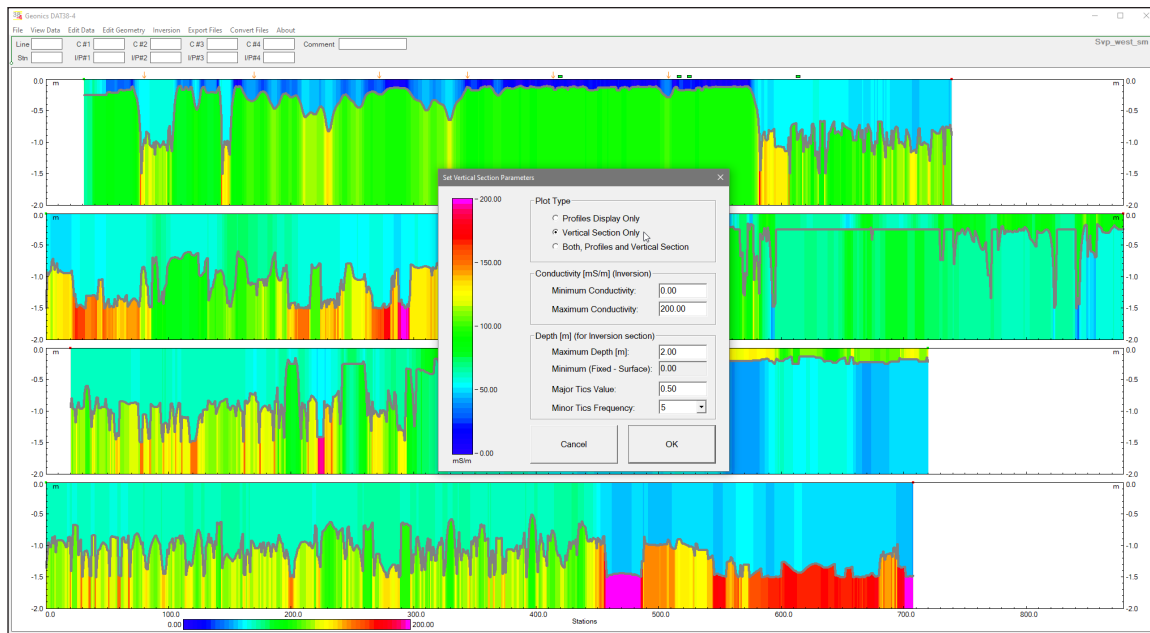


Figure 2.12 The DAT38-4 screen set to the Vertical Section Only type of display

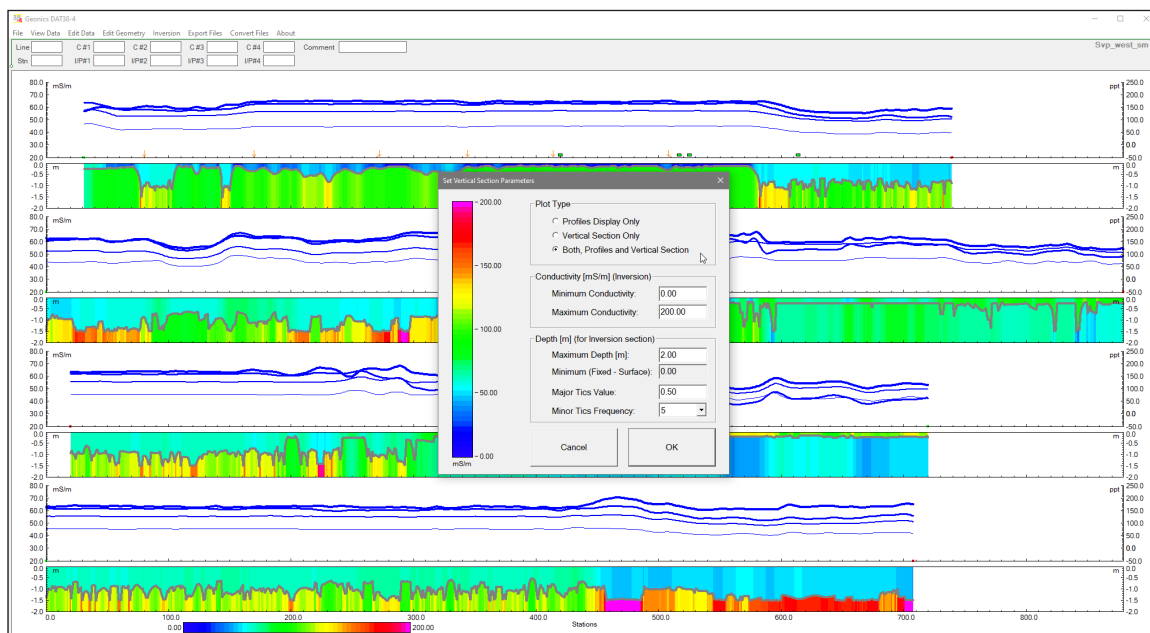


Figure 2.13 The DAT38-4 screen set to the Both, Profiles and Vertical Section type of display

## Setting Profiles Graphic Attributes

To modify profile colors and line thickness, go to **Display | Line Attributes** (Figure 2.14).

- Click a color button to open the Select Color window.
- Choose a color and adjust thickness as needed.



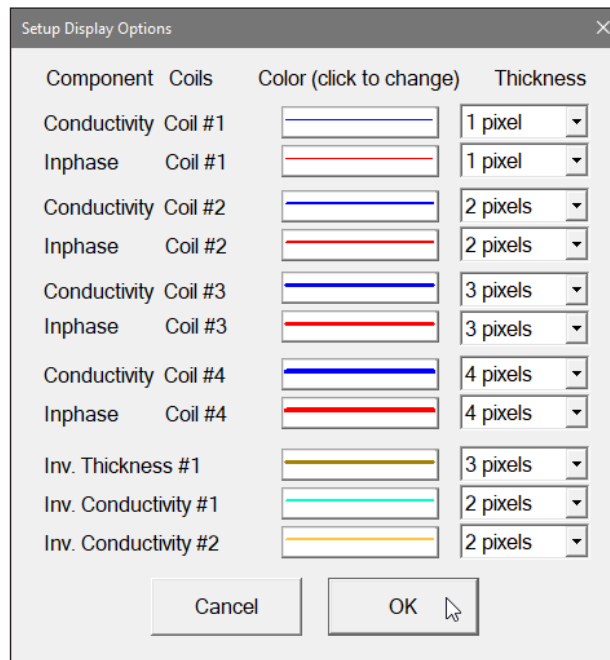


Figure 2.14 Selecting attributes for profiles

## 2.3 Editing Data

The Edit Data option allows for adjustments to entire survey lines, including response level shifting, applying linear corrections, and smoothing data for selected survey lines and components. To access this option, select Edit Data from the main menu at the top of the screen (Figure 2.15).

The Edit Data menu contains four key functions:

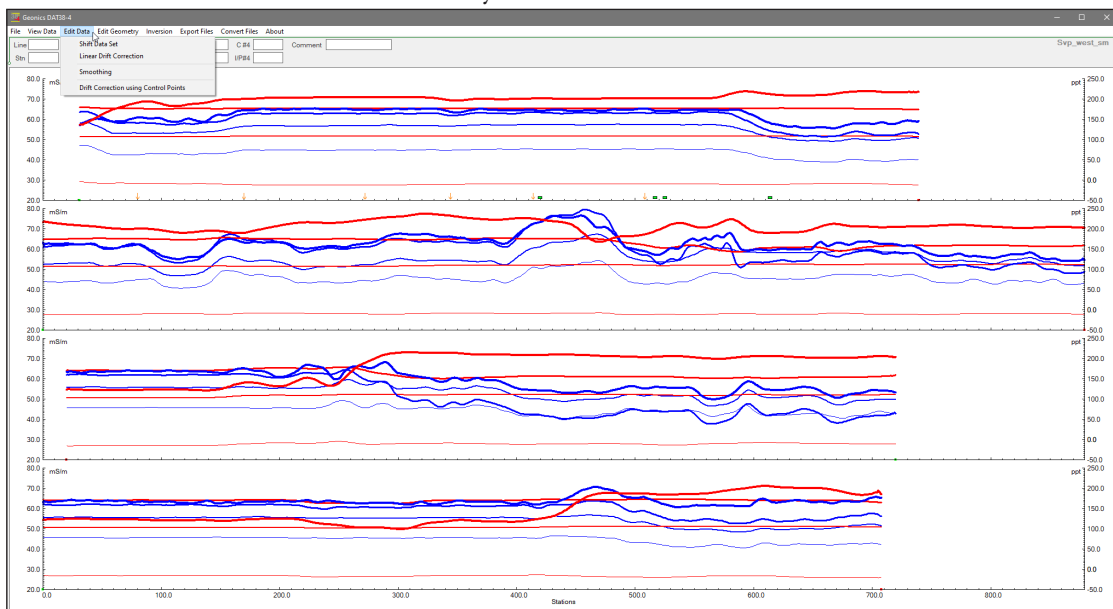


Figure 2.15 Edit Data menu

- **Shift Data Set** – Adjusts the amplitude level for a selected survey line and component.
- **Linear Correction** – Removes possible linear drift effects from selected survey lines and components.
- **Smoothing** – Applies smoothing to data with a selected degree of intensity for specific survey lines and components.

- **Drift Correction Using Control Points** – Corrects drift based on control point measurements taken during the survey (available in EM38-4 version 1.06 or later).

These options are only available when using the Profiles Display Only mode. If another display mode is active, an appropriate notification will appear.

## 2.4 Editing Survey Geometry

The Edit Geometry option allows for adjustments to survey profile geometry, including repositioning start and end stations, shifting survey lines, and modifying stations marked with fiducial switches. Select Edit Geometry from the main menu (Figure 2.16).

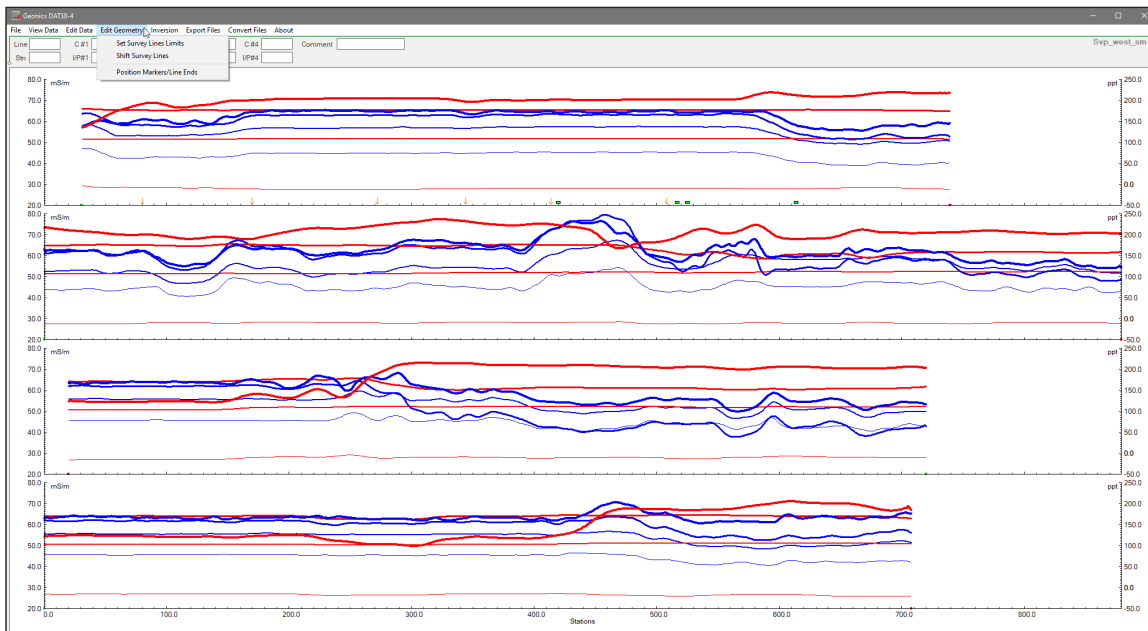


Figure 2.16 Edit Geometry menu

The Edit Geometry menu includes three functions:

- **Set Line Limits** – Modifies selected survey lines' start and end stations.
- **Shift Survey Lines** – Moves selected survey lines along the profile axis in a positive or negative direction.
- **Position Markers** – Aligns fiducial markers and adjusts survey lines' start and endpoints.

Editing data positions is generally unnecessary for surveys conducted without fiducial markers. However, common field errors—such as incorrect start stations or line directions—can be corrected using the Set Line Limits or Shift Survey Lines options.

If fiducial markers were used, the following two-step adjustment process is recommended:

1. Adjust survey line start and end positions using Set Line Limits or Position Markers.
2. Align fiducial markers using the Position Markers tool.

Even when fiducial markers were not used, the Position Markers tool can still effectively adjust survey line start and end stations.

## 2.5 Inversion

This option allows users to calculate inversion results if the inversion setting was not enabled during data collection or to re-calculate inversion after data value modifications, mainly when using the Data Shift or Smooth Data options.

When the Inversion menu item is selected, the Inversion Setup dialog appears (Figure 2.17). This dialog and its parameters are identical to those in the data acquisition program, with one key difference: it allows users to modify the EM38-4 Height (always in meters) and displays the EM38-4 Height value specified during data collection. A detailed description of all parameters in the Inversion Setup dialog can be found in Chapter 6.

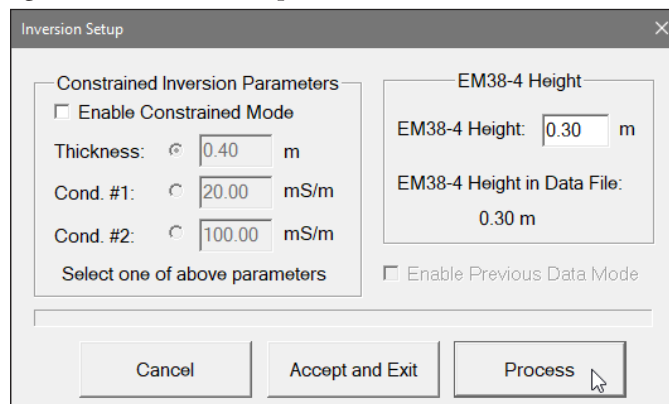


Figure 2.17 Inversion Setup dialog

Clicking the **Process** button initiates inversion calculations for each data point. A progress bar (Figure 2.18) indicates the status of the process, which may take several minutes for large data files. Once completed, the results are updated according to the settings in the Set Data Type, Set Profiles Display Parameters, and Set Vertical Section Parameters dialogs.

Users can either accept the new inversion values (**Accept and Exit**) or discard them (**Cancel**). If canceled, the display will revert to the original inversion values. Use the Save or Save As options to save the new inversion values in the data file permanently.

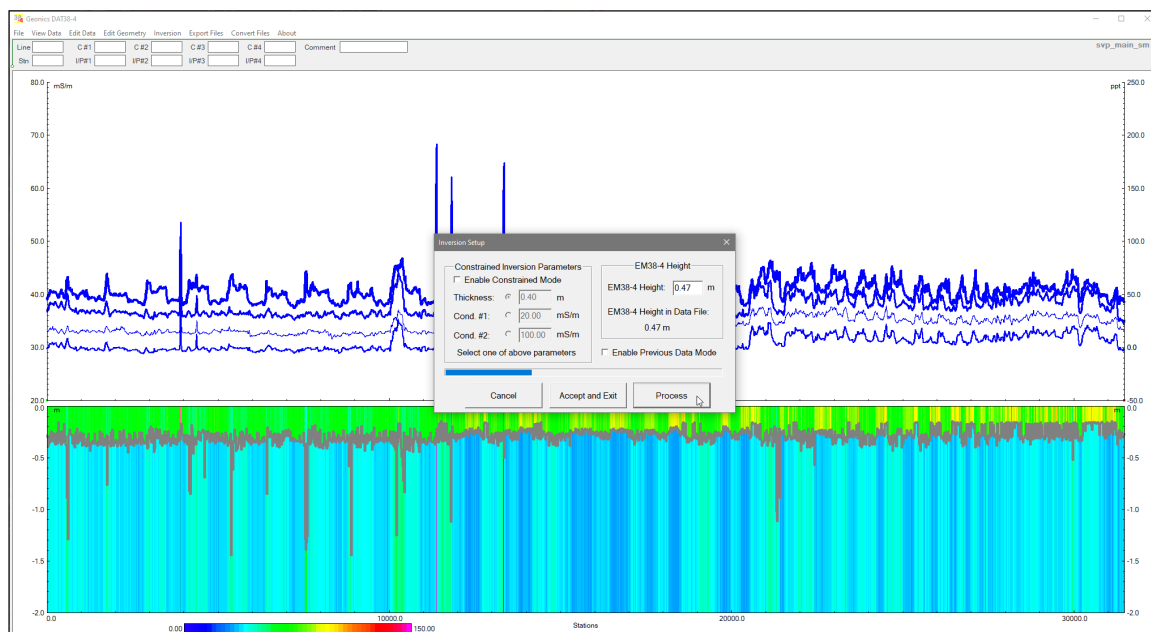


Figure 2.18 Inversion procedure during processing

## 2.6 Export Files

To access export options, select Export Files from the main menu. This menu contains four options (Figure 2.19):

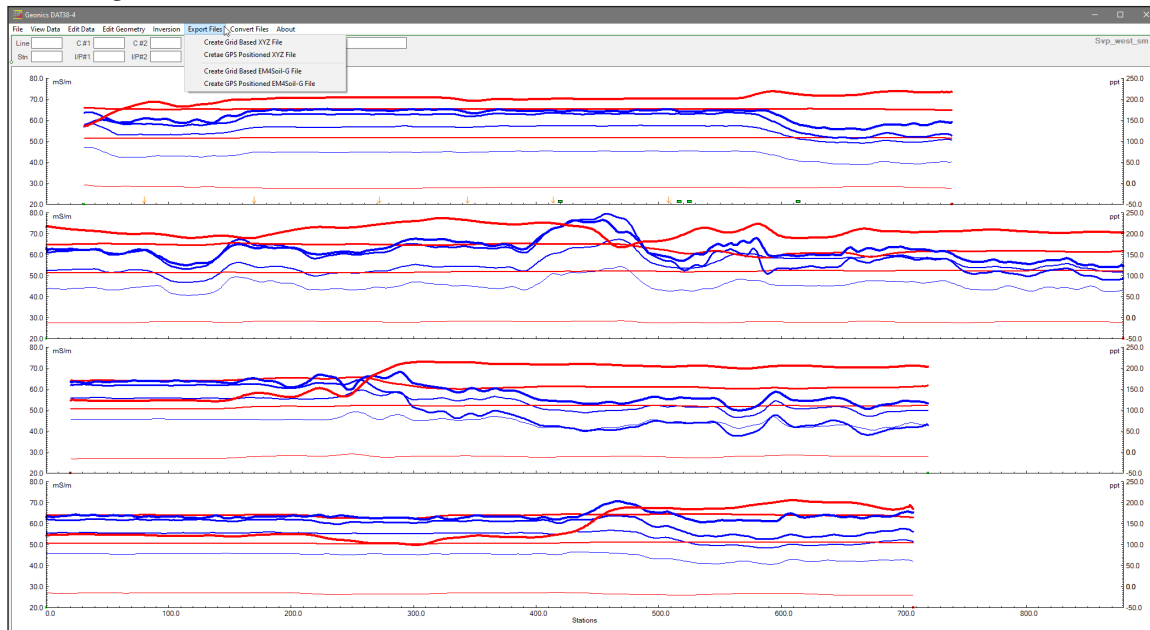


Figure 2.19 2Export Files menu

1. Create a Grid-Based XYZ File
2. Create a GPS-Positioned XYZ File
3. Create Grid-Based EM4Soil-G File
4. Create GPS-Positioned EM4Soil-G File

The first two options generate standard XYZ files for various mapping systems, while the latter two create input files for the EM4Soil-G inversion program (developed by EMtomo). The EM4Soil-G file format is similar to XYZ files but uses the gxyz extension.

### Grid-Based Export Options

The Create Grid-Based XYZ File and Create Grid-Based EM4Soil-G File options generate files based on survey lines arranged in an N-S or W-E configuration. These options assume data was collected along a predefined grid, and it is strongly recommended that each file contains parallel lines surveyed in one direction (either W-E or N-S).

The program interprets survey stations along the lines as one coordinate (X or Y) and the line names as the other coordinate. Line names can be adjusted using the Rename function in the Select Survey Lines window if they do not match the expected coordinate. Before generating the XYZ file, use the Edit Geometry menu options to properly organize station positions (e.g., line endpoints, fiducial markers).

### GPS-Positioned Export Options

The Create GPS-Positioned XYZ File and Create GPS-Positioned EM4Soil-G File options are available only when EM38-4 data is collected with GPS positioning. The GPS receiver must be connected to the Mesa3 (or another field computer logging EM38-4 readings) via a serial port, and GPS data must be recorded in the EM38-4 file.

## Create Grid-Based Files

Selecting **Export Files | Create Grid-Based XYZ File** opens the Create Grid-Based XYZ File dialog (Figure 2.20). Similarly, choosing **Export Files | Create Grid-Based EM4Soil-G File** opens the Export EM4Soil-G Format with Grid Layout-Based Positions dialog (Figure 2.21). The EM4Soil-G dialog is more straightforward since its format and content are fixed, requiring only the File Name and Survey Lines Orientation.

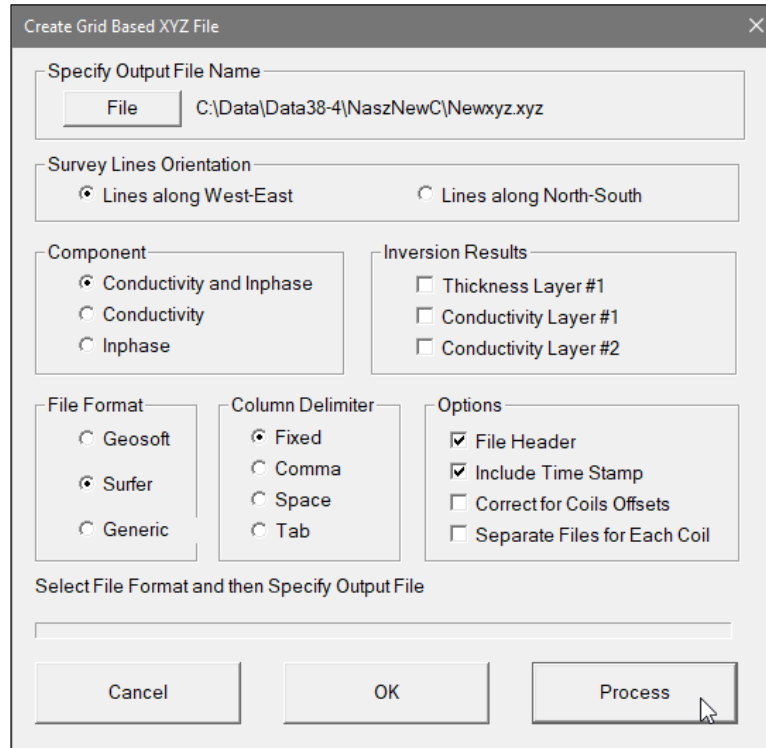
The dialog box is titled "Create Grid Based XYZ File". It contains several sections: "Specify Output File Name" with a "File" button and a text field showing "C:\Data\Data38-4\NaszNewC\Newxyz.xyz"; "Survey Lines Orientation" with radio buttons for "Lines along West-East" (selected) and "Lines along North-South"; "Component" with radio buttons for "Conductivity and Inphase" (selected), "Conductivity", and "Inphase"; "Inversion Results" with checkboxes for "Thickness Layer #1", "Conductivity Layer #1", and "Conductivity Layer #2"; "File Format" with radio buttons for "Geosoft", "Surfer" (selected), and "Generic"; "Column Delimiter" with radio buttons for "Fixed" (selected), "Comma", "Space", and "Tab"; and "Options" with checkboxes for "File Header" (checked), "Include Time Stamp" (checked), "Correct for Coils Offsets", and "Separate Files for Each Coil". At the bottom, there is a text field with the instruction "Select File Format and then Specify Output File" and three buttons: "Cancel", "OK", and "Process".

Figure 2.20 Create Grid Based XYZ File dialog

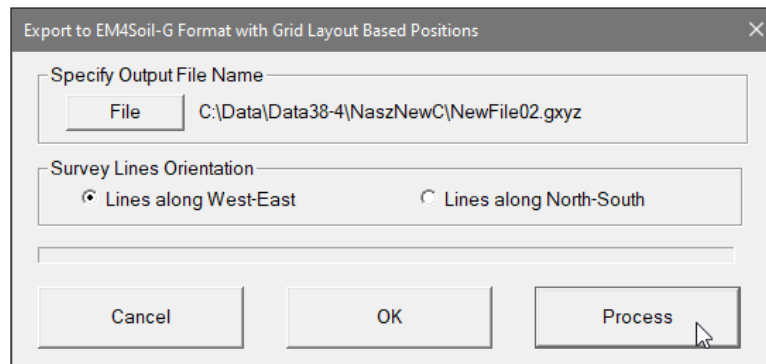
The dialog box is titled "Export to EM4Soil-G Format with Grid Layout Based Positions". It contains: "Specify Output File Name" with a "File" button and a text field showing "C:\Data\Data38-4\NaszNewC\NewFile02.gxyz"; "Survey Lines Orientation" with radio buttons for "Lines along West-East" (selected) and "Lines along North-South"; and three buttons at the bottom: "Cancel", "OK", and "Process".

Figure 2.21 Create Grid Based EM4Soil-G File dialog

Several parameters must be specified for the XYZ file:

- **Survey Line Orientation** – Choose W-E or N-S. If W-E is selected, the program assumes the line name represents the Y (N-S) coordinate and that stations are aligned along the X (W-E) axis. If survey lines are incorrectly labeled, rename them in the Select Lines window. If a line name starts with a number followed by a letter (e.g., 10N), only the number is recognized as the Y coordinate.

- **Component Selection** - Select the EM38-4 data type and the components to be included in the output file. The data is arranged as follows: X coordinate, Y coordinate, followed by components for each coil separation (four total).
- **Inversion Results** - This is enabled only if the inversion mode was active during data collection. Inversion results always follow the selected data components.
- **File Format** – Choose the appropriate format for contouring software. Options include:
  - o Generic – A multi-column format without text headers, compatible with software like Geosoft and Surfer.
  - o Geosoft – Uses the .xyz extension by default.
  - o Surfer – Uses the .dat extension.
  - o Generic – Uses the .asc extension.
- **Column Delimiter** - Choose the delimiter format required by your application. The Fixed option provides a consistent field width with spaces between columns, ensuring compatibility with most text editors.
- **Additional Options** - Enable headers, timestamps, or date columns. If the Create Additional File option is checked, a separate file containing comments (with associated coordinates and timestamps) is generated. If no comments exist, this option is disabled.

Clicking **Process** starts file creation, with a progress bar displaying the completion status.

## Create GPS-Positioned Files

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To export EM38-4 files containing GPS data:

- Select **Export Files | Create GPS-Positioned XYZ File** to open the Create XYZ File Based on GPS Positions dialog (Figure 2.22).
- Select **Export Files | Create GPS-Positioned EM4Soil-G File** to open the Export to EM4Soil-G Format with GPS-Based Positions dialog (Figure 2.23).

Since the EM4Soil-G format has a fixed structure, only coordinates and GPS quality parameters must be specified.

Before creating the XYZ file, specify:

- **Output File Name** – Click File to open the Select XYZ File window, choose a file name, and click Save. The selected file name appears next to the File button.
- **Component Selection** - Choose the EM38-4 data type and components to include. The data is arranged as X coordinates, Y coordinates, and components for each coil separation.
- **Inversion Results** – Enabled only if inversion mode was active during data collection. Inversion results always follow the selected components.
- **Additional Options** – Enable headers, GPS quality, elevation, timestamps, or comments. The GPS Quality parameter includes:
  - o Quality – Degree of differential corrections.
  - o Number of satellites.
  - o HDOP parameter – A measure of horizontal accuracy.
- **XYZ Format** – Choose the appropriate format for contouring software. If the Header is enabled, the file includes a comment describing column contents and coordinates.

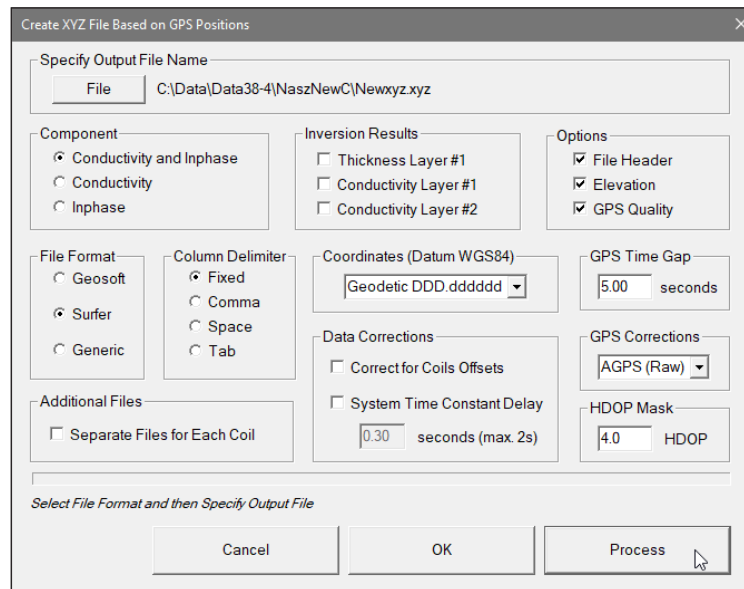


Figure 2.22 Create XYZ File Based on GPS Positions dialog

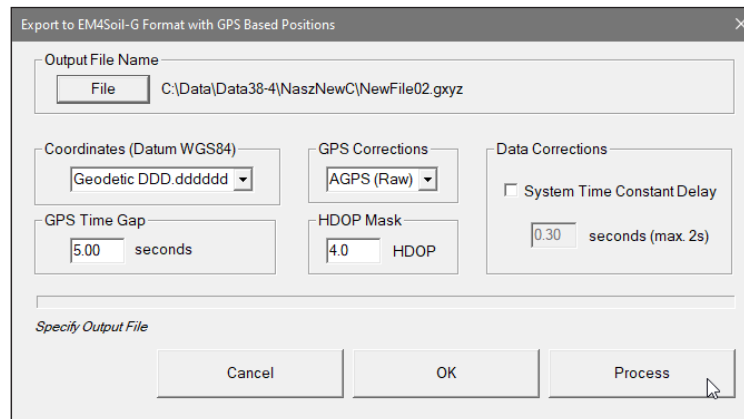


Figure 2.23 Export to EM4Soil-G Format with GPS Based Positions dialog

- **Column Delimiter** – Select a delimiter format (fixed-width fields are recommended for easy viewing in text editors).
- **Coordinate System** – Output can be in:
  - o Geodetic coordinates (Latitude/Longitude, in degrees).
  - o UTM coordinates (in meters, feet, or US Survey feet, using the WGS1984 datum).
- **GPS Time Gap** – Specifies the maximum interpolation time (in seconds) between GPS positions. A value 2-5 times the GPS acquisition frequency is typically appropriate.
- **GPS Corrections** – Select the minimum GPS differential correction level required.
- **HDOP Mask** – Set an HDOP threshold; readings with higher HDOP values are excluded.
- **Correct for Coil Offsets** – Adjusts for varying measurement center positions for different coil separations (0.50m, 0.75m, 0.88m). The program interpolates readings based on system movement direction and transmitter coil position.
- **System Time Constant Delay** - Enter a correction value for time delays in the EM38-4 and GPS receiver system. Set it to zero to disable it.

Clicking **Proceed** starts file creation, with a progress bar showing progress.





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## 3. Loading/Displaying Data

The DAT38-4 software displays files as stacked profiles before allowing editing, reorganizing survey lines, or exporting to grid- or GPS-based XYZ data files. Files containing EM38-4 readings use the F38 extension. This section describes these files. Conversion from binary raw (384) format to F38 format is explained in section 2.1. The formats for instrument binary files (extension 384) and DAT38-4 files (extension F38) are detailed in Appendix A.

### 3.1 Loading Profile Files

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#### Loading Data File

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Loading a Data File

- **Startup:** When the DAT38-4 starts, most menu items are disabled. They become enabled once a data file (F38) is loaded.
- **To Load:** Choose **File | Open Profile File** (see Figure 3.1).

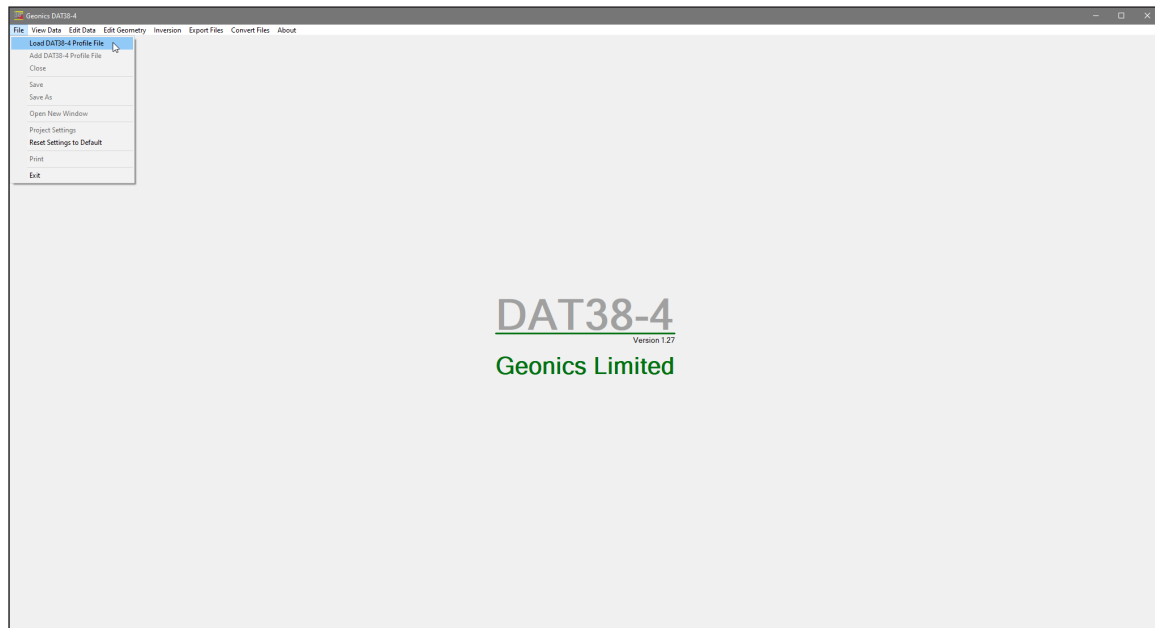


Figure 3.1 DAT38-4 File menu before any data file is loaded

- **File Selection:** The Select Profile File dialog appears (Figure 3.2). Navigate to the desired directory, select the file, then click **Open** (or double-click, or press Alt+O).
- **Progress Indicator:** A progress bar may indicate the loading percentage for large files.
- **Display:** Once loaded, data appears as stacked profiles (Figure 3.3). Each survey line is shown in a separate panel—even if lines share the same name.

In each panel:

- The default display profiles the Conductivity and Inphase components for all four coil separations.

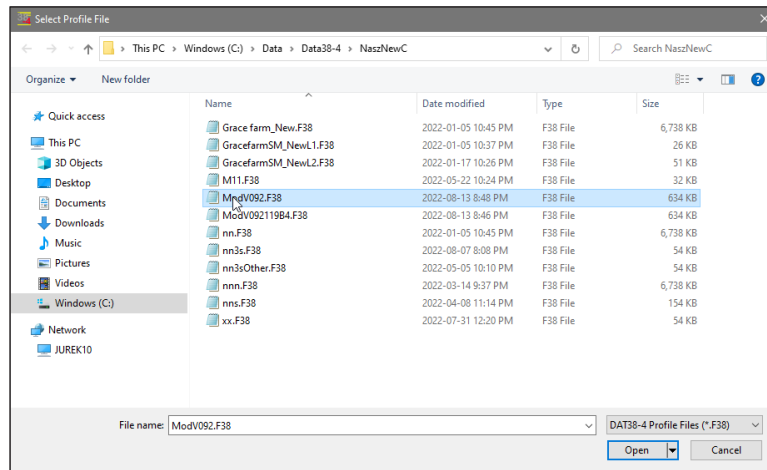


Figure 3.2 Select EM38-4 Profile File dialog

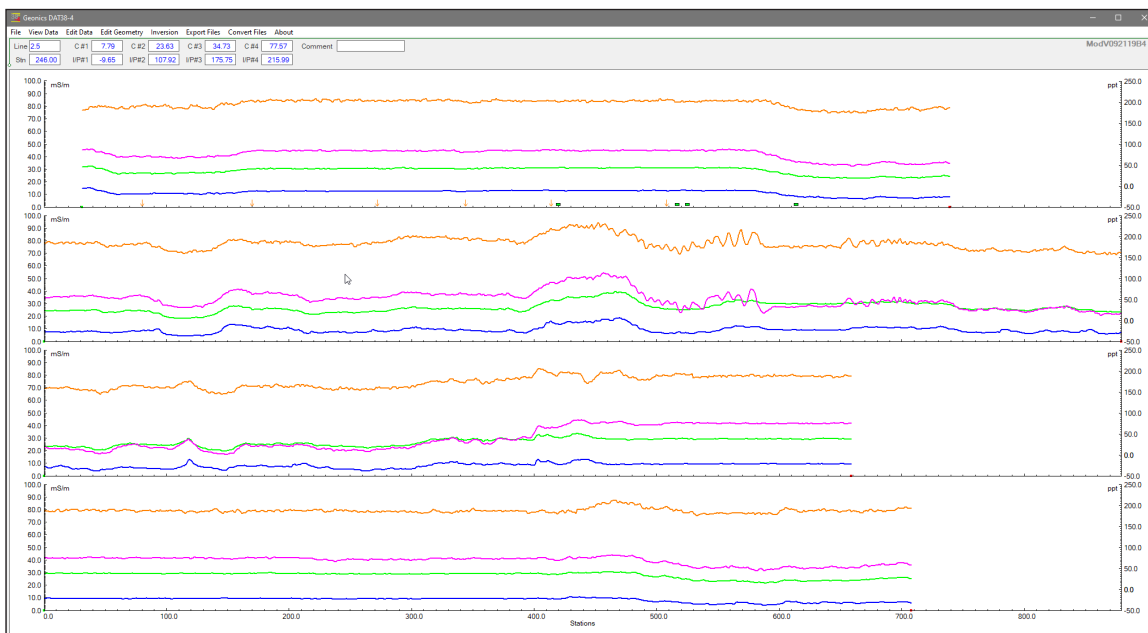


Figure 3.3 DAT38-4 screen with stacked profiles

- Inversion results can be selected.
- The left vertical axis shows EM38-4 conductivity (in mS/m), while the right axis shows the Inphase component (in ppt of Primary Field or mS/m, based on conversion settings).
- When Inversion Results are chosen, Inphase profiles are disabled. The Inphase axis is replaced by a Thickness axis (in meters), while the Conductivity axis is used for layer conductivity profiles.

### Loading Additional Data Files in the Same Window

- Select **File | Add DAT38-4 Profile File** (Figure 3.4).
- The file selection dialog (Figure 3.2) appears. After choosing a file, a new stacked profile window appears below the previous data set (Figure 3.5).
- Multiple files can be combined and then saved as one data set.

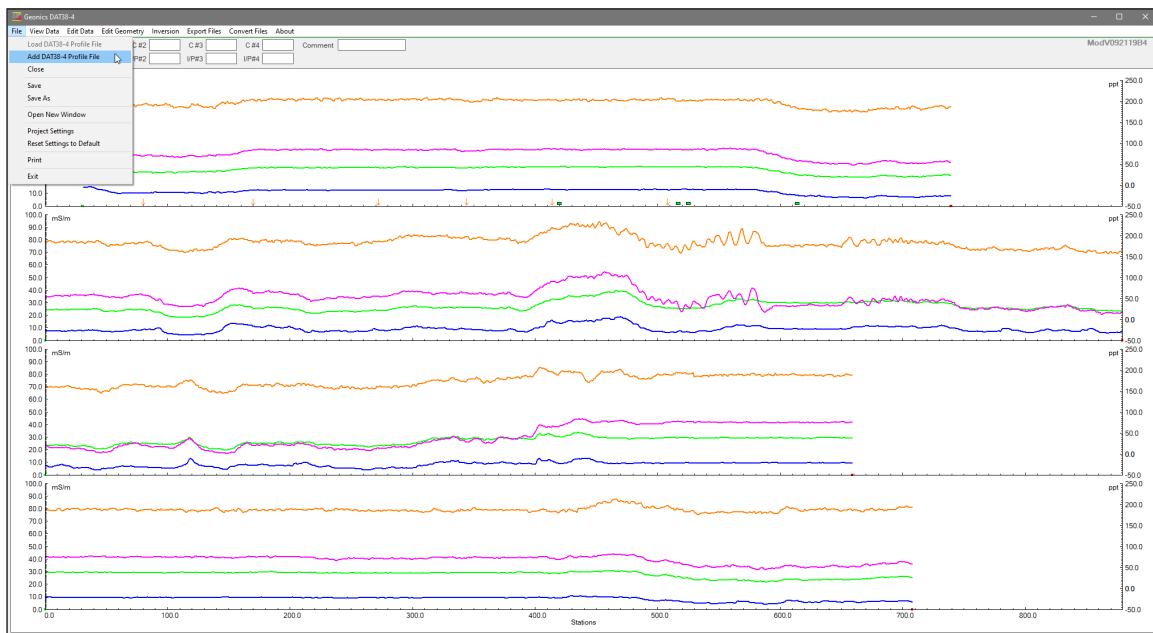


Figure 3.4 Add DAT38-4 Profile File menu

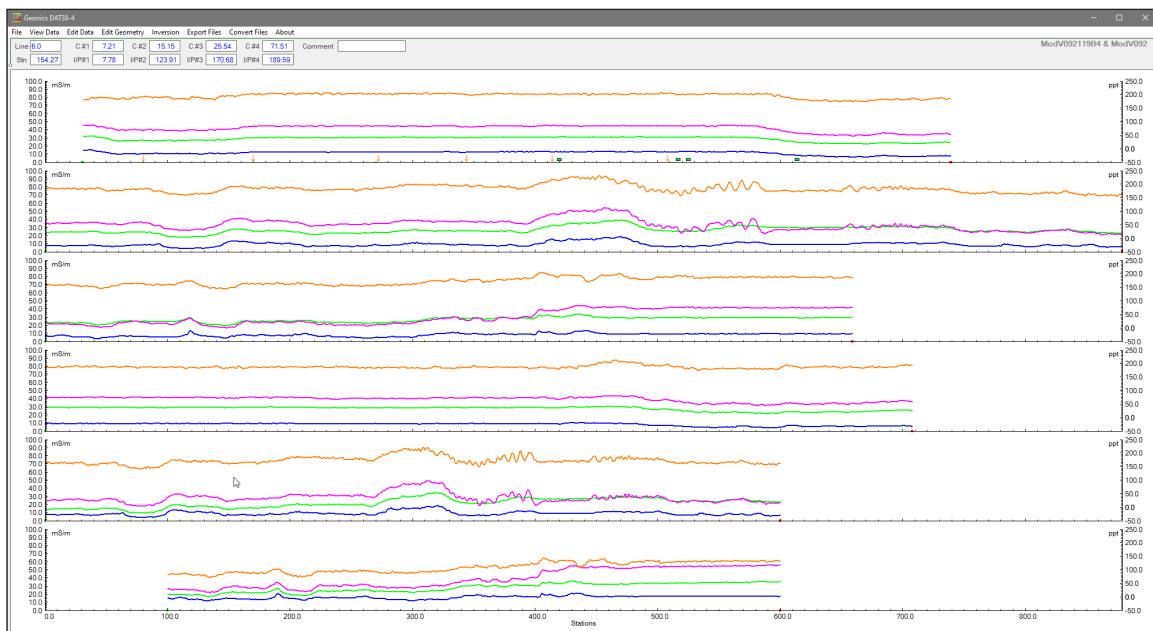


Figure 3.5 DAT38-4 screen after additional file is loaded

### Loading Additional Data Files in Separate Windows

- To open another data set (even the same file) in a new window, choose **File | Open New Window** (Figure 3.6).
- A new program window appears with a slight offset (Figure 3.7), where you can load a new file.
- Note: DAT38-4 is a Single Document Interface; each data set opens in its window with an independent menu. Windows can be re-sized, moved, and arranged freely—even if they display the same file.

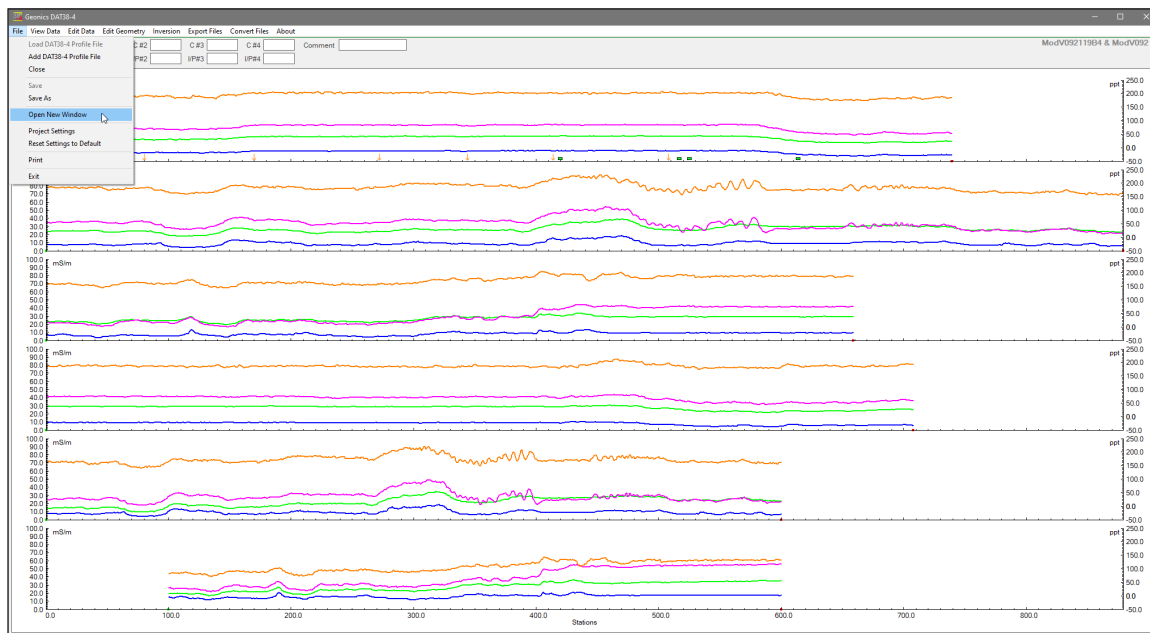


Figure 3.6 DAT38-4 File menu, Open New Window

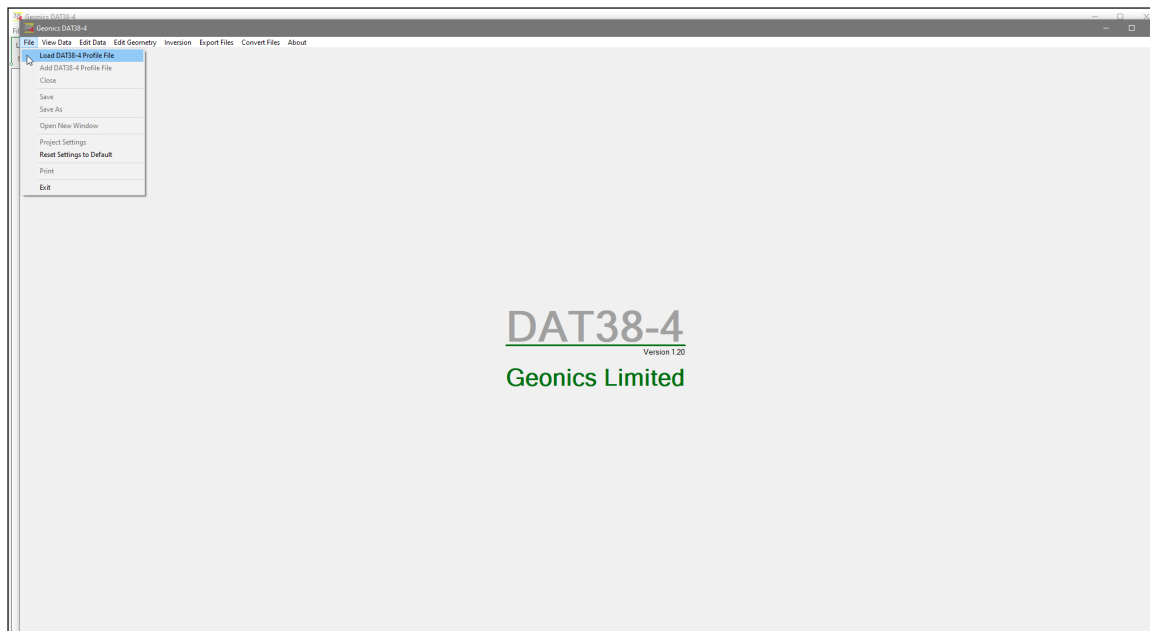


Figure 3.7 New DAT38-4 Program Window on top of previous data set

## 3.2 Closing Profile Window and Saving Data

### Closing a Window

- To close an active window, select **File | Close** (Figure 3.8) or click the window's close button.
- If unsaved changes exist, a Save Changes dialog appears (Figure 3.9).

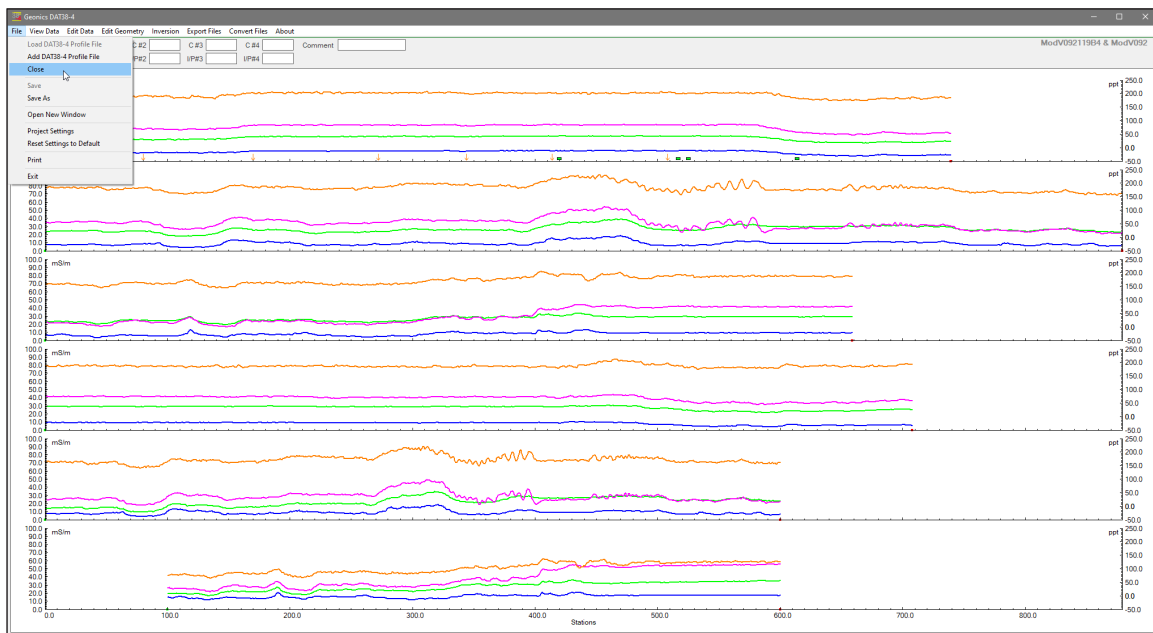


Figure 3.8 DAT38-4 File menu, Close item

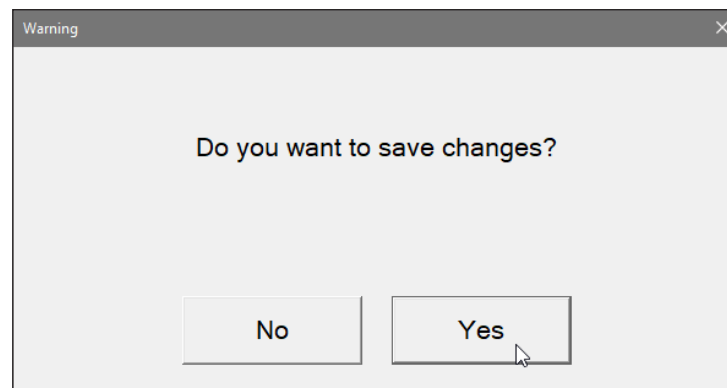


Figure 3.9 Save Changes dialog

## Saving Data

- **Save:** To update the current file, select **File | Save** (Figure 3.8). The window's caption shows the file name.
- **Save As:** It is recommended to use **Save As** (Figure 3.6) to preserve the original file. In the Save As dialog (Figure 3.10), choose a directory, enter a file name, and click **Save** (double-click or press Alt+S). Files saved this way use the F38 extension.

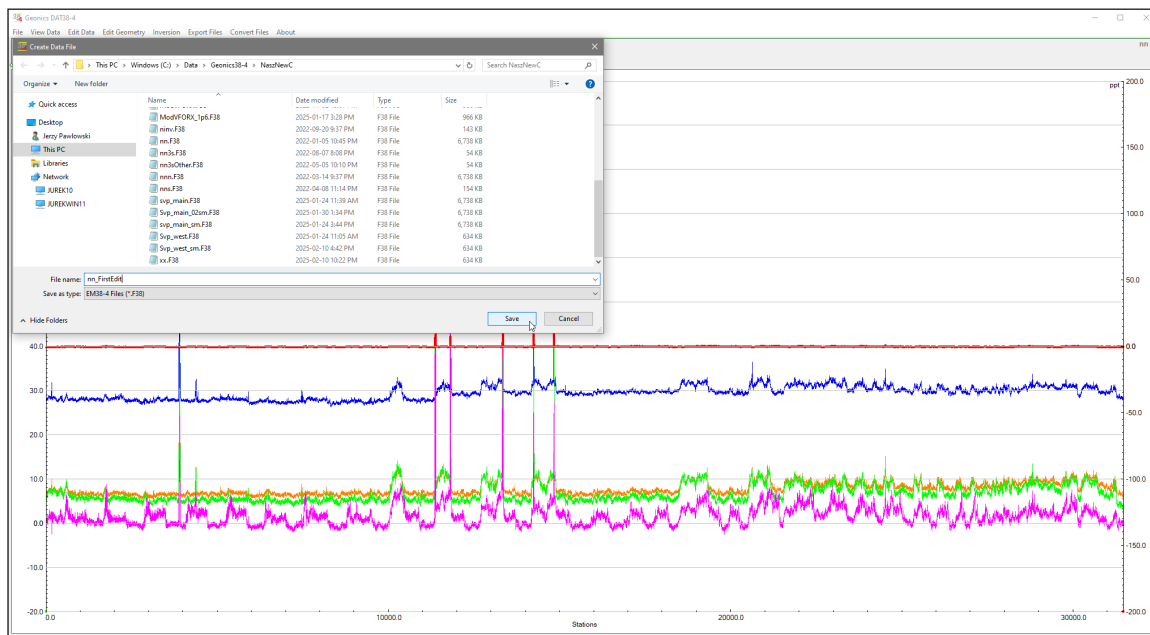


Figure 3.10 DAT38-4 Save As dialog

### 3.3 Project Settings

Some parameters can be adjusted in the loaded data set:

- **Distance Units:** Critical for grid-based XYZ file creation.
- **Inphase Units:** Can be set to mS/m or ppt. Adjust the range to properly display Inphase profiles.
- **EM38-4 Height:** The default, recorded during data collection, is used in inversion calculations. Update if necessary.
- **Instrument Orientation:** Specify the transmitter (TX) antenna position. The standard mode assumes the TX antenna is at the front. If it is at the back, check the appropriate option.

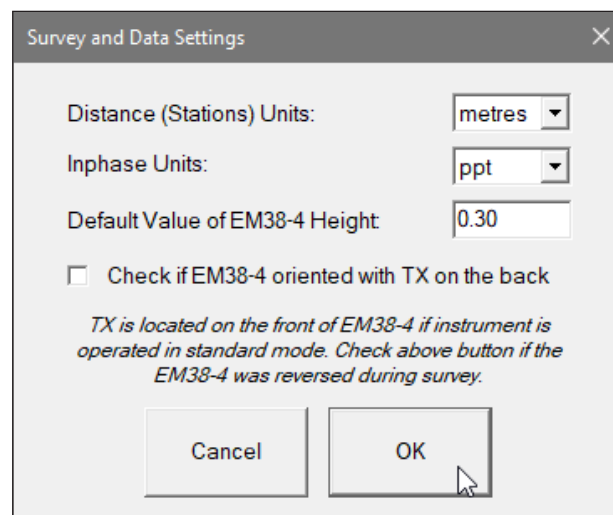


Figure 3.11 Survey and Data Settings dialog

Access these settings via **File | Project Settings** (Figure 3.11 above). All changes remain active until the program is closed. Use Save or Save As to make changes permanent.

## 3.4 Reset Parameters to Default

To restore all settings to their default values:

- Select **File | Reset Parameters to Default** (Figure 3.12).
- A warning dialog appears. Clicking **OK** will close the program. On the next startup, default settings are applied.

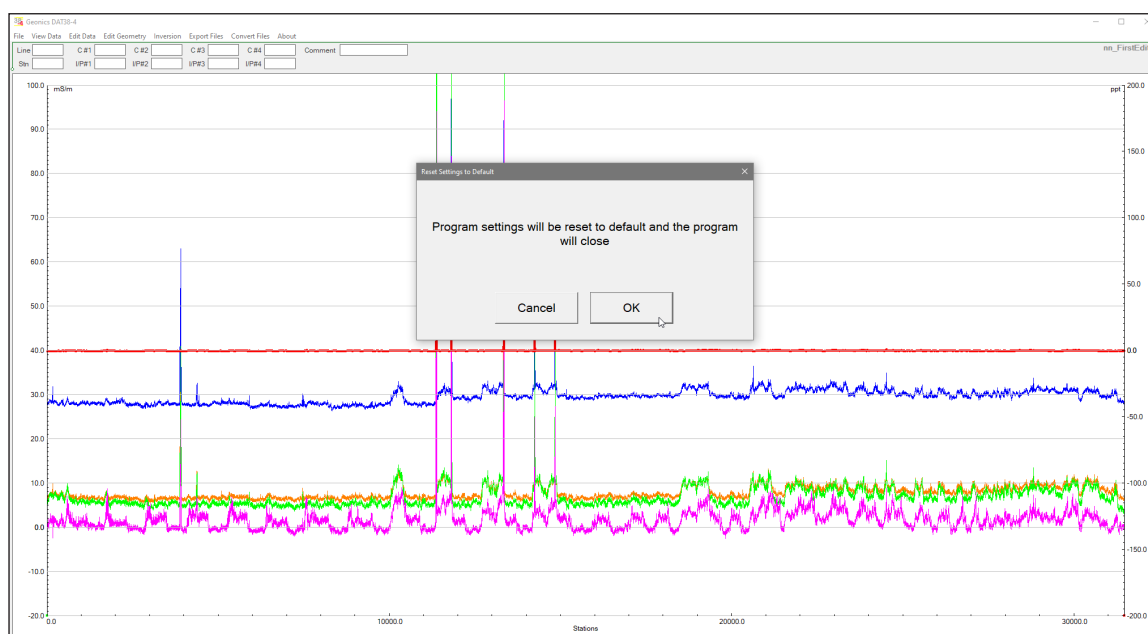


Figure 3.12 Reset Settings to Default dialog

## 3.5 Select, Delete and Rename Survey Lines

### Selecting Survey Lines

- When a data file is loaded, all survey lines appear.
- To filter lines, choose **View Data | Select Lines** (Figure 3.13).
- In the Select Survey Lines dialog (Figure 3.14):
  - The top right shows counts for Total, Selected, and Deleted lines.
  - The left list box displays all available lines, while the right shows the selected ones.
  - You can click line names to select/deselect them, use Select All/Unselect All, or reverse the order (Figure 3.15).
- **Note:** This selection only affects display; saving operations include all non-deleted lines.

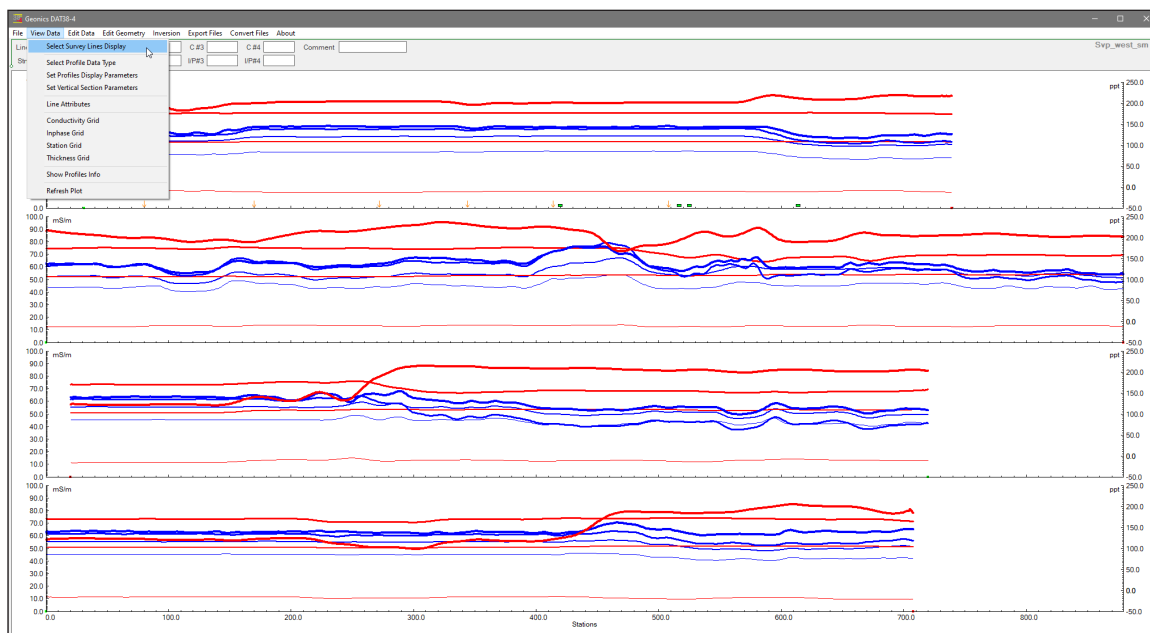


Figure 3.13 DAT38-4 View Data menu

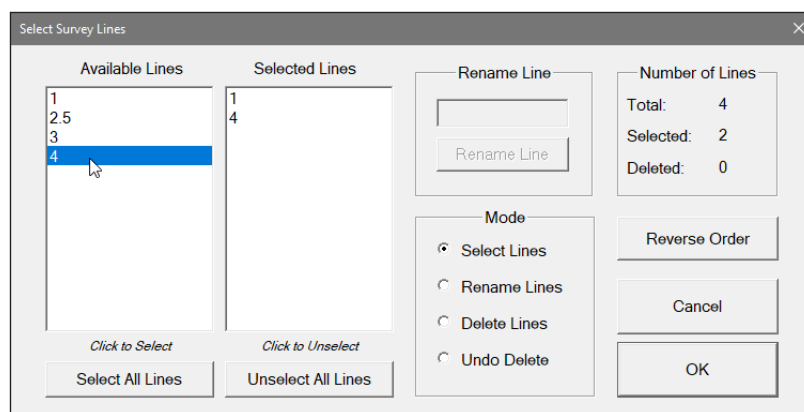


Figure 3.14 Select Survey Lines dialog

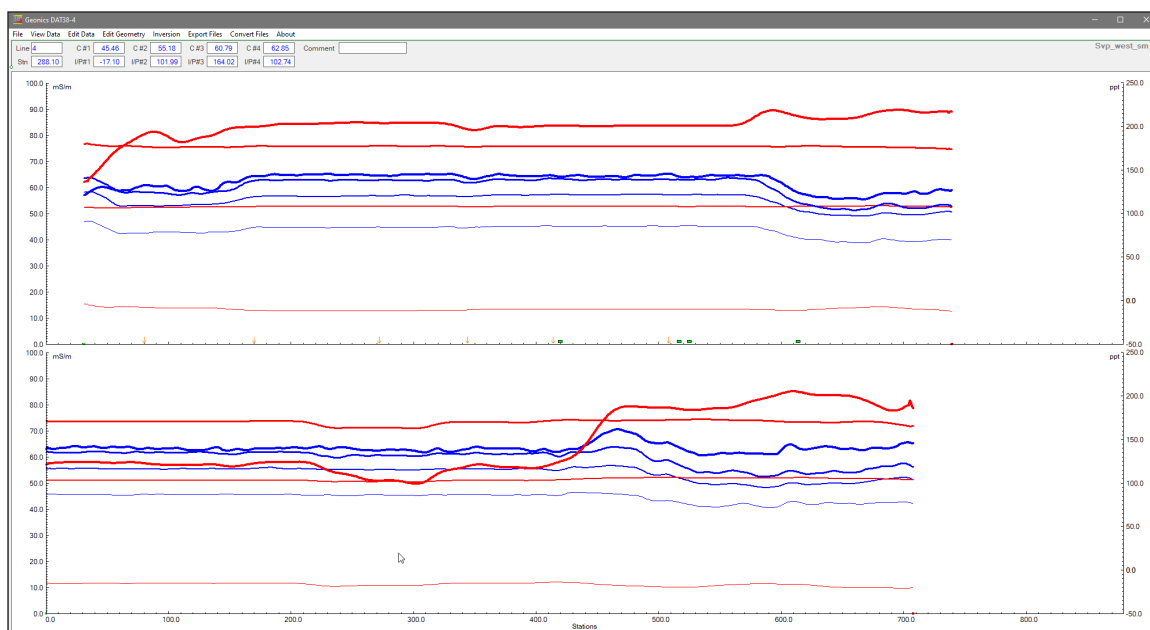


Figure 3.15 DAT38-4 screen with selected survey lines



## Deleting Survey Lines

- In the Select Lines window, switch to Delete mode (Figure 3.16).

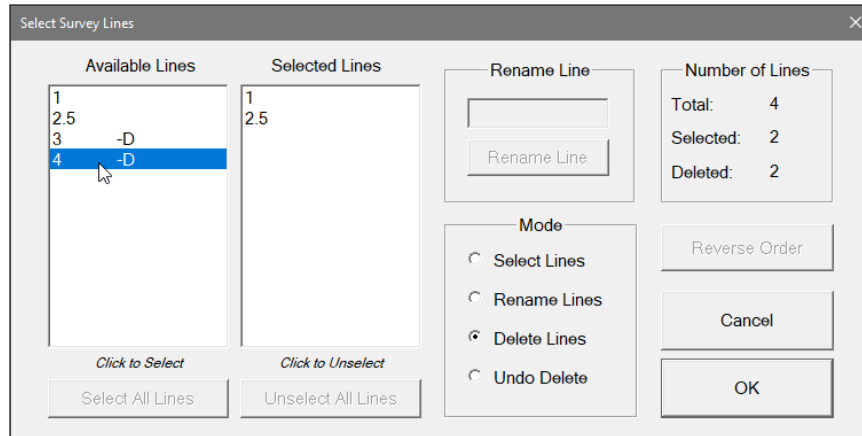


Figure 3.16 Select Survey Lines dialog during Delete Line procedure

- Click a line in the Available Lines list. A “D” appears next to its name (Figure 3.14) and will be omitted from display and saved files.
- To undelete, choose Undo Delete mode and click the line with the “D.”

## Renaming Survey Lines

- In Rename mode (in the Select Lines window), click a line name. The name appears in the Rename Line box (Figure 3.17).
- Edit the name and click Rename Line.
- **Note:** Changes are temporary until saved with Save As.

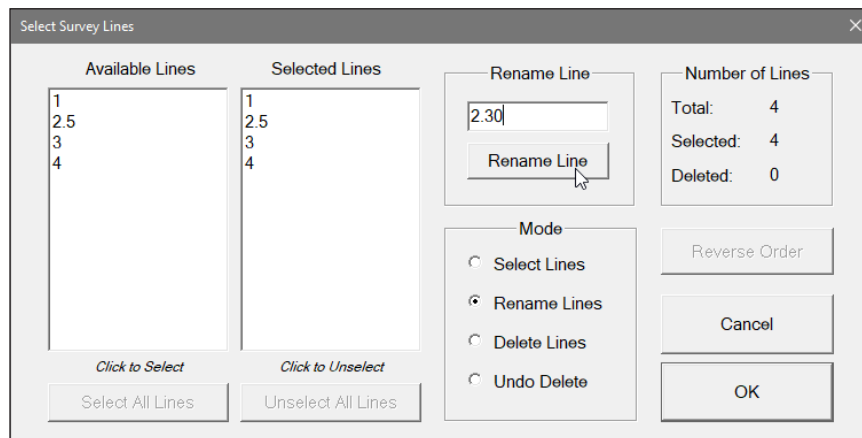


Figure 3.17 Select Lines window during Rename Line procedure

## 3.6 Select Profile Data Type

- Choose **View Data | Select Data Type** (Figure 3.13) to choose which data channels to display. The dialog appears as shown in Figure 3.18.
- Available data channels include:

- **Conductivity:**
  - #1 (Coil Separation 0.50 m)
  - #2 (Coil Separation 0.75 m)
  - #3 (Coil Separation 0.88 m)
  - #4 (Coil Separation 1.00 m)
- **Inphase:**
  - #1 (Coil Separation 0.50 m)
  - #2 (Coil Separation 0.75 m)
  - #3 (Coil Separation 0.88 m)
  - #4 (Coil Separation 1.00 m)
- **Inversion Results:**
  - Thickness of the first layer
  - Conductivity of the first layer (C. Layer #1)
  - Conductivity of the second layer (C. Layer #2)
- Inversion profiles are available only if inversion was applied during data collection. Selecting any inversion parameter automatically disables Inphase profiles (Figure 3.19), and a Thickness axis replaces the Inphase axis.
- Click **OK** to apply or **Cancel** to exit without changes.

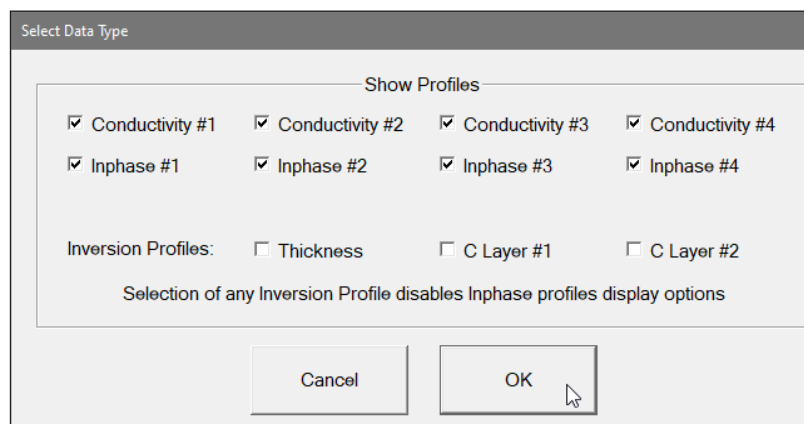


Figure 3.18 Select Data Type window

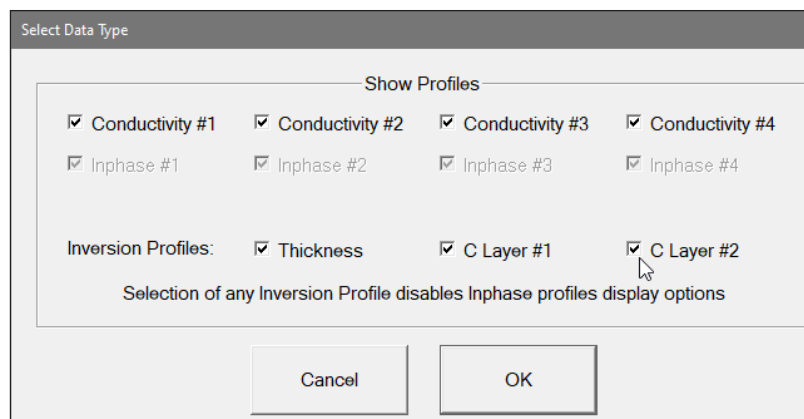
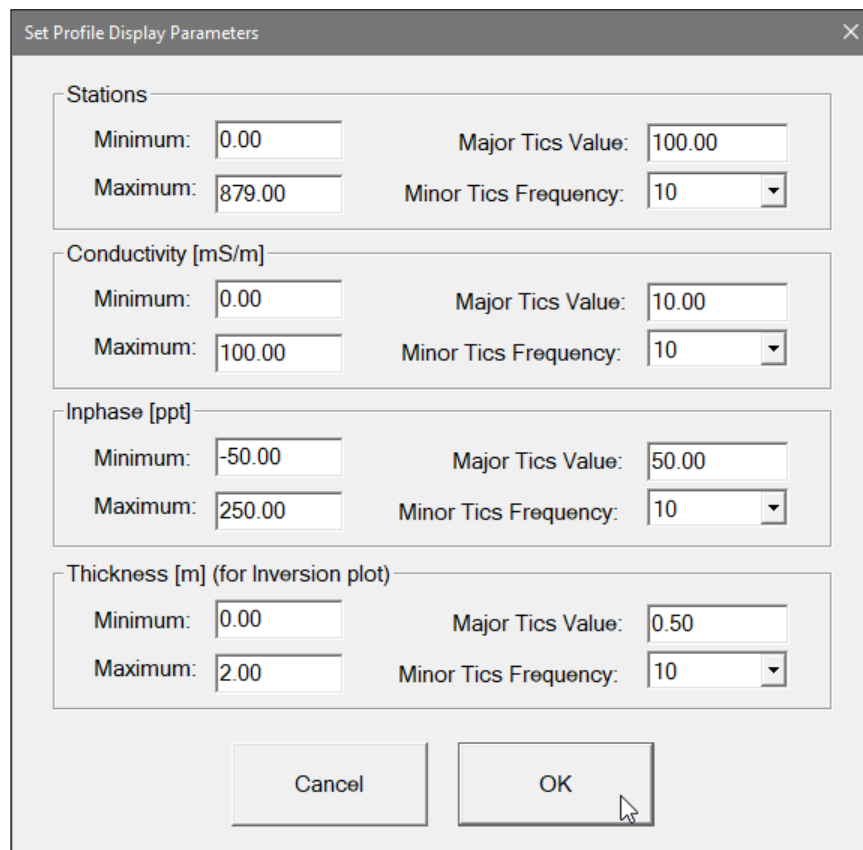


Figure 3.19 Select Data Type dialog with Inversion selected

## 3.7 Set Profile Display Parameters

- Open the Set Display Parameters dialog via **View Data | Set Display Parameters** (Figure 3.13 and Figure 3.20).
- Adjust the following:
  - Line length (stations displayed)
  - EM38-4 conductivity amplitude (mS/m)
  - Inphase amplitude (ppt or mS/m)
  - Thickness for Inversion (m), if applicable
- You can also set major and minor tick intervals, with labels and grid lines at major ticks only.
- Click **OK** to update the display.



The dialog box is titled "Set Profile Display Parameters" and contains four sections for configuring different data series. Each section has input fields for minimum and maximum values, major tick values, and minor tick frequencies. The sections are: Stations, Conductivity [mS/m], Inphase [ppt], and Thickness [m] (for Inversion plot). At the bottom are "Cancel" and "OK" buttons.

Parameter	Minimum	Maximum	Major Tics Value	Minor Tics Frequency
Stations	0.00	879.00	100.00	10
Conductivity [mS/m]	0.00	100.00	10.00	10
Inphase [ppt]	-50.00	250.00	50.00	10
Thickness [m] (for Inversion plot)	0.00	2.00	0.50	10

Figure 3.20 Set Display Parameters dialog

## 3.8 Set Vertical Section Parameters

- To adjust vertical cross-section settings, choose **Display | Set Vertical Section Parameters** (Figure 2.21).
- The dialog is divided into three sections:
  - **Plot Type:**
    - Profile Display Only (stacked profiles, see Figure 2.22)
    - Vertical Section Only (vertical sections, see Figure 2.23)
    - Both (display both profiles and vertical sections, see Figure 2.24)
  - **Conductivity [mS/m] (Inversion):**
    - Specify the conductivity range using a color bar updated in real time. This range is used when a vertical cross-section is included.
  - **Depth [m] (Inversion):**
    - Define maximum depth, major tick interval, and minor tick frequency. The minimum depth is fixed at zero (the soil surface).

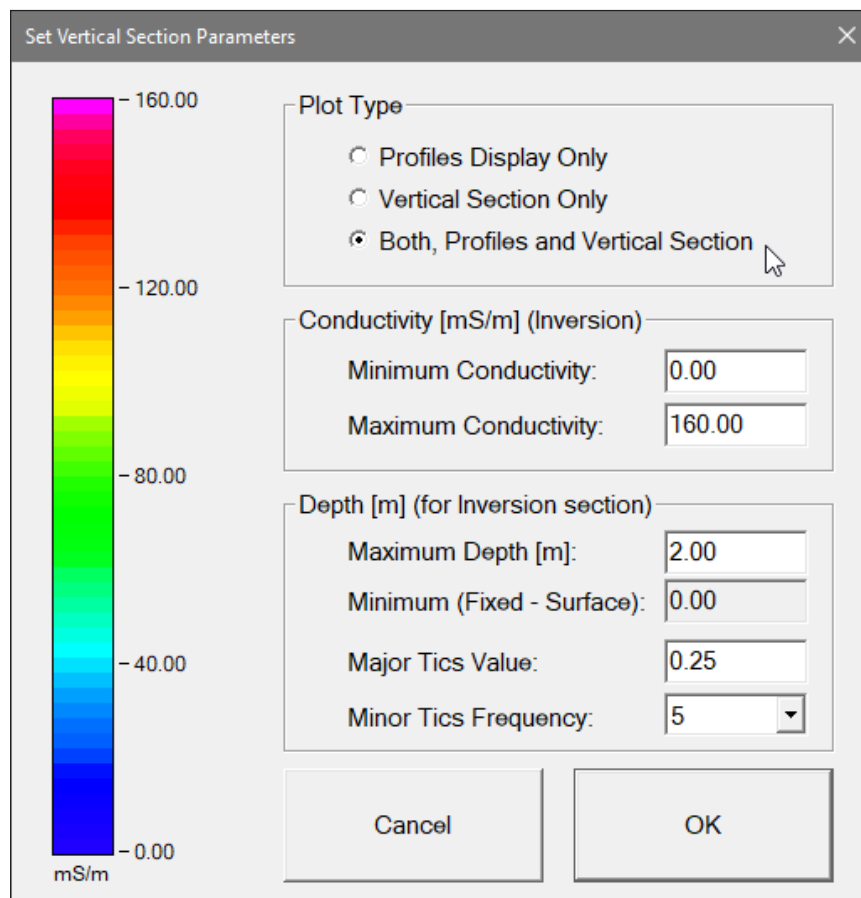


Figure 3.21 Set Vertical Section Parameters dialog

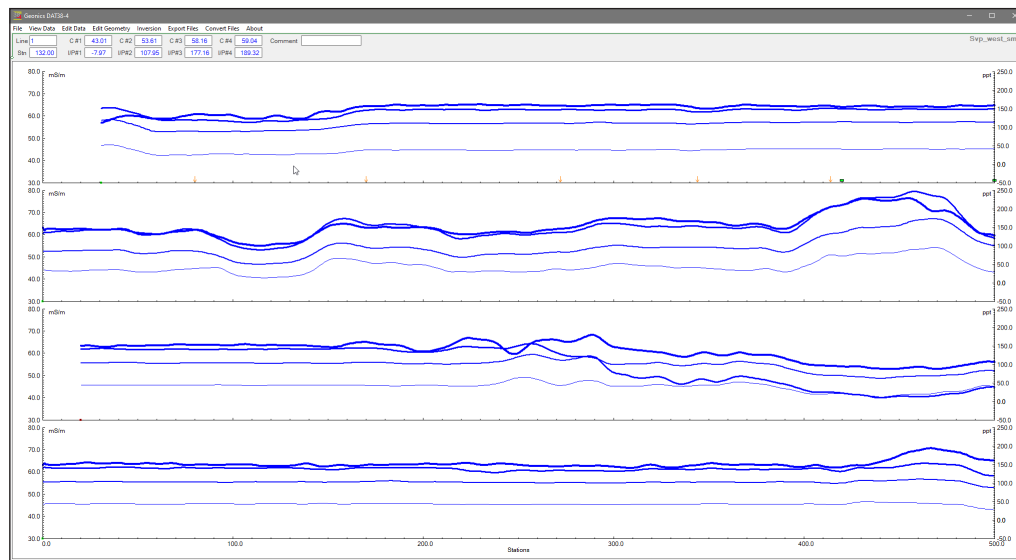


Figure 3.22 DAT38-4 screen set to the Profile Display Only type of display

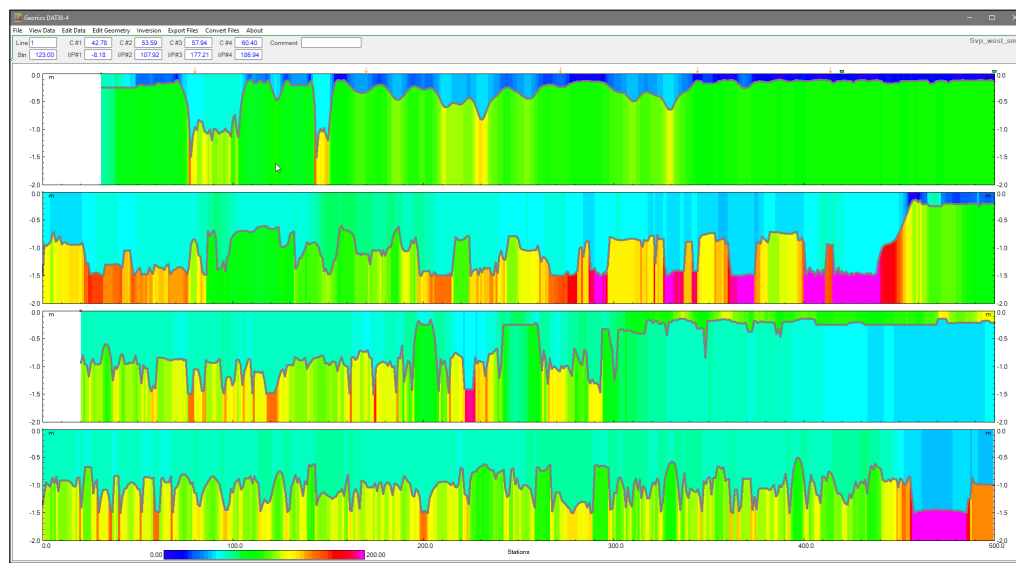


Figure 3.23 DAT38-4 screen set to the Vertical Section Only type of display

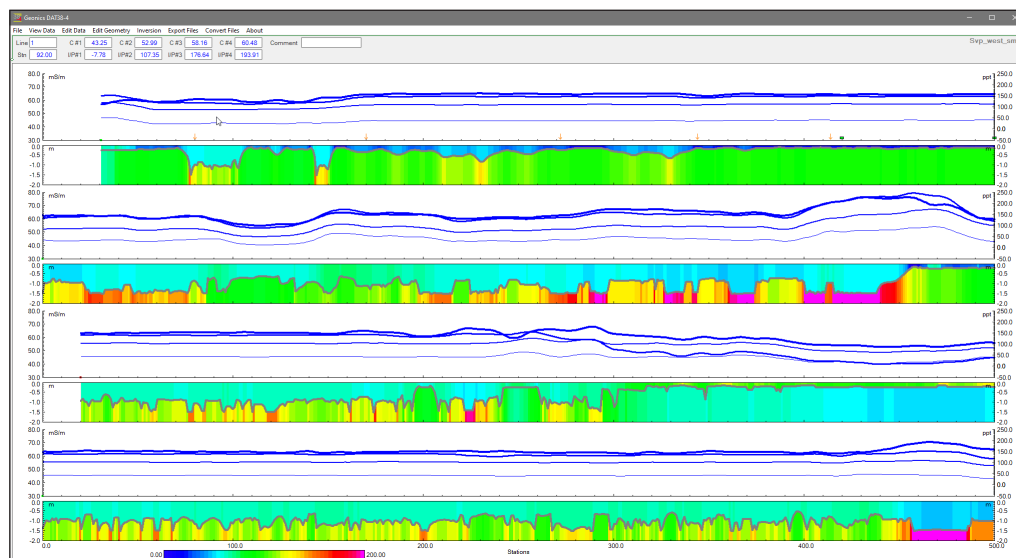


Figure 3.24 DAT38-4 screen set to the Both, Profiles and Vertical Section type

## 3.9 Line Attributes

- To change the color and thickness of profile lines, select View Data | Line Attribute (Figure 3.13).
- The Setup Display Options dialog appears (Figure 3.25, left):
  - Each line is labeled by its data type (e.g., Conductivity, Inphase, and Inversion Results).
  - Current color samples are shown as buttons. To change a color, click the button, select a new color in the Color dialog (Figure 3.26), and click OK.

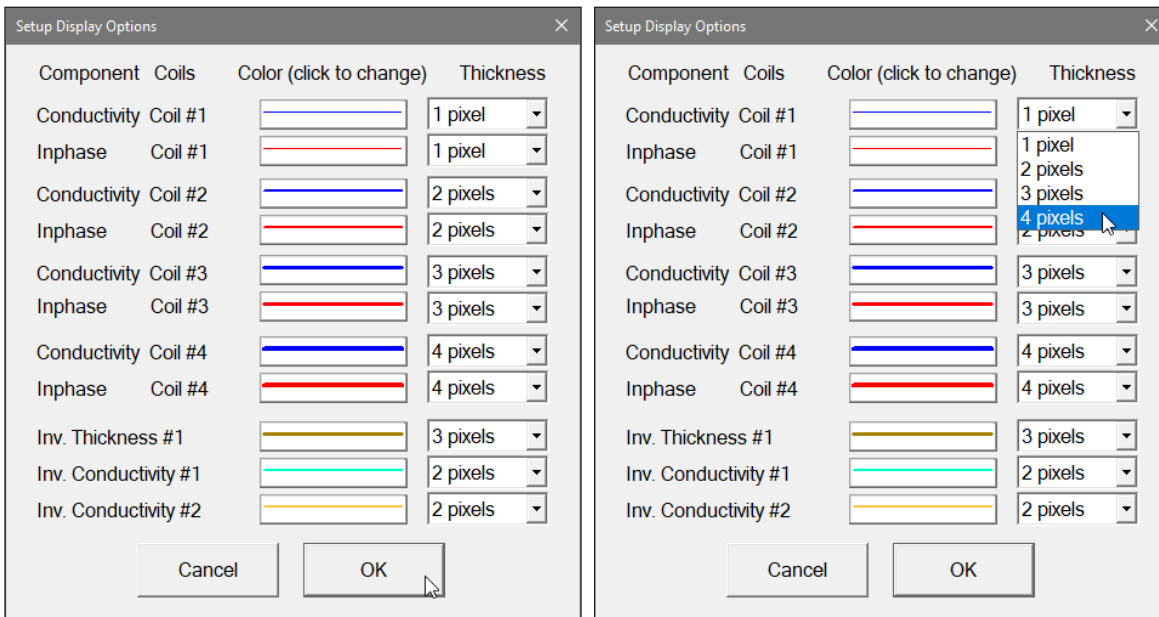


Figure 3.25 Select Display Options dialog and selecting profile line thickness

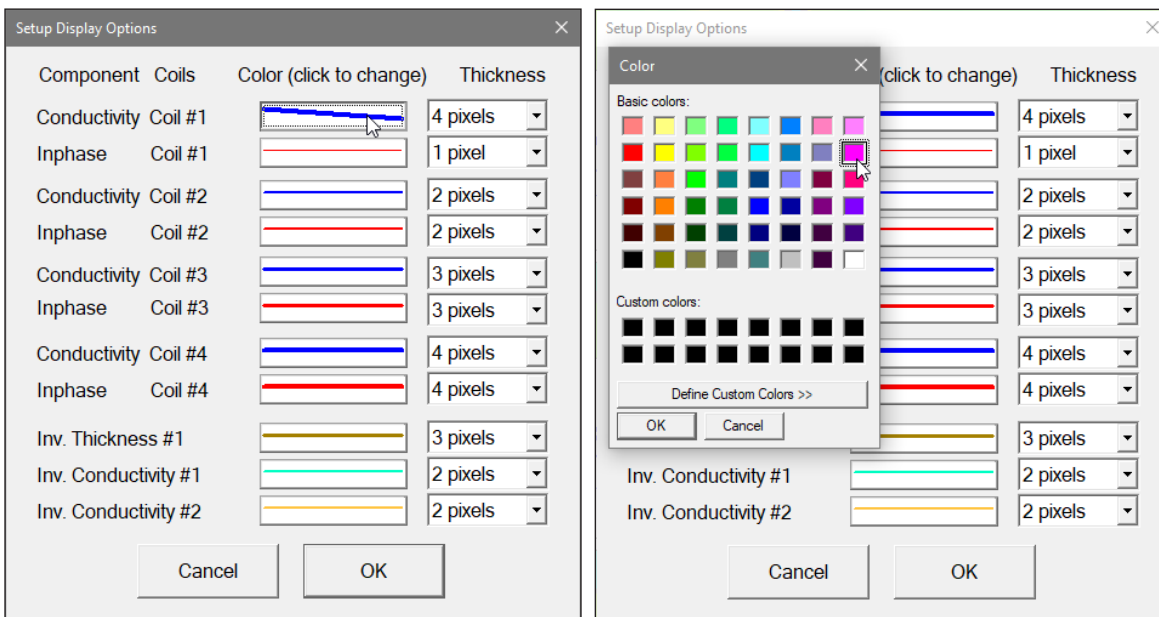


Figure 3.26 Selecting colour for a profile in the Setup Display Options and Color dialogs

- Change the line thickness using the corresponding combo box (Figure 3.25, right).
- Click OK to update the display. These settings are saved to the configuration file and used as defaults in future sessions.

## 3.10 Show Profiles Info

- Select this option to open a small window labeled Profiles Info (Figure 3.27) that displays graphic attributes for each profile.
- Click Exit to hide the window.

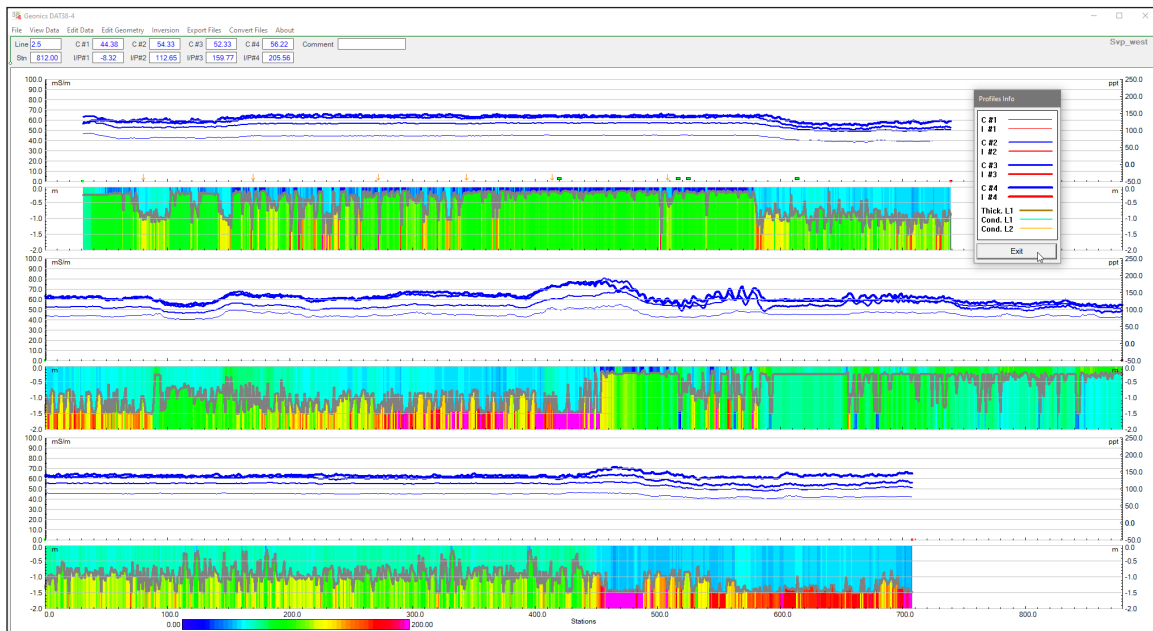


Figure 3.27 DAT38-4 screen with displayed legend for each profile

## 3.11 Grid Lines

- To display grid lines, select the following from the View Data menu:
  - Conductivity Grid
  - Inphase Grid
  - Station Grid
  - Thickness Grid (for inversion results)
- Grid lines are drawn at major tick marks as light grey lines (Figure 3.28). These lines help examine anomaly alignment and compare anomaly amplitudes across survey lines.

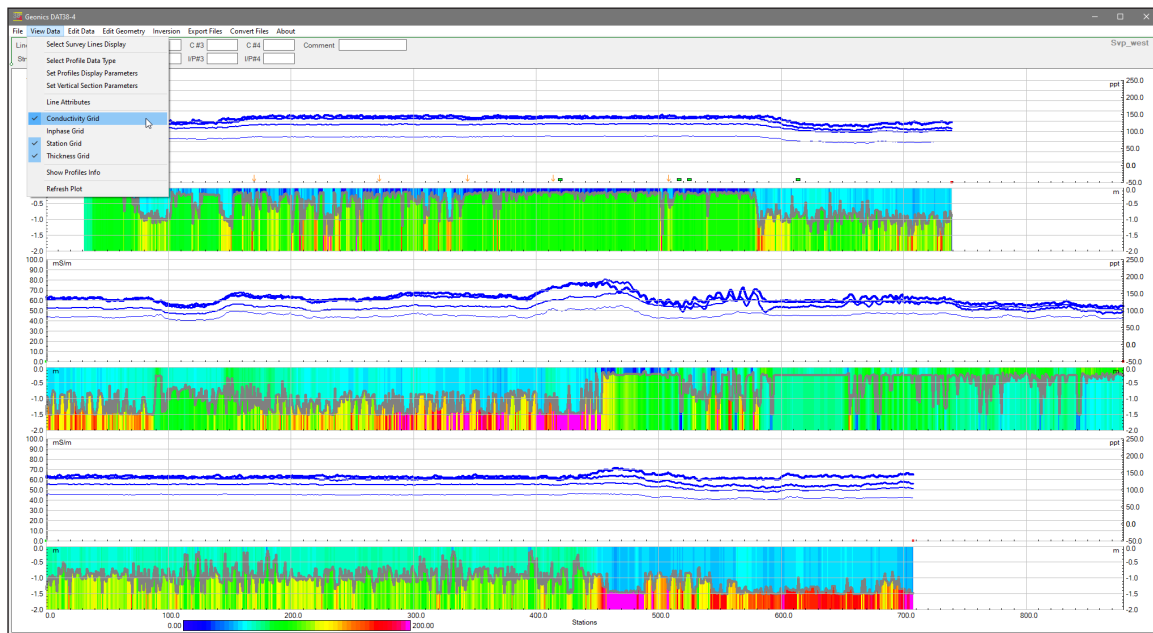


Figure 3.28 DAT38-4 screen with stacked profiles display while grid lines for conductivity, thickness, and stations are enabled



## 4. Edit Data

To access the Edit Data functions, select **Edit Data** from the main menu at the top of the screen (Figure 4.1). In the current version, this menu includes four options: **Shift Data Set**, **Linear Drift Correction**, **Smoothing Data**, and **Drift Correction using Control Points** (the latter is available when drift control points were recorded during data collection). These functions are enabled only when the profile plots display type is active; a corresponding message will be shown if a vertical section is included.

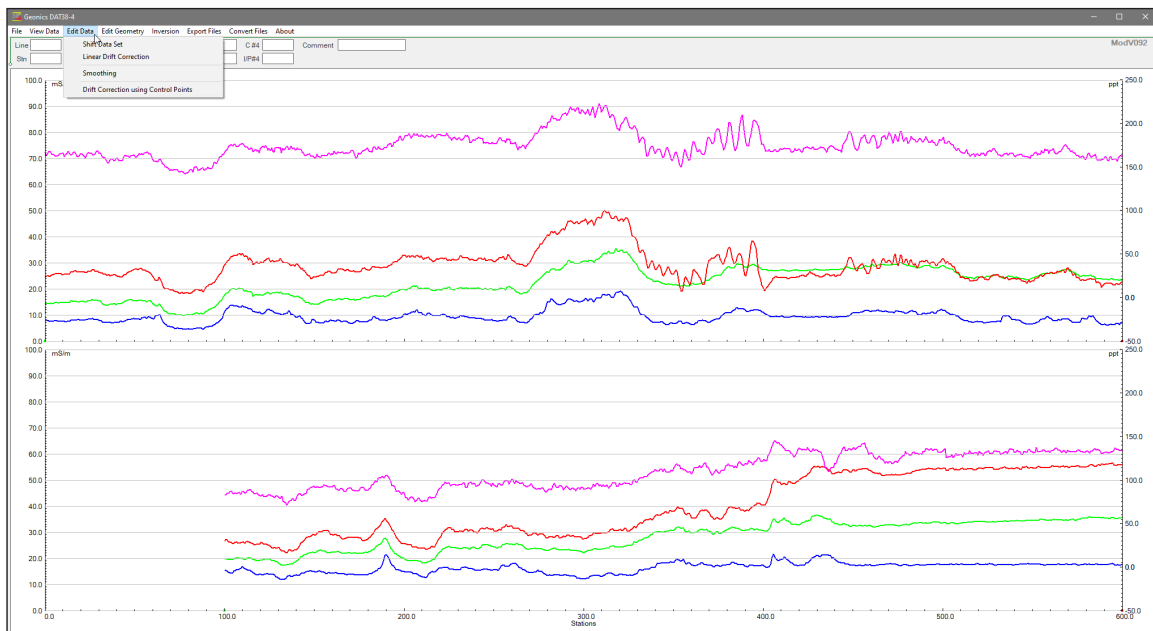


Figure 4.1 DAT38-4 Edit Data menu

### 4.1 Shift Data Set

To open the Shift Data Set dialog, select **Edit Data | Shift Data Set** from the main menu (Figure 4.1). The dialog appears as shown in Figure 4.2.

The image shows a 'Shift Data' dialog window. It has four main sections: 'Available Lines' with a list containing '6.0' and '7.0' and a 'Click to Toggle' button; 'Select Type' with a list containing 'Conductivity #1', 'Inphase #1', 'Conductivity #2', 'Inphase #2', 'Conductivity #3', 'Inphase #3', 'Conductivity #4', and 'Inphase #4', and a 'Click to Toggle' button; 'Step and Shift Buttons' with input fields for 'Cond.: 0.00' and 'Inphase.: 0.00', and 'Shift UP' and 'Shift DOWN' buttons; and 'Total Shift' with a table showing 'Cond. #1: 0.00', 'Inph. #1: 0.00', 'Cond. #2: 0.00', 'Inph. #2: 0.00', 'Cond. #3: 0.00', 'Inph. #3: 0.00', 'Cond. #4: 0.00', and 'Inph. #4: 0.00'. At the bottom, there are 'Refresh Plot', 'Cancel', and 'Accept & Exit' buttons. A note at the bottom states: 'Shift values apply to current selection of lines and profile type only'.

Figure 4.2 Shift Data Set window

This function lets you adjust (shift) all readings for one or more survey lines by a constant amount.

- **Selecting Survey Lines and Data Types:**
  - Click on survey line names in the **Available Lines** box.
  - Choose the data types by clicking on the items in the **Select Type** box.
  - Selected items are highlighted (see Figure 4.3).
  - To shift data for all survey lines and types, click the **All Lines** and **All Profiles** buttons.



Figure 4.3 DAT38-4 during Shift Data operation

- **Specifying the Shift:**
  - Enter the shift increments for Conductivity and Inphase in the respective edit boxes (**Cond** and **Inphase**) under the **Step and Shift** section. (An increment of 0 means no shift for that component.)
  - Click **Shift UP** or **Shift DOWN** to apply the change.
  - The total shift is displayed in the **Total Shift** box, and the profile view updates in real-time.
  - The Shift Data Set window can be repositioned as needed (see Figure 4.3). Original profiles appear as gray lines for easy comparison; if any parts of the profiles disappear, click the **Refresh Plot** button.
- **Exiting:**
  - Click **Accept & Exit** to close the window and temporarily save the changes. To make these changes permanent, use the **Save** or **Save As** options from the File menu.

## 4.2 Linear Drift Correction

To open the Linear Drift Correction dialog, select **Edit Data | Linear Drift Correction** from the main menu (Figure 4.1). The dialog appears as shown in Figure 4.4.

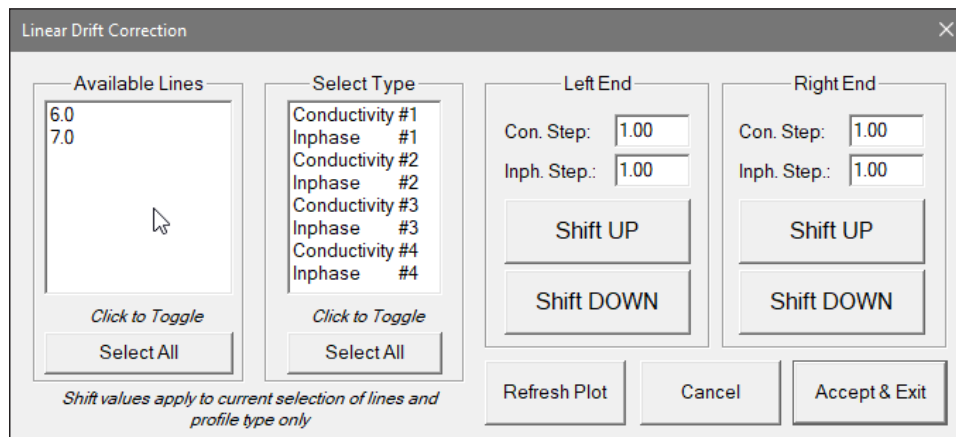


Figure 4.4 Linear Drift Correction dialog

This feature lets you correct linear drift—caused by site properties or other factors—by shifting one or both ends of a survey line.

- **Selecting Survey Lines and Data Types:**
  - Select survey lines by clicking their names in the **Available Lines** box.
  - Choose data types by clicking the items in the **Data Type** box.
  - The selected items are highlighted (see Figures 4.4 and 4.5).
- **Specifying End Shifts:**
  - Enter shift increments in the edit boxes labeled **Step** under the **Left End** and **Right End** sections.
  - Click **Shift UP** or **Shift DOWN** in the respective section to apply the shift.
  - The adjusted data is recalculated and displayed in real-time, with the dialog movable for convenience (Figure 4.5). The updated profiles (see Figures 4.5 and 4.6 for conductivity and Inphase) still show the original curves as gray lines for comparison.



Figure 4.5 DAT38-4 during Linear Drift Correction procedure

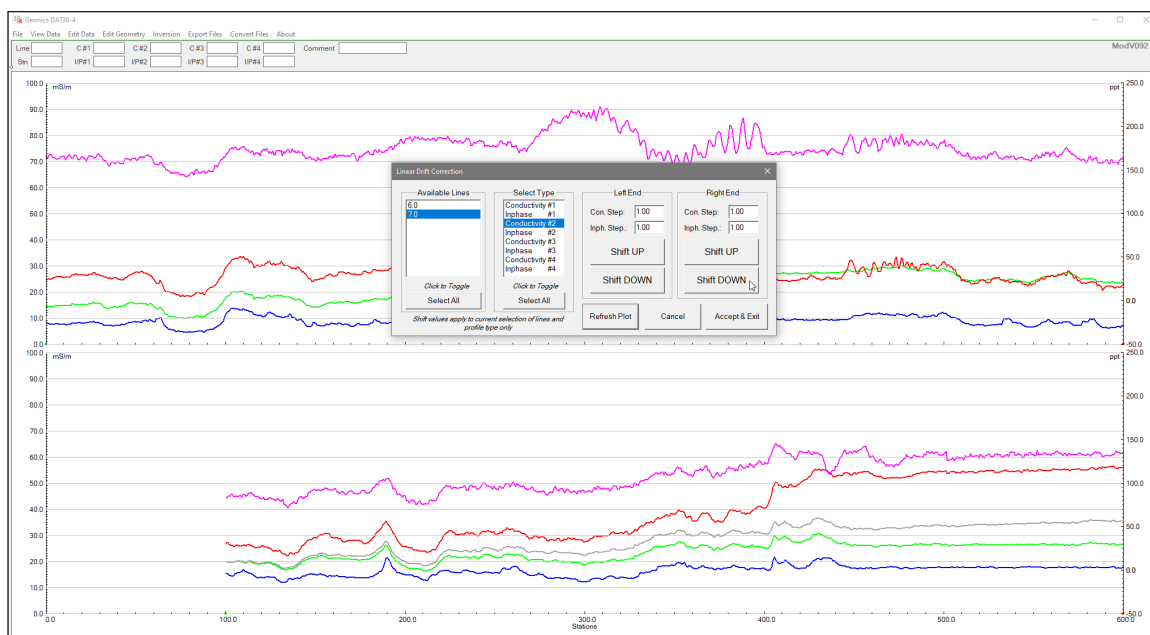


Figure 4.6 DAT38-4 during Linear Drift Correction procedure

- Exiting:
  - Click **Accept & Exit** to close the dialog and temporarily save your changes. Use **Save** or **Save As** from the File menu to permanently update the data file.

## 4.3 Smoothing Data

To open the Smooth Data window, select **Edit Data | Smooth Data** from the main menu (Figure 4.1). The window appears as shown in Figure 4.7.

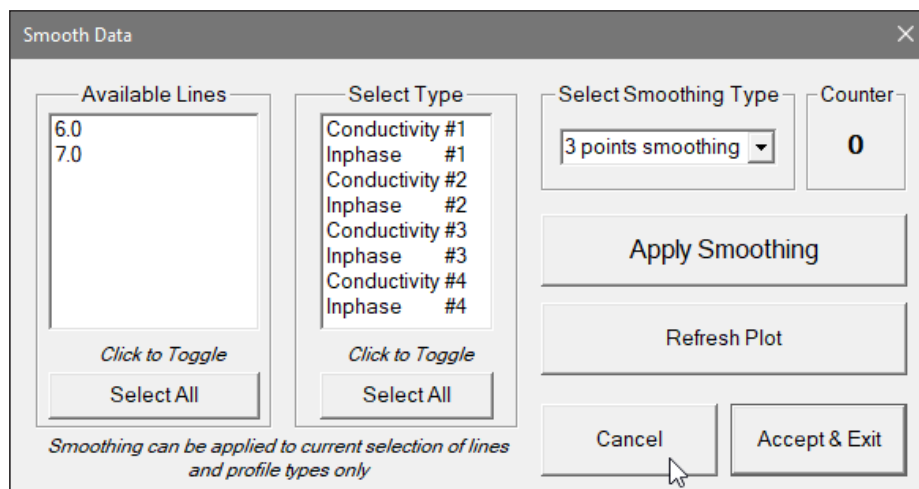


Figure 4.7 Smoothing Data dialog

This function applies a smoothing algorithm to reduce noise in selected survey lines and data types.

- **Selecting Data:**
  - Choose the desired survey lines from the **Lines** list box.
  - Select the channels to smooth from the **Select Type** section.

- **Choosing a Smoothing Method:**
  - Several smoothing routines are available (for example, 3-point linear smooth, 5-point linear smooth, etc.).
  - Select the desired routine from the **Select Smooth Routine** pull-down menu (Figure 4.8).

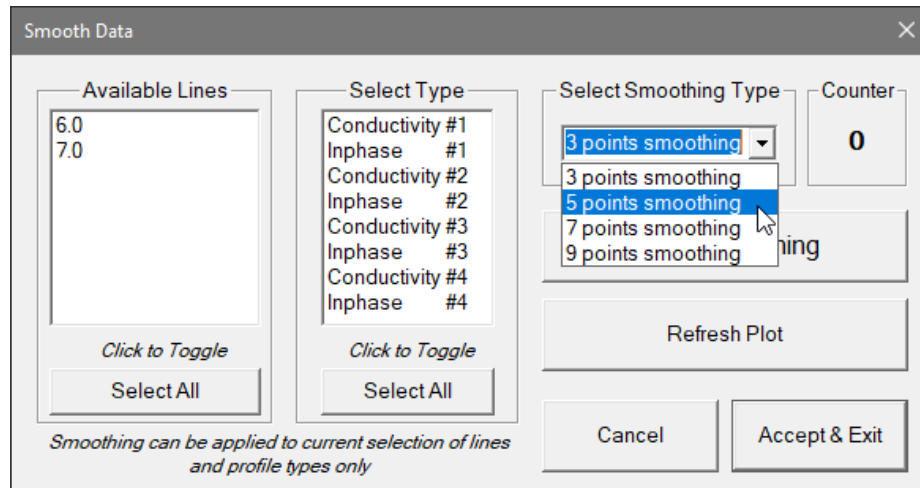


Figure 4.8 Smoothing Data - Available Smooth procedures

- **Applying Smoothing:**
  - After making your selections, click **Apply**.
  - You can apply smoothing multiple times; the number of iterations is displayed in the **Counter** section (upper right corner of the dialog).
  - The profile view updates in real-time, with the original curves in gray for easy comparison (Figure 4.9).

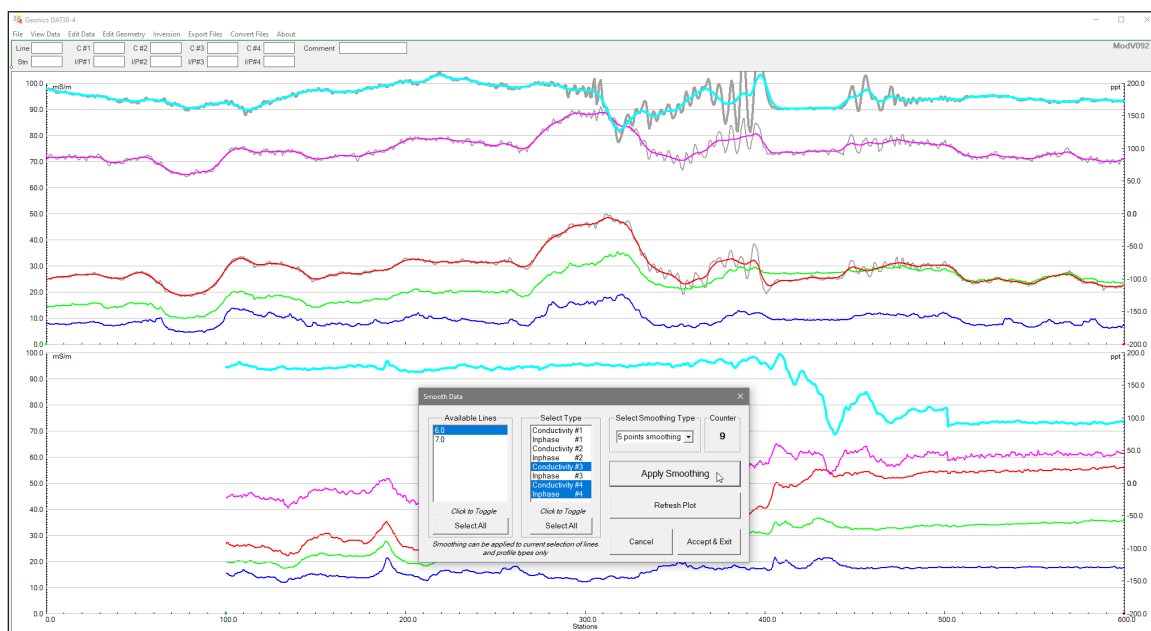


Figure 4.9 DAT38-4 during Smoothing procedure

- **Exiting:**
  - Click **Accept & Exit** to close the window and temporarily save the changes. Permanent changes require using **Save** or **Save As** (it is recommended to use **Save As** to preserve the original data).
  - The final display with smoothed profiles is shown in Figure 4.10 (compare with Figures 4.6 and 4.9).

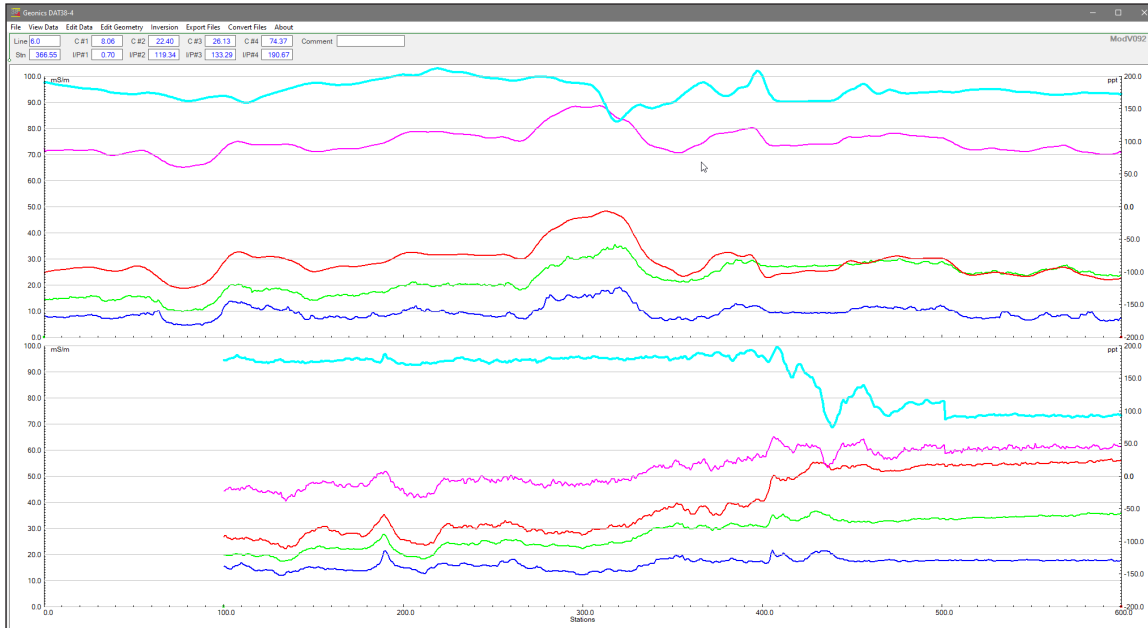


Figure 4.10 DAT38-4 screen with some profiles smoothed (compare with Figure 4.6)

## 4.4 Drift Correction using Control Points

Drift Control Points—recorded by the EM38-4 (version 1.06 or later)—appear as small green arrows along the horizontal axis. For example, Figure 4.11 shows a survey line with four green arrows. All four conductivity profiles should ideally remain constant in that example (a short stationary measurement with artificially induced drift). However, visible discontinuities occur due to drift (recorded at the survey start, near stations 1690 and 1770, and at the end). These discontinuities

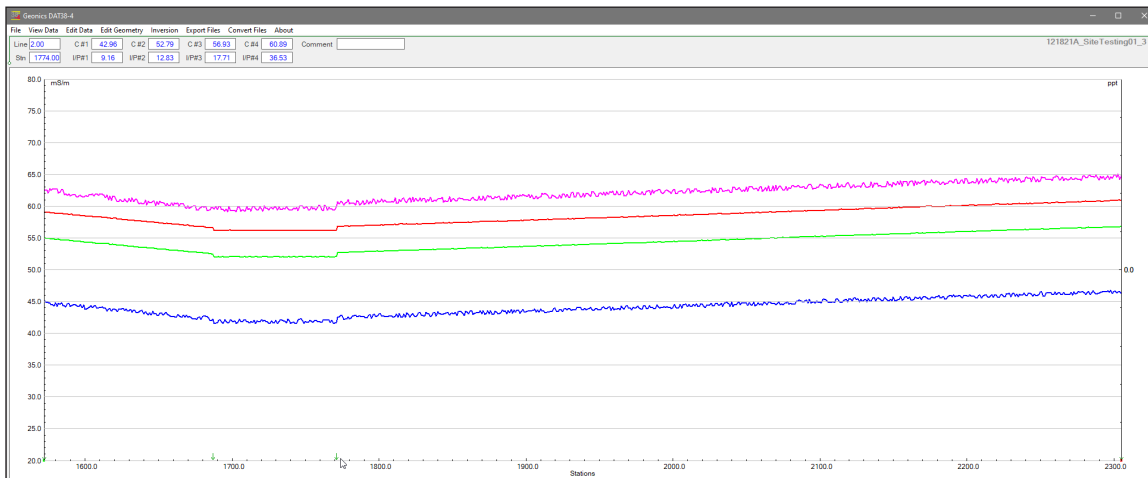


Figure 4.11 DAT38-4 screen with survey line that contains Drift Control Points

result from unusually high drift and a delay (about 10 seconds) in starting the logging process. Additionally, profiles are plotted based on station number rather than time, which may exaggerate the appearance of rapid signal changes between stations.

- **Important Points:**

- The Drift Correction procedure can be applied only once per data set.
- Green arrows indicate that drift correction has not been performed. After correction, these arrows change to blue (see Figure 4.15).

- **Procedure:**

1. Select **Edit Data | Drift Correction using Control Points** from the main menu (Figure 4.12).

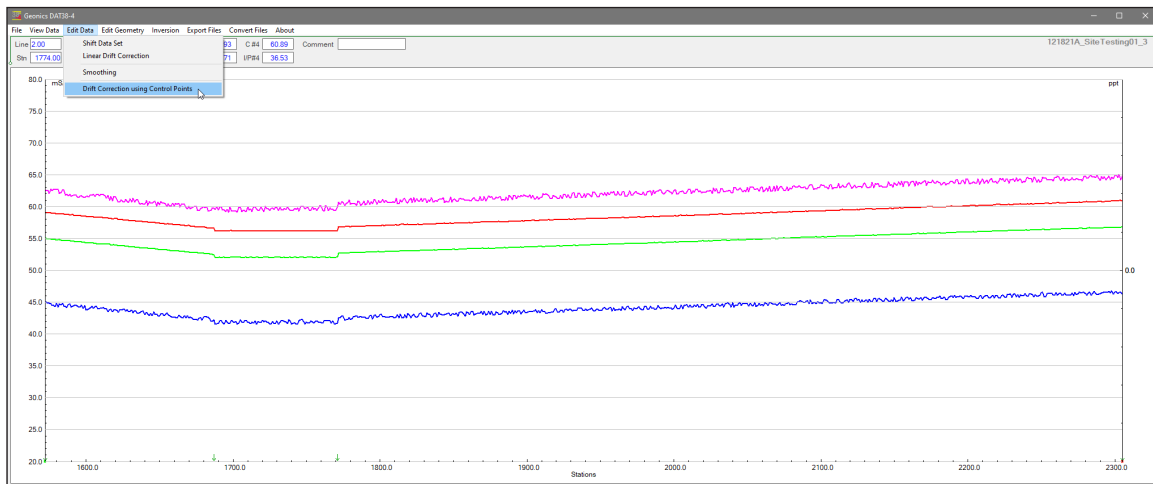


Figure 4.12 DAT38-4 screen with the Drift Correct menu item selected

2. The Drift Correction dialog (Figure 4.13) shows the number of available Control Points. A warning at the bottom notes that there is no Undo function.

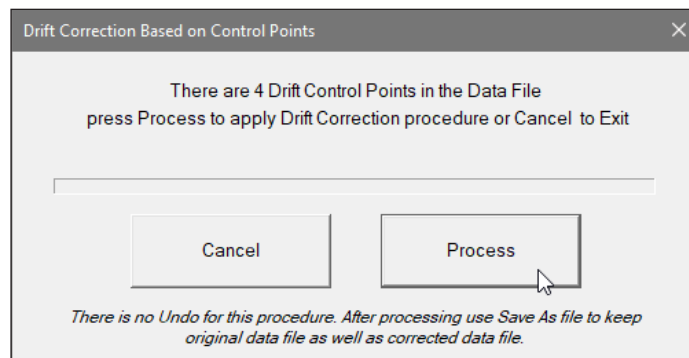


Figure 4.13 Drift Correction... dialog

3. Use **Save As** to create a new file that preserves the original data for safety.
  4. Click the **Process** button to start the correction; a progress bar indicates the procedure's progress (Figure 4.14). The duration depends on the data file's size.
  5. Once complete, the corrected profile plots are redrawn, and the Drift Control Points are shown as blue arrows (Figure 4.15).
- **Additional Considerations:**
    - If you attempt to run the Drift Correction procedure on data that has already been corrected (indicated by blue arrows), a message will appear (Figure 4.16).

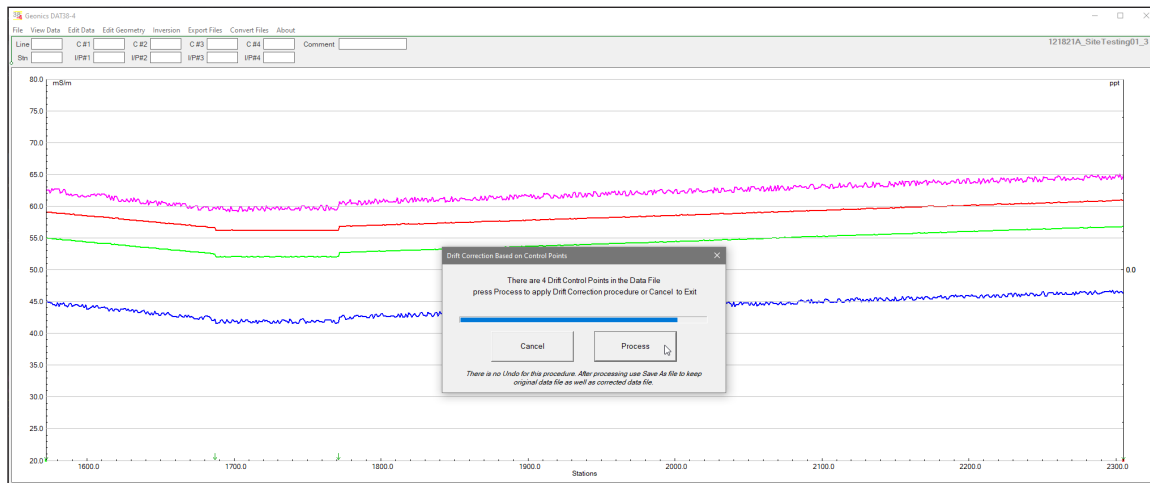


Figure 4.14 DAT38-4 screen during Drift Correction procedure

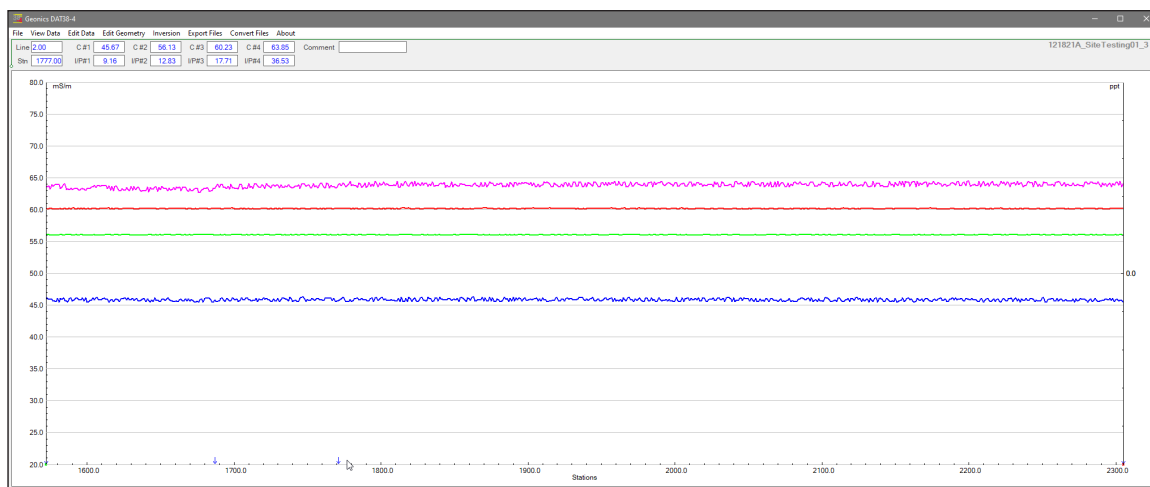


Figure 4.15 DAT38-4 screen with Drift Corrected profiles (compare with Figure 4.11 or 4.12)

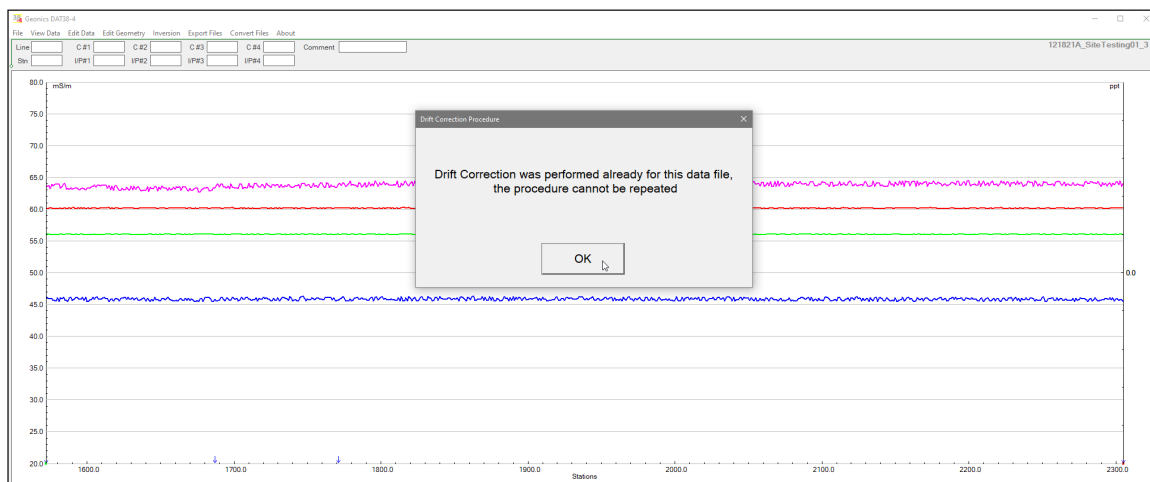


Figure 4.16 DAT38-4 screen with info about previously performed Drift Correction procedure

- If the data file contains none or only one Drift Control Point, an information message is displayed (Figure 4.17).



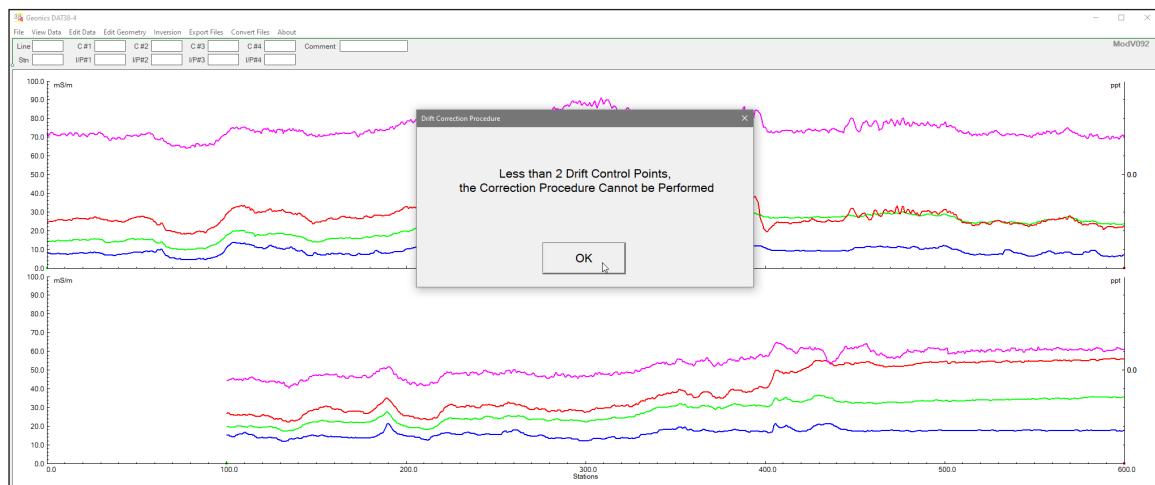


Figure 4.17 Dialog indicating insufficient Drift Control Points to perform Drift Correction

- The Drift Correction procedure cannot be applied to appended data sets (using **Add DAT38-4 Profile File**). A message will appear if multiple data files are loaded (Figure 4.18). In such cases, perform drift correction on each file separately, then use the **Add DAT38-4 Profile File** function to combine them into a single data set.

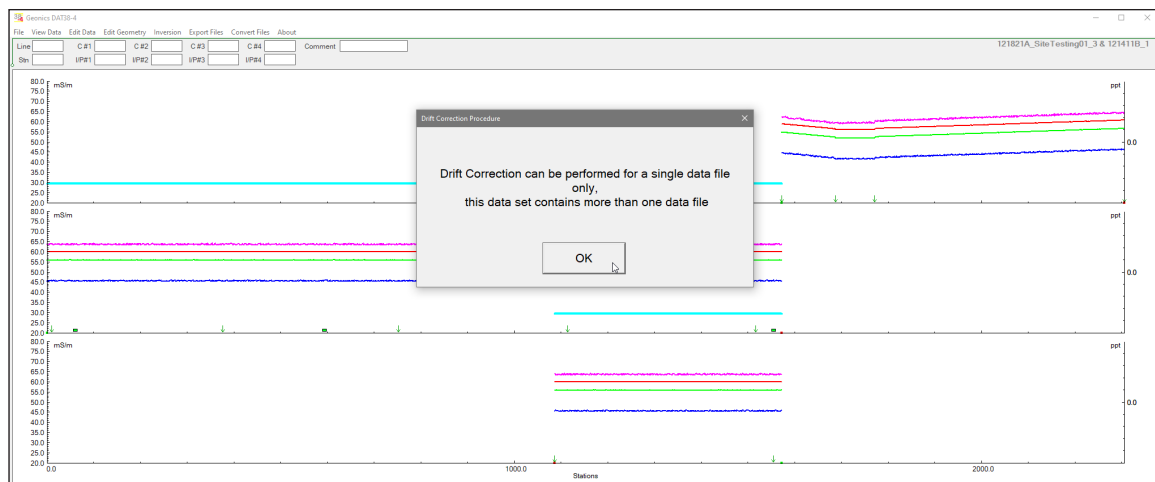


Figure 4.18 Warning message displayed when more than one data files are loaded and Drift Correction is attempted



# 5. Edit Survey Geometry

The Edit Geometry option lets you adjust the profile geometry by repositioning the start and end stations of survey lines and any stations marked with a fiducial switch. To access this menu, select **Edit Geometry** from the main menu at the top of the screen (Figure 5.1). This menu provides three functions:



Figure 5.1 DAT38-4 Edit Geometry menu

- **Set Line Limits:** Change the start and end station positions for selected survey lines.
- **Shift Survey Lines:** Move selected survey lines left or right along the profile axis.
- **Position Markers/Line Ends:** Align fiducial markers and adjust start/end stations efficiently.

## 5.1 Set Line Limits

To open the Set Line Limits dialog, select **Edit Geometry | Set Line Limits** from the main menu (Figure 5.1). The dialog appears as shown in Figure 5.2.

- **Selecting Lines:**
  - Use the **Select Lines** list box to choose one or more survey lines.
  - The **Current Line Limits** display shows the selected lines' minimum (Left) and maximum (Right) station positions.
  - Initially, no lines are selected; when you choose lines, the **Current Selection Limits** boxes update with the corresponding minimum and maximum values.
- **Setting New Limits:**
  - Enter new Left and Right End positions in the **Set Lines Selection Limits** edit boxes.
  - Click **Apply Settings** to adjust the limits. The graphic displays updates in real time (Figure 5.3).

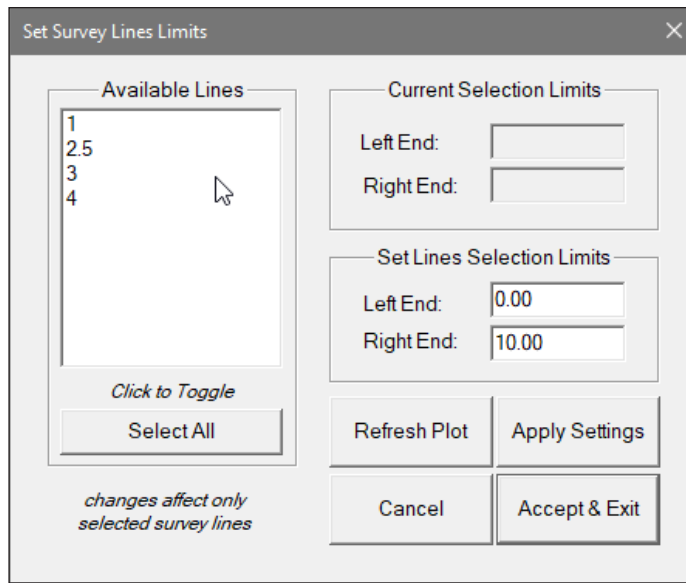


Figure 5.2 Set Line Limits dialog

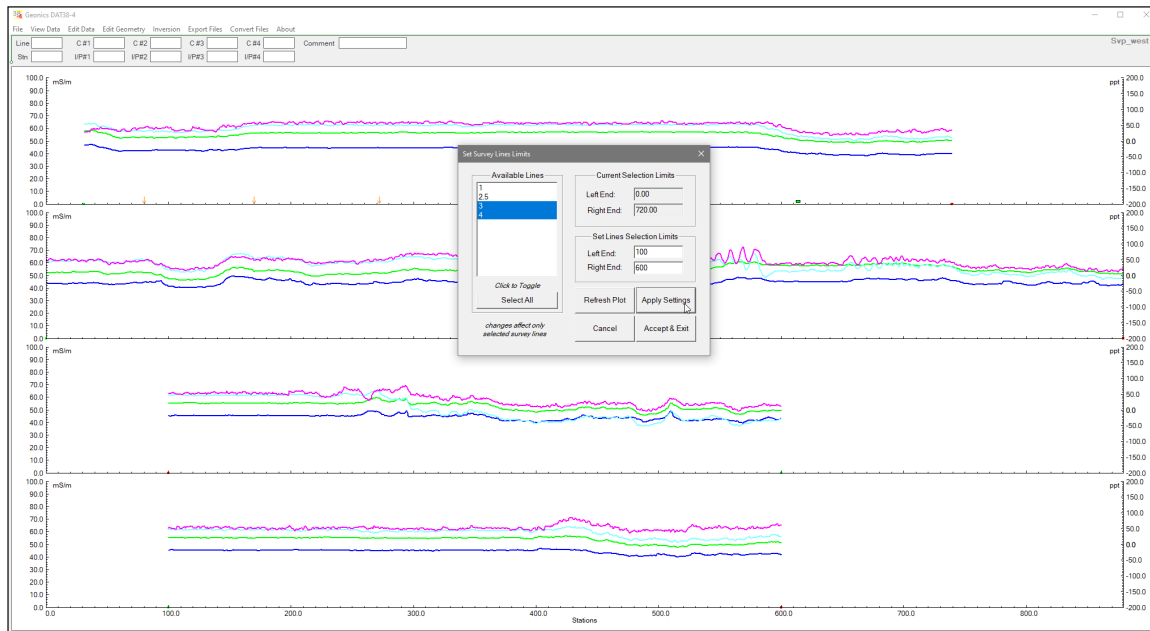


Figure 5.3 Set Line Limits dialog with Lines 3 and 4 repositioned to 100 to 600 (compare with Figure 5.1).

- **Reversing Line Direction:**
  - You can reverse the direction of survey lines by setting a Left End value higher than the Right End. An example is shown in Figure 5.4.
  - Figure 5.5 illustrates all available lines adjusted to the same range of values.
- **Finalizing or Canceling Changes:**
  - Click **Accept & Exit** to save the new geometry temporarily. Then, use **Save** or **Save As** from the File menu to make the changes permanent.
  - If you are not satisfied, click **Cancel** to revert all changes.

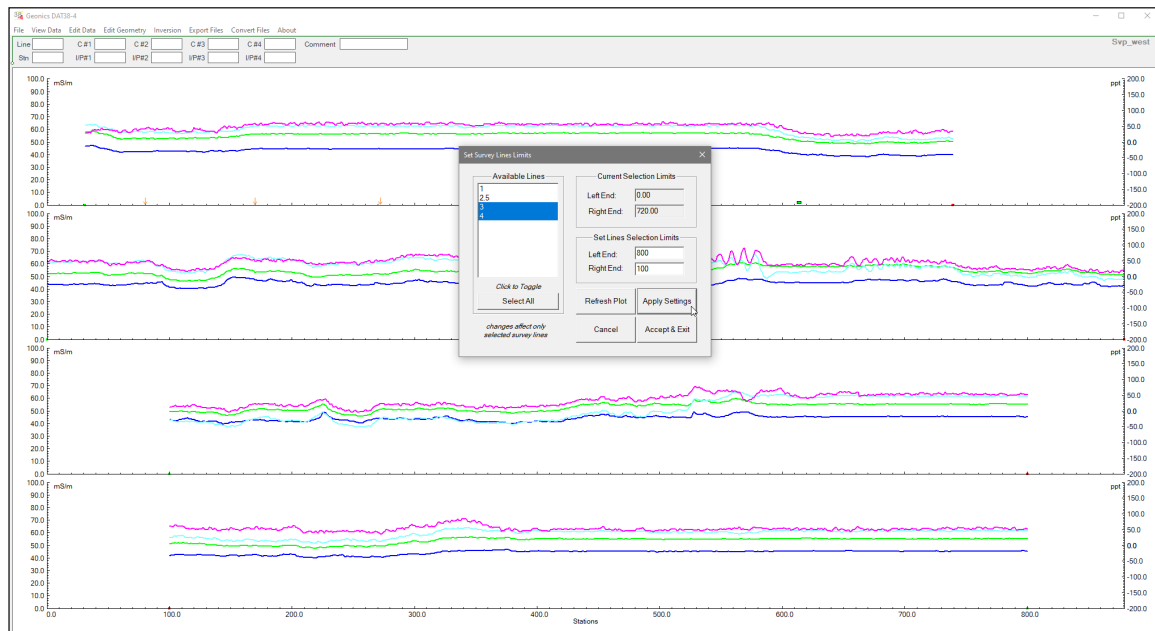


Figure 5.4 DAT38-4 profile display with reversed lines 3 and 4 (compare with Figures 5.1 and Figure 5.3)



Figure 5.5 DAT38-4 profile display after action in Set Line Limits has been applied to all available survey lines.

## 5.2 Shift Survey Lines

To open the Shift Survey Lines window, select **Edit Geometry | Shift Survey Lines** from the main menu (Figure 5.1). The window is displayed as shown in Figure 5.6.

- **Selecting Lines and Viewing Current Positions:**
  - Choose survey lines from the **Available Lines** list box.
  - The **Current Position** display shows the selected line(s) endpoint positions.

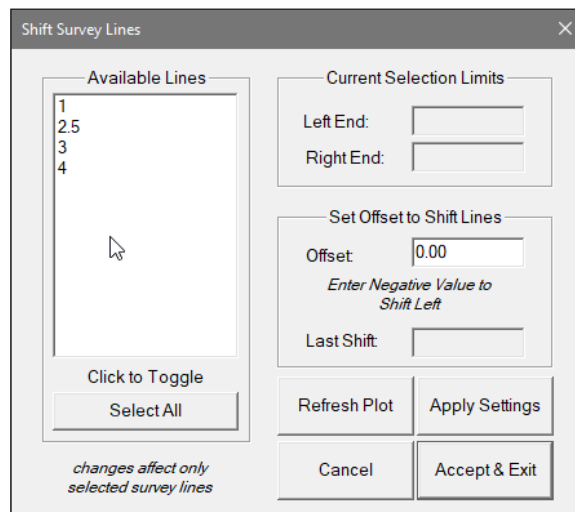


Figure 5.6 Shift Survey Lines dialog

- **Setting the Shift:**
  - Enter the shift increment in the **Set Offset to Shift Lines** edit box.
    - A positive value shifts the lines to the right (increasing station numbers).
    - A negative value shifts them to the left (decreasing station numbers).
  - The lengths of the survey lines and the spacing between stations remain unchanged.
- **Applying the Shift:**
  - Click **Apply Offset**. The graphic displays update in real time.
  - For example, Figures 5.7 and 5.8 show lines 3 and 4 shifted 100 stations to the right.
- **Finalizing or Canceling Changes:**
  - Click **OK** to close the dialog and apply the changes.
  - If the change is unsatisfactory, click **Cancel** to revert to the original positions.

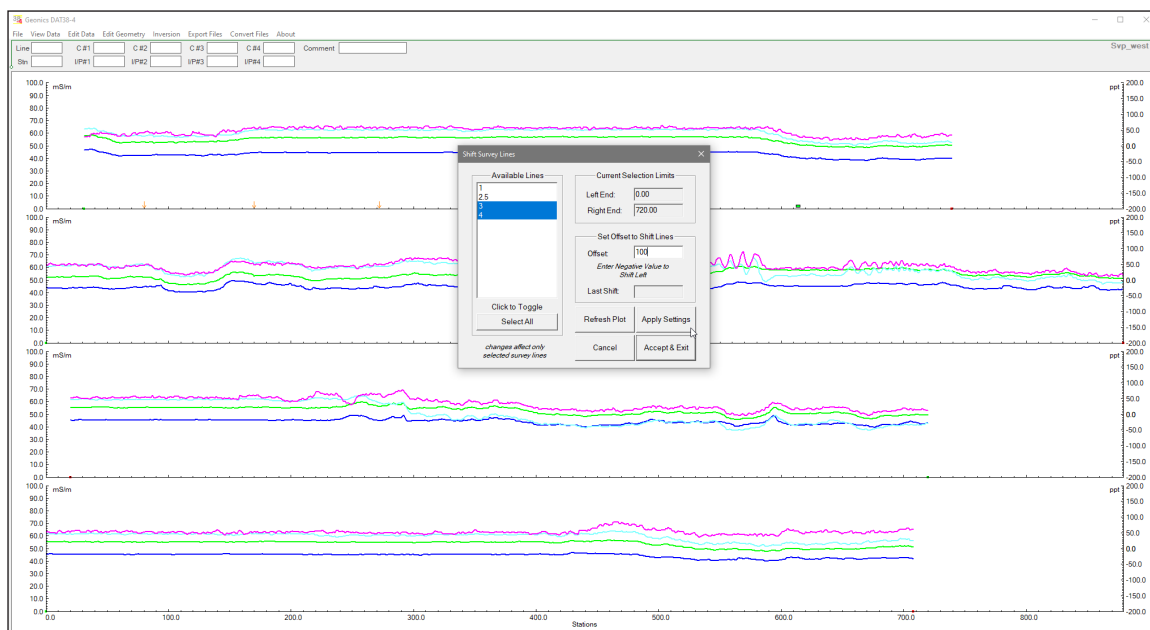


Figure 5.7 DAT38-4 profile display before Shift of survey lines is applied

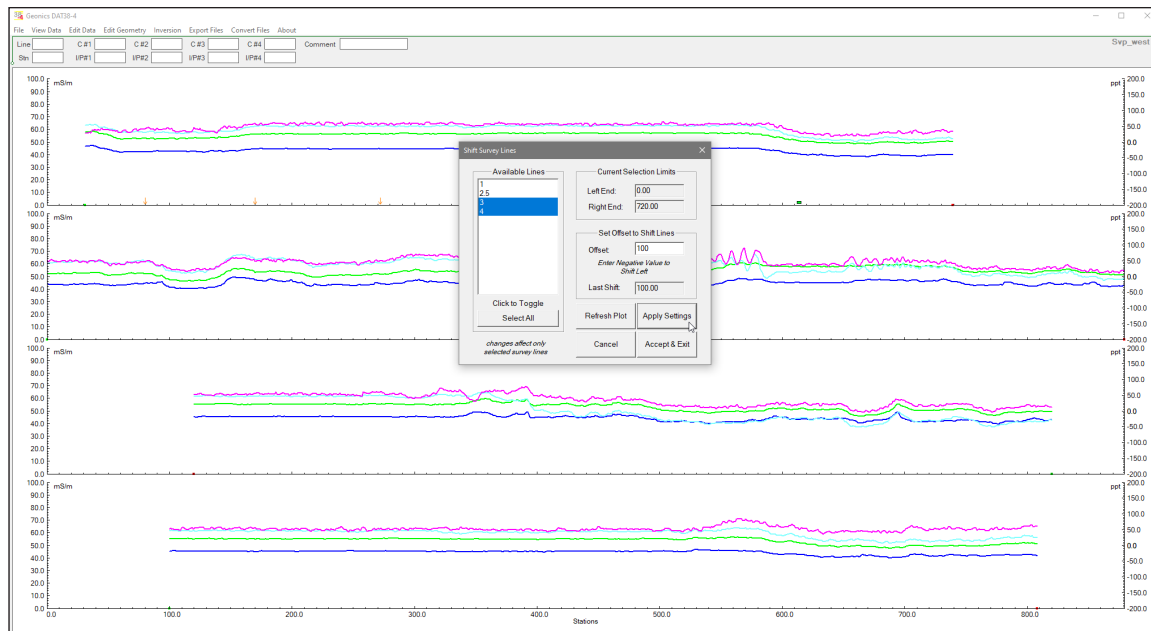


Figure 5.8 DAT38-4 profile display after Shift of 100 stations has been applied to last two survey lines (lines 3 and 4)

## 5.3 Position Markers/Line Ends

To open the Position Markers dialog, select **Edit Geometry | Position Markers/Line Ends** from the main menu (Figure 5.1). The dialog appears as shown in Figure 5.9.

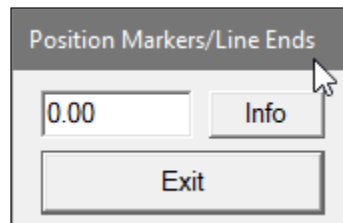


Figure 5.9 Position Marker dialog

- **Purpose:**
  - This function allows you to reposition fiducial markers (set by pressing the fiducial marker button during logging) and adjust start/end station positions.
- **Using the Dialog:**
  - An unlabeled edit box is provided for entering the desired station value.
  - After entering a value, click on the Marker (indicated by an orange arrow) or any end station near which you want to reposition.
  - The program locates the nearest marker/end station and moves it to the specified station.
  - For instance, Figure 5.10 shows the mouse cursor near a marker at station close to 500; after entering a new value of 700 and clicking, the marker immediately moves to station 700 (see Figure 5.11).
  - Spacing between stations is automatically adjusted between neighboring markers or line ends.

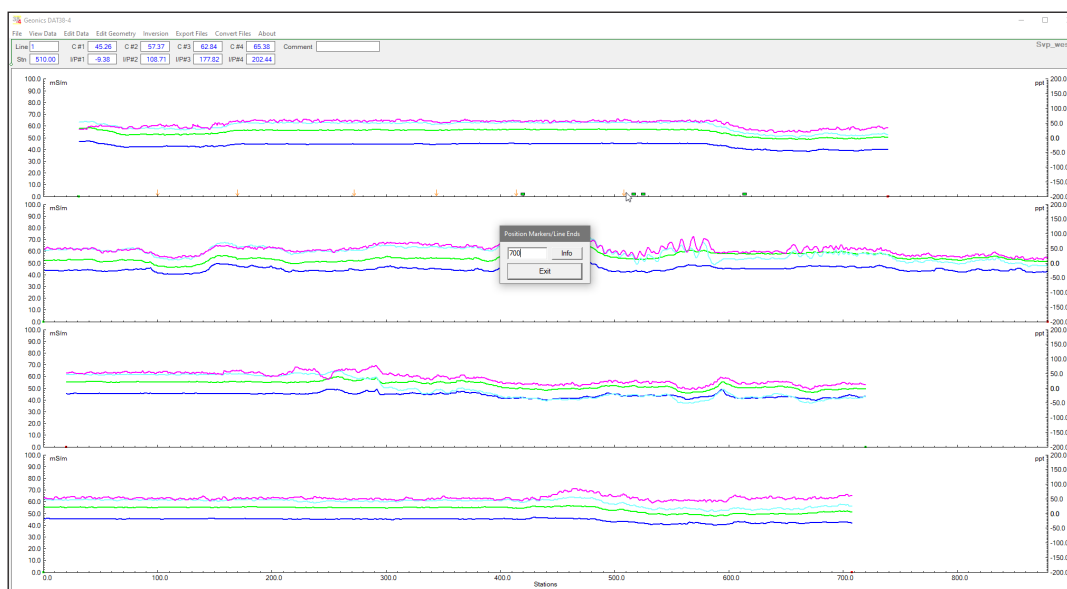


Figure 5.10 DAT38-4 profile display while positioning cursor at Marker to be moved

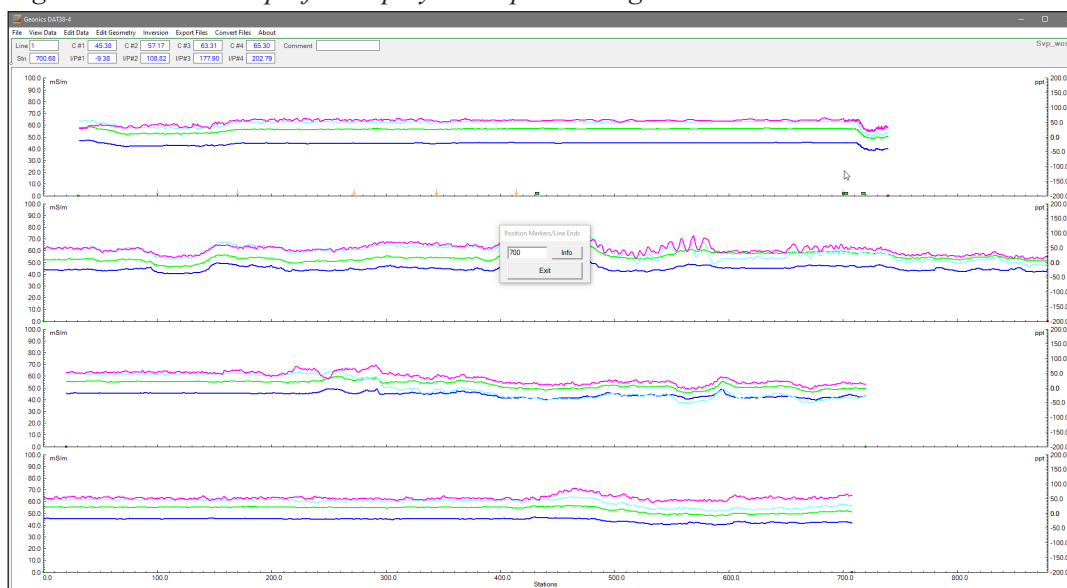


Figure 5.11 DAT38-4 profile display after the Marker is repositioned to station 700

- Additional Help and Finalizing:
  - Click the Info button to display related help information (Figure 5.12).
  - When finished, click **Exit** to close the dialog.
  - **Note:** This operation has no Undo function, so creating a backup of the original data file is advisable before making adjustments.

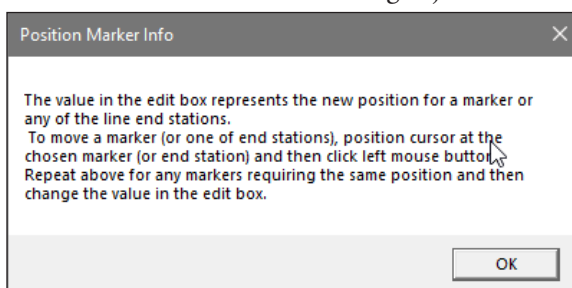


Figure 5.12 Position Marker Info message box



# 6. Inversion

The inversion procedure in DAT38-4 uses the same functions and calculations as the EM38-4 data acquisition program. This option is provided for several reasons:

1. **Inversion Not Enabled During Data Collection:** Calculate inversion results after the fact if it was not activated during logging.
2. **Re-calculation After Data Editing:** Recalculate inversion when data has been modified (e.g., using Data Shift or Smooth Data).
3. **Incorrect Instrument Height:** Update inversion results if an incorrect EM38-4 height was entered during logging.
4. **Testing Different Inversion Types:** Experiment with various inversion settings by adjusting Constrain Parameters.

## 6.1 Inversion Setup and Processing

- **Accessing the Inversion Setup Dialog:**

The Inversion Setup dialog appears after clicking the Inversion menu item (Figure 6.1).

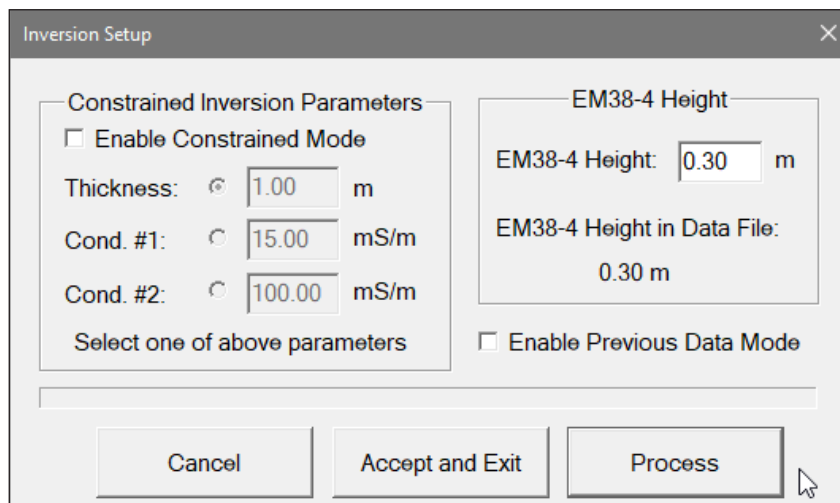


Figure 6.1 Inversion Setup dialog

- If inversion profiles are part of the display, the right axis automatically shows a scale in meters (representing Thickness) (Figure 6.2).
- This dialog closely mirrors the one used during data acquisition but also allows you to modify the EM38-4 Height (always in meters). The displayed height reflects the value recorded during data collection or that set in the Project Settings.
- **Example Scenario:**  
Figures 6.2, 6.3, and 6.4 illustrate recalculating inversion after updating the instrument height. Figure 6.2 also shows updated conductivity profiles for all four coil separations and a vertical cross-section displaying the inversion results.
- **Starting the Inversion Calculation:**  
Click the **Process** button to begin inversion calculations for each data point. A progress bar in the dialog shows the procedure's progress (Figure 6.3).

- **Note:** The processing time depends on the file length and can take several minutes for large data sets.

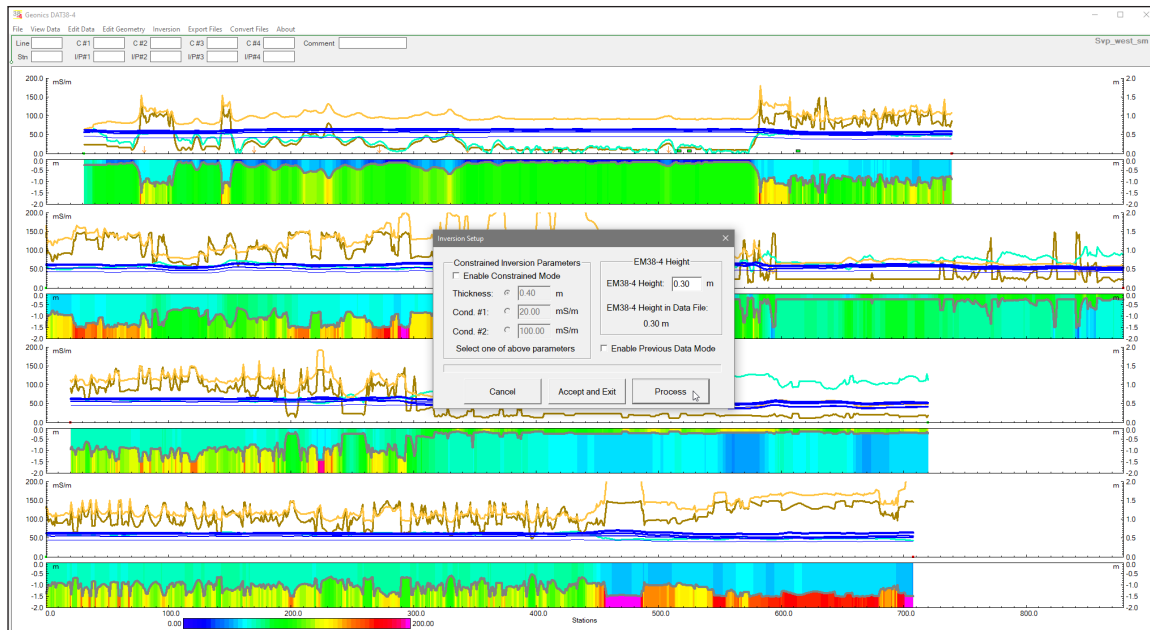


Figure 6.2 Inversion Setup dialog with updated EM38-4 height and displayed results of original inversion and Inversion results profiles (Thickness and Conductivity for both layers)

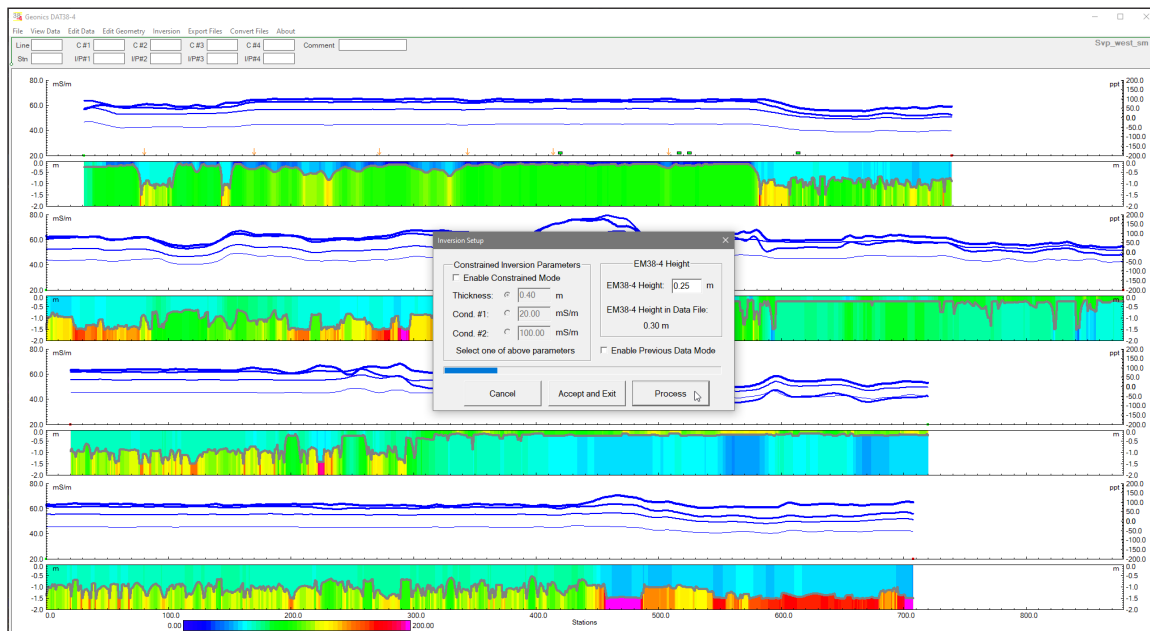


Figure 6.3 The program screen during processing inversion

- **Completion and Acceptance of New Inversion Values:**  
Once the inversion is complete, the profiles (if selected) and the vertical cross-section are redrawn with the new results (Figure 6.4).
  - To accept the new inversion values, click **Accept and Exit**.
  - To cancel the changes, click **Cancel**—the original vertical section with previous values will then be restored.
  - Remember, if you accept the new values, you must use **Save** or **Save As** to update the data file permanently.

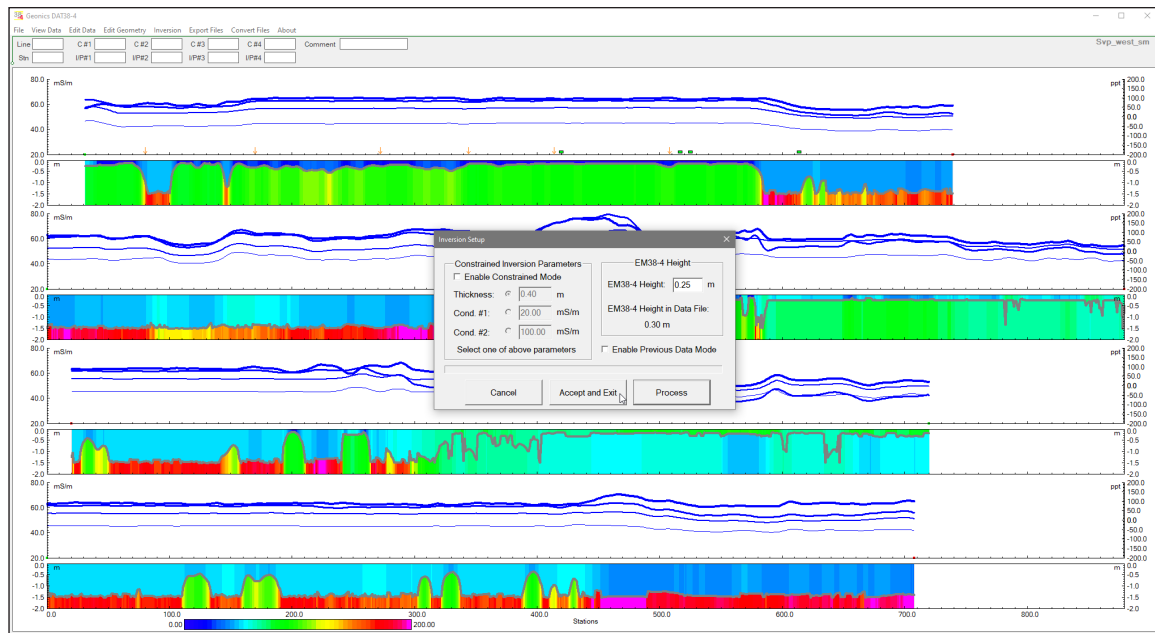


Figure 6.4 The DAT38-4 Inversion Setup dialog and display of the updated vertical section after calculations are completed.

## 6.2 Constrained Inversion Parameters

- Fixing Parameters:**  
 Clicking the **Constrain Inversion Parameters** button (Figure 6.5) allows you to fix one of parameters at a specified value.
  - The inversion procedure then runs as described above.
  - After processing, you can accept or cancel the new values (Figure 6.6).

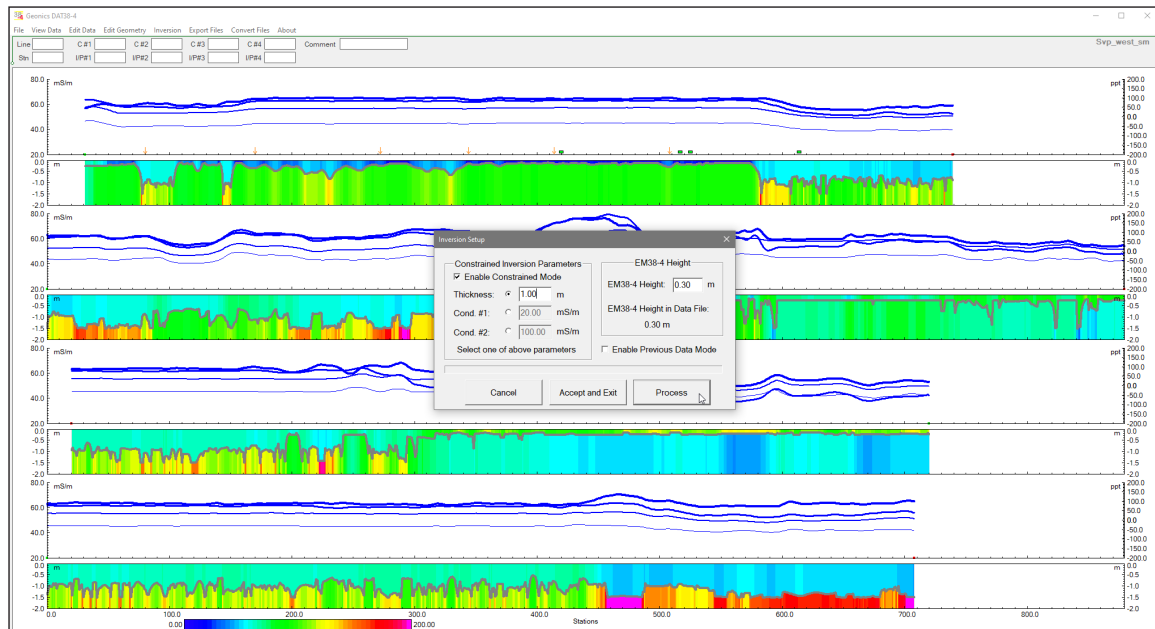


Figure 6.5 The DAT38-4 Inversion Setup dialog with constrained value for Thickness.

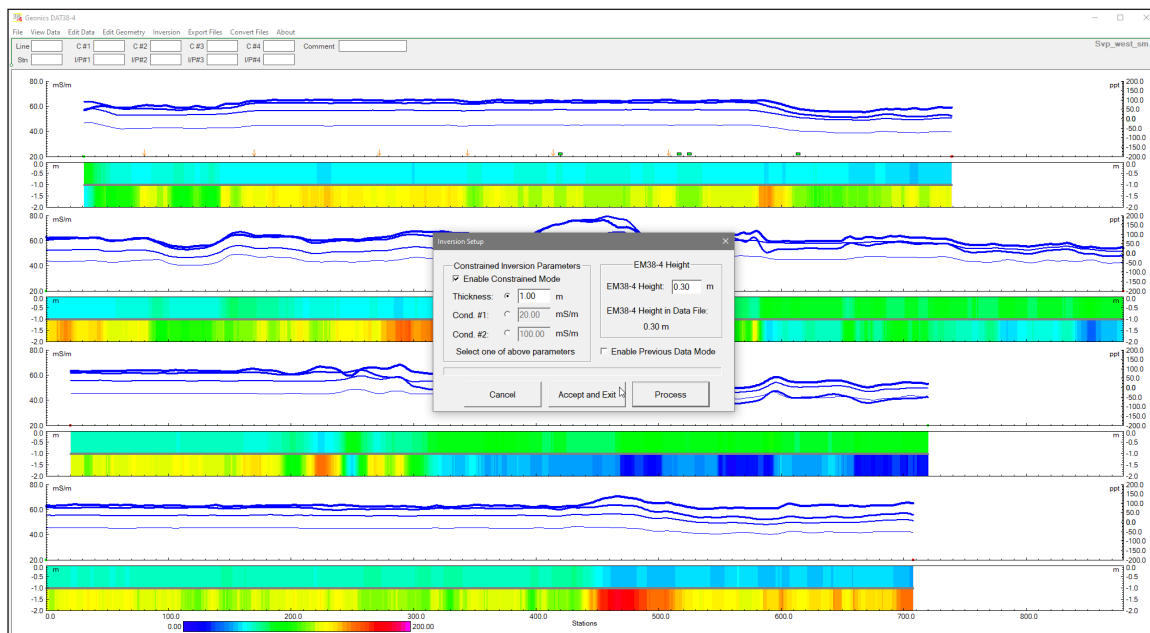


Figure 6.6 The DAT38-4 Inversion procedure completed, compare with above Figure 6.5.

## 6.3 Enable Previous Data Mode

- Using Previous Data for Enhanced Consistency:**  
 The Inversion Setup dialog also includes an **Enable Previous Data Mode** check button. When this mode is enabled:
  - The inversion calculation for a given station uses the previously calculated data model for the neighboring station.
  - The exception is the first station in each survey line, which is always calculated in standard mode (i.e., not influenced by the previous survey line's last station).

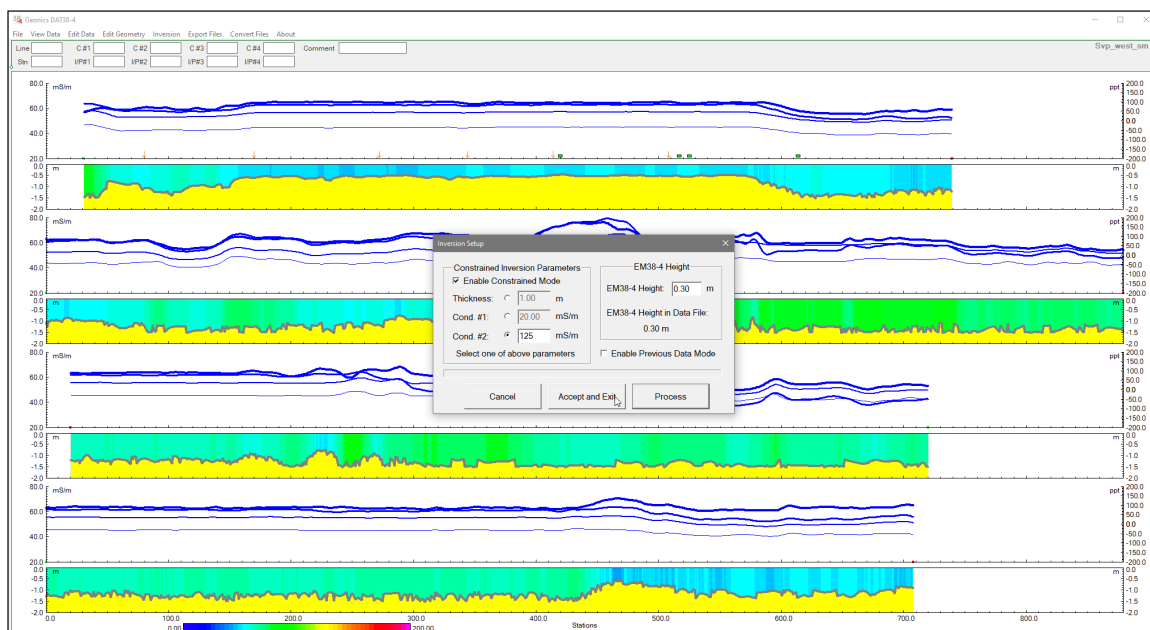


Figure 6.7 The DAT38-4 Inversion Setup dialog with enable Previous Data Mode.

- Examples demonstrating the effect of enabling Previous Data Mode are shown in Figures 6.7 and 6.8.

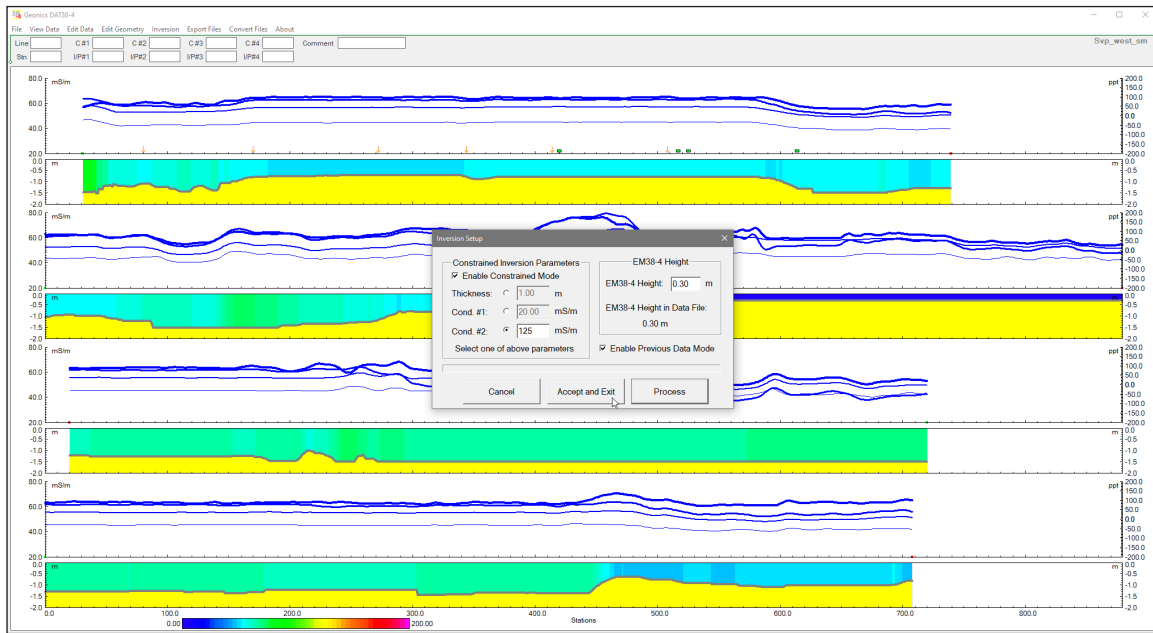


Figure 6.8 The DAT38-4 after Inversion procedure with enabled Previous Data Mode option is completed.



# 7. Export Files

The Export Files option enables you to create two-dimensional (XYZ-type) ASCII files for use with various contouring/mapping systems and as input for the EM4Soil-G inversion program. These files contain three or more columns (X, Y, Z1, Z2, etc.), where Z1 (for example) might represent conductivity in mS/m—depending on your settings. Files exported in the EM4Soil-G format are similar to XYZ files but offer fewer customization options due to their fixed structure. Before running this option, all data must be loaded via the **Load DAT38-4 Profile File** menu.

To access these export options, select Export Files from the main menu at the top of the screen (Figure 7.1). The menu includes four options:

- **Create Grid Based XYZ File**
- **Create GPS Positioned XYZ File**
- **Create Grid Based EM4Soil-G File**
- **Create GPS Positioned EM4Soil-G File**

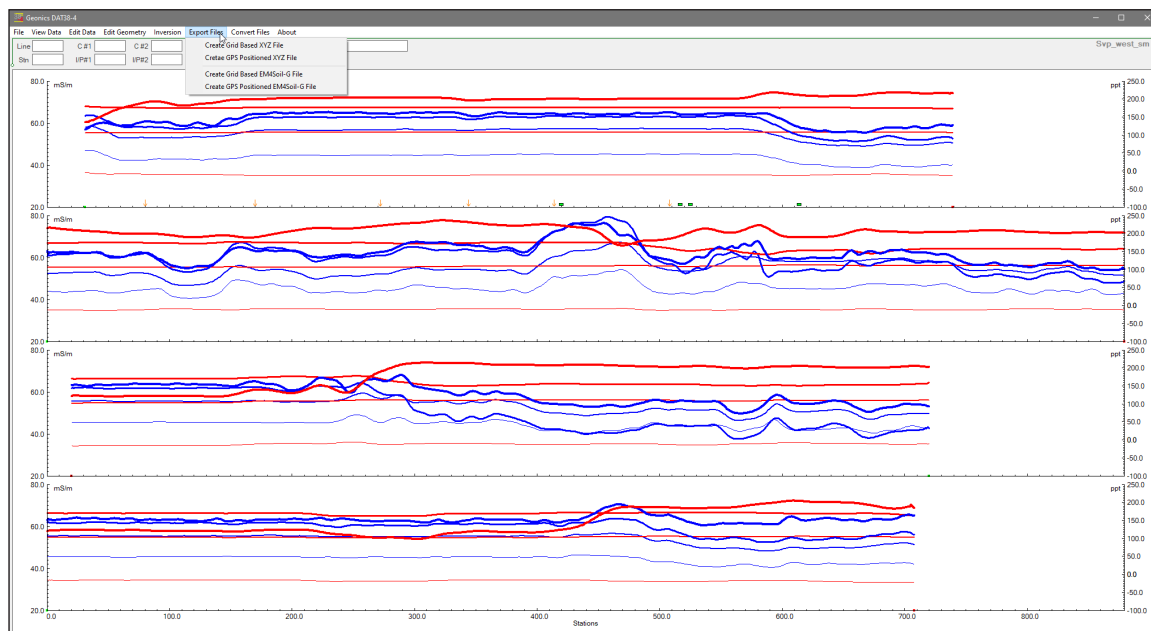


Figure 7.1 DAT38-4 Export Files menu

Below is a detailed explanation of each option.

## 7.1 Create Grid Based XYZ File

This option is intended for surveys collected along pre-arranged grids with a North-South (N-S) and West-East (W-E) layout. It is recommended that each file contains survey lines that are parallel and collected in one direction (either W-E or N-S). The program assumes that:

- **Stations** along a survey line correspond to one coordinate (X or Y).
- **Line names** indicate the other coordinate.

If line names do not match the appropriate coordinate, they can be renamed using the Rename function in the Select Survey Lines window. Additionally, adjust station positions (line endpoints and fiducial markers) using the Edit Geometry function before exporting.

**Procedure:**

- **Accessing the Dialog:**  
Select **Export Files | Create Grid Based XYZ File** from the profile menu. The Create Grid Based XYZ File window appears (Figure 7.2).

Figure 7.2 Create Grid Based XYZ File window

- **Setting Parameters:**  
Specify several parameters that affect file content and format:
  - **Orientation of Survey Lines:**
    - *W-E Orientation:* Line names are assumed to provide the Y (N-S) coordinate, with stations aligned along the X axis.
    - *N-S Orientation:* Line names are assumed to provide the X (W-E) coordinate, with stations aligned along the Y axis.
    - **Note:** Only the number is recognized if a line name starts with a number and ends with a letter (e.g., 10N or 10A). Ensure negative values are marked with a minus sign (e.g., -10).
  - **Component Selection:**
    - Choose the EM38-4 data type (component) to export using the corresponding radio buttons in the **Component** section (Figure 7.2).
    - Data for all four coil separations is exported in order: first, separation's two components (Conductivity and Inphase or one component), then similarly for separations #2, #3, and #4.



- **Inversion Results** (optional): If present, these are appended after the selected components (order: Thickness of the first layer, then Conductivity for layers #1 and #2). This option is enabled only if inversion data exists (Figure 7.5).
- **File Format and Delimiters:**
  - **File Format:**  
Choose the format based on your target contouring software:
    - **Generic:** Creates a multi-column file (default extension: XYZ).
    - **Geosoft:** Adds a survey line tag (default extension: XYZ).
    - **Surfer:** Uses the DAT extension.
    - *Note:* Surfer and Generic are identical except for the file extension.
  - **Column Delimiter:**
    - Options include Fixed (with fixed field widths), Comma, Single Space, and Tab.
- **Additional Options:**
  - **File Header:** Adds one or two lines of descriptive text at the top.
  - **Include Time Stamp:** Appends a time stamp as the last column.
  - **Correct for Coils Offsets:** Interpolates readings from coils #1, #2, and #3 to align them with the center of the EM38-4 (coil #1.0 m).
  - **Separate Files for Each Coil:** Create an individual XYZ file for each coil separation.
- **Output File Selection:**
  - Click the **Output File** button. The **Select XYZ File Name** window appears (Figure 7.3).

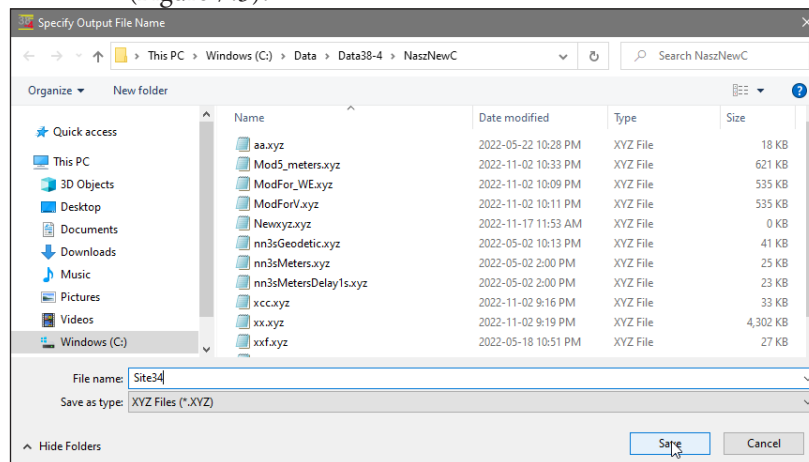


Figure 7.3 Select XYZ File Name window

- A default file name is provided based on the selected output format.
- Specify or select a file name and click **Save**. If the file already exists, you will receive a warning. The selected file name appears at the bottom of the Create Grid Based XYZ File window, and the Process button becomes active (Figure 7.4).
- **Creating the File:**
  - Click **Create XYZ File**. A progress bar shows the export progress at the bottom (Figure 7.5).

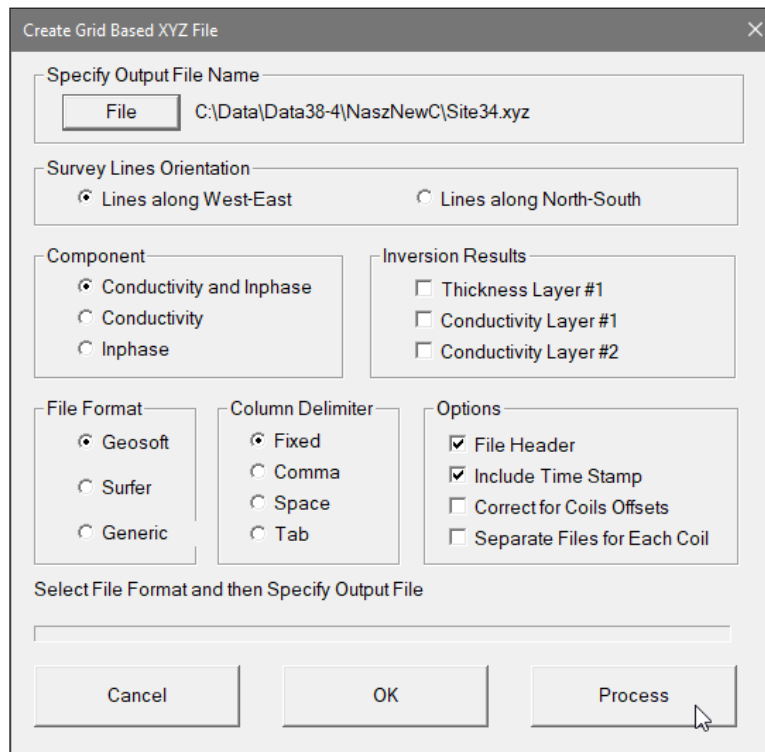


Figure 7.4 Create Grid Based XYZ File dialog after Output File Name is specified

- Once complete, a label confirms the file name, and the operation is finished.
- The resulting file can be viewed in any text editor or input to mapping program, and Figure 7.6 displays an example of the spatial layout of lines and stations.

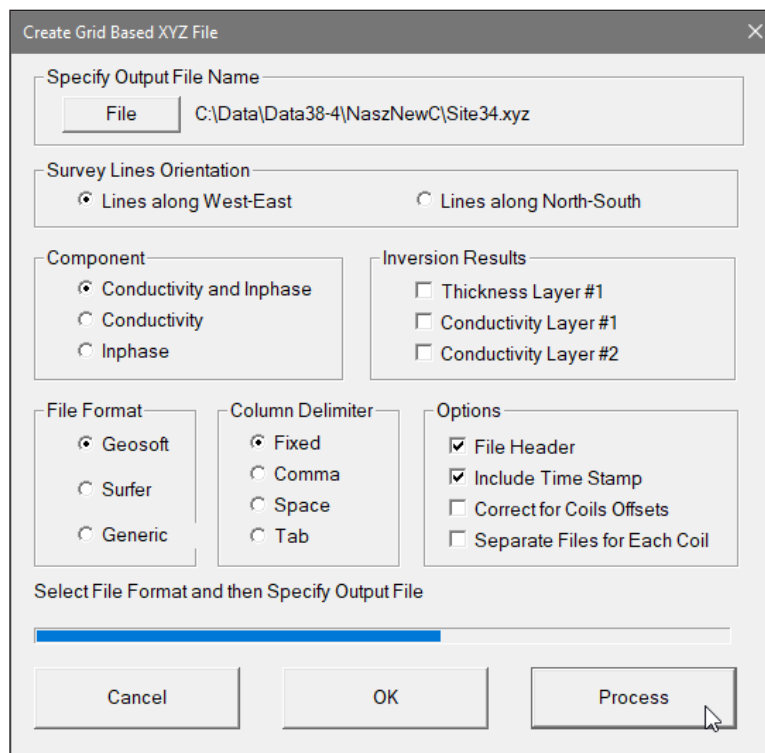


Figure 7.5 Create Grid Based XYZ File dialog during creating output file



Figure 7.6 Layout of stations after an XYZ file is created

## 7.2 Create GPS Based XYZ File

This option is used when GPS data is recorded along with the EM38-4 readings. When a GPS receiver is connected to the EM38-4 logger (via the serial port), and GPS data (in GGA NMEA-0183 format) is recorded, you can export an XYZ file using GPS positions.

### Procedure:

- Accessing the Dialog:**  
 Select **Export Files | Create GPS Positioned XYZ File**. The **Create XYZ File Based on GPS Positions** dialog appears (Figure 7.7).

Figure 7.7 Create XYZ File Based on GPS Positions dialog

- Output File Selection:**
  - Click the **File** button to open the **Select XYZ File** window (Figure 7.8).
  - The default file extension is based on your selected output format (xyz, dat, or asc).
  - Specify the file name, click **Save**, and the name appears in the dialog (Figure 7.9). The **Proceed** button is then activated.

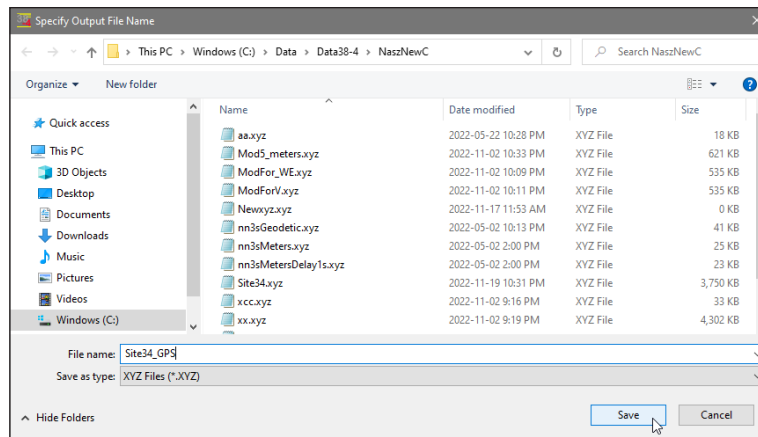


Figure 7.8 Select XYZ File dialog

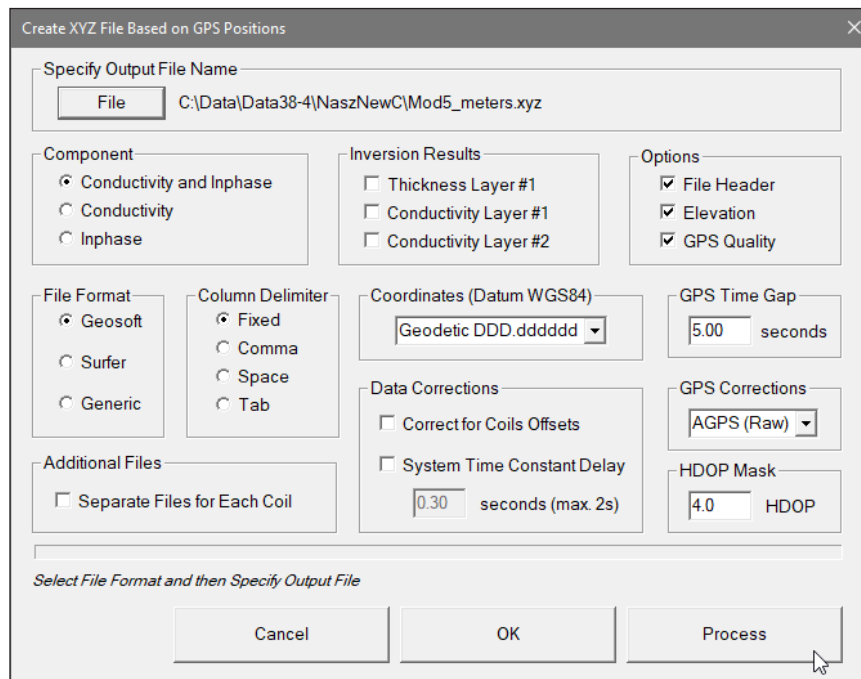


Figure 7.9 Create XYZ File Based on GPS Positions dialog after Output File name is specified

- **Component and Inversion Results:**
  - Select the desired EM38-4 component in the **Component** section (Figure 7.10).
  - Inversion Results (if available) are appended in the order described earlier.
- **Additional GPS Options:**
  - **Header Description:** If selected, a two-line comment describing the datum and column contents is added.
  - **GPS Quality:** Three parameters (degree of differential corrections, number of satellites, and HDOP) are appended at the end if enabled.
  - **Additional Files:** Optionally, check to create separate files for each coil separation.
- **File Format and Column Delimiter:**
  - Select the file format (Generic, Geosoft, or Surfer) that determines the default file extension (XYZ or DAT).
  - Choose the column delimiter (Fixed, Comma, Space, or Tab).

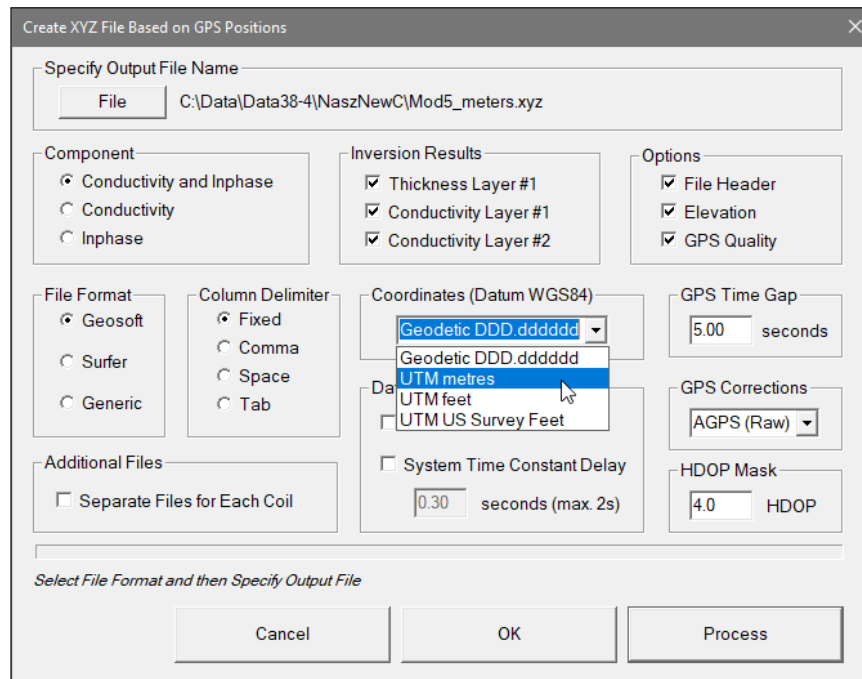


Figure 7.10 Selecting Coordinates in Create XYZ File Based on GPS Positions window

- **Coordinates:**
  - Choose whether to export coordinates as Geodetic (Latitude/Longitude in degrees, format DD.DDDDDDDDD) or convert them to UTM coordinates (in meters, feet, or US Survey feet). The program uses the WGS84 datum.
  - Select the appropriate option from the combo box labeled **Coordinates (Datum WGS84)** (Figure 7.10).
- **GPS Time Gap:**
  - Specify the maximum time (in seconds) during which EM38-4 data will be linearly interpolated between two GPS positions. A value 2–5 times greater than the GPS update rate is recommended.
- **GPS Corrections and HDOP Mask:**
  - **GPS Corrections:** Select the minimum acceptable quality from options including:
    1. AGPS (Raw)
    2. Differential (DGPS)
    3. RTK (RTK-3)
    4. RTK (RTK-4)
    5. RTK (RTK-5)
    6. Higher (>5)
(See Figure 7.11.)
  - **HDOP Mask:** Enter the maximum acceptable HDOP value. GPS positions with HDOP values exceeding this value will be excluded.

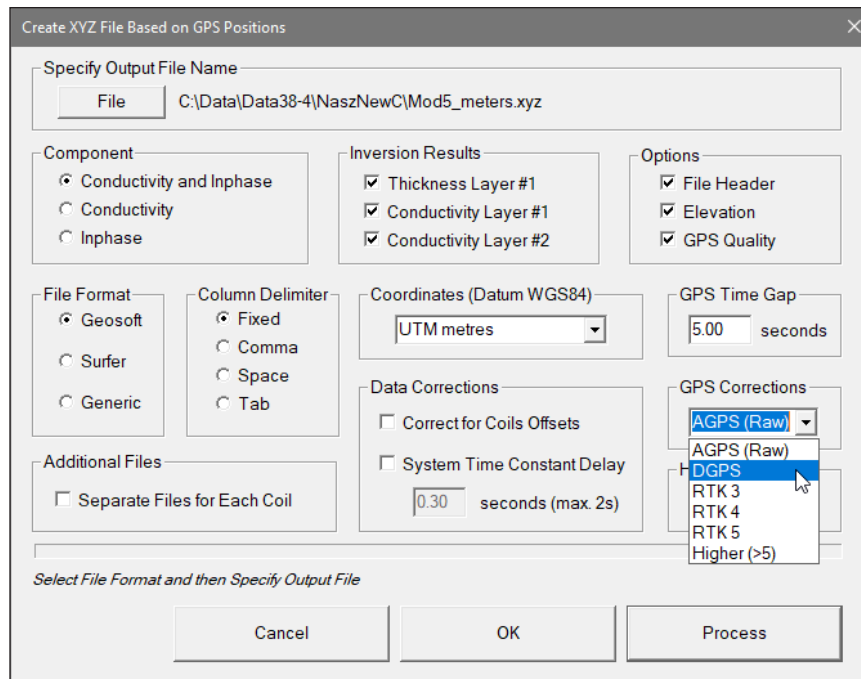


Figure 7.11 Selecting GPS Corrections in Create XYZ File Based on GPS Positions window

- **Data Corrections:**
  - **Correction for Coil Offsets:** As described above, coil readings are interpolated so they reference the center of the EM38-4.
  - **System Time Constant Delay** (System Latency):
    - This correction adjusts for the delay between the EM38-4 and the GPS receiver.
    - Determine the delay by surveying over a known target, then enter the time delay (in seconds; default is 0, which turns off the option).
    - **Note:** To apply this correction, the Time Stamp option must be selected in the Options section.
- **Creating the File:**
  - After all parameters are set, click the **Proceed** button. A progress bar appears (Figure 7.12), showing the export progress.
  - The resulting file(s) can be used as input for any mapping program.

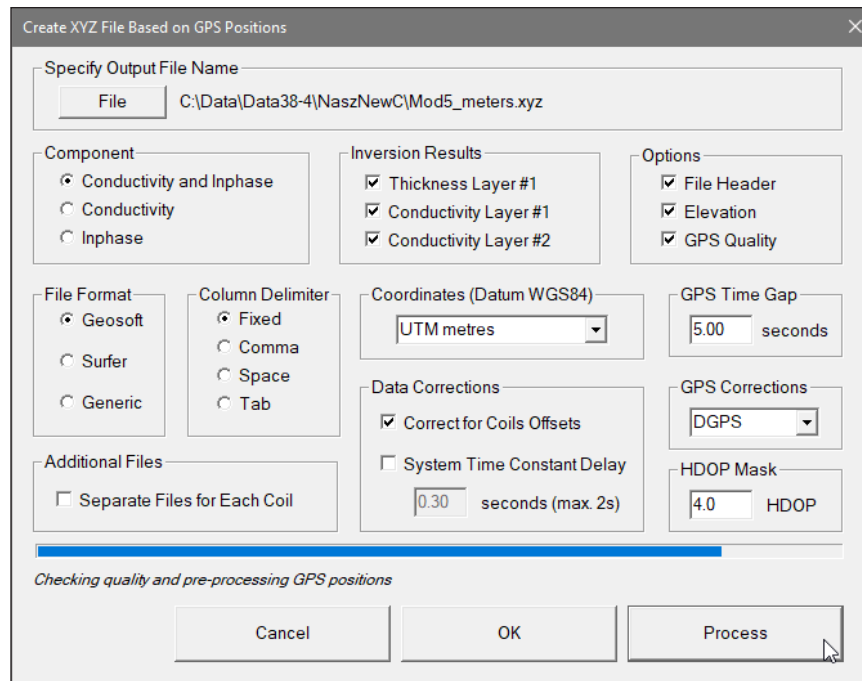


Figure 7.12 Create XYZ File Based on GPS Positions dialog during creating output file

## 7.3 Create Grid Based EM4Soil-G File

Using grid-based positions, this option exports EM38-4 data in the EM4Soil-G format (with the .gxyz extension).

### Procedure:

- **Accessing the Dialog:**  
Select **Export Files | Create Grid Based EM4Soil-G File**. The **Export to EM4Soil-G Format with Grid Layout Based Positions** dialog appears (Figure 7.13).

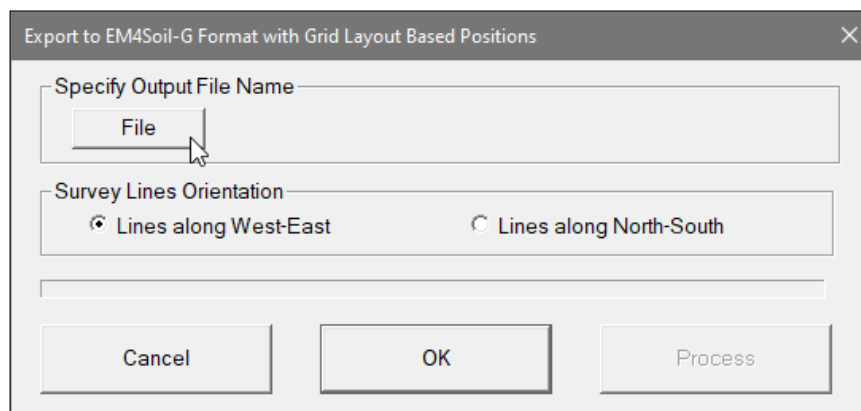


Figure 7.13 Export to EM4Soil-G Format with Grid Layout... dialog

- **Setting Parameters:**
  - **Output File:**
    - Click the **File** button to open the **Select EM4Soil-G File Name** window (Figure 7.14).

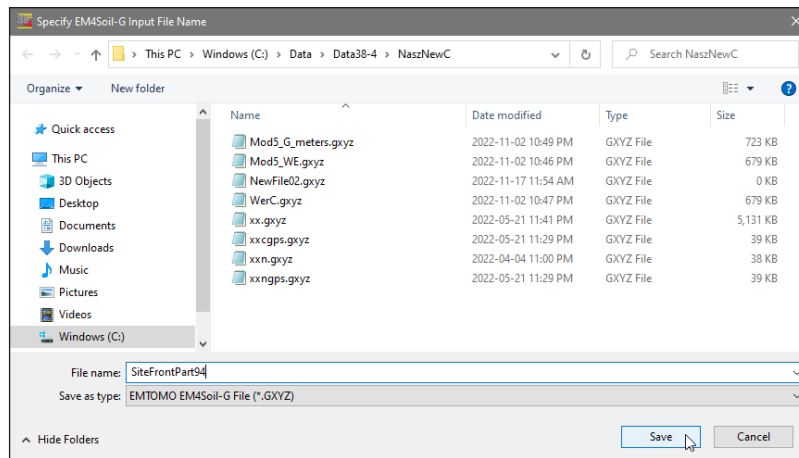


Figure 7.14 Select EM4Soil-G File Name dialog

- Specify or select a file name and click **Save**. A warning appears if the file already exists. The chosen file name is displayed at the bottom of the dialog, activating the **Process** button (Figure 7.15).
  - **Orientation of Survey Lines:**
    - Choose the orientation (W-E or N-S) with the same assumptions regarding line names and station alignment as described in Section 7.1.
- **Creating the File:**
  - Click **Create XYZ File**. A progress bar indicates the export progress (Figure 7.15).
  - When complete, the file can be viewed in any text editor or opened in the EM4Soil-G program.

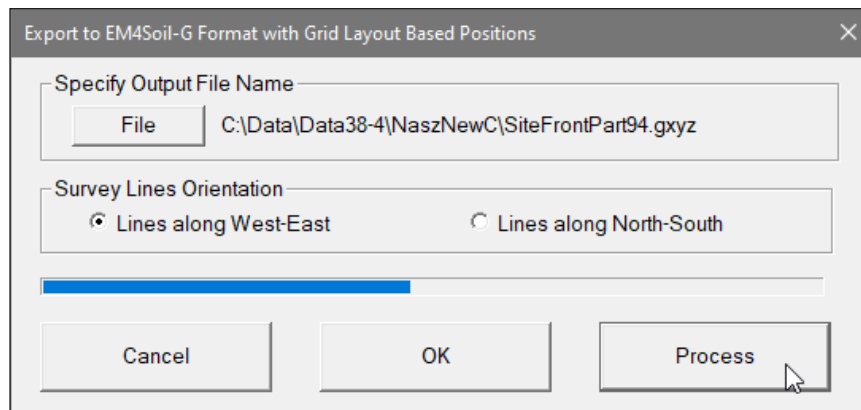


Figure 7.15 Export to EM4Soil-G Format with Grid Layout... dialog during creating xyz file

## 7.4 Create GPS Based EM4Soil-G File

This option is used when GPS data is recorded along with EM38-4 measurements. Using GPS-based positions, it exports data directly in the EM4Soil-G format (file extension .gxyz).

### Procedure:

- **Accessing the Dialog:**  
Select **Export Files | Create GPS Positioned EM4Soil-G File**. The **Export to EM4Soil-G Format with GPS Based Positions** dialog appears (Figure 7.16).



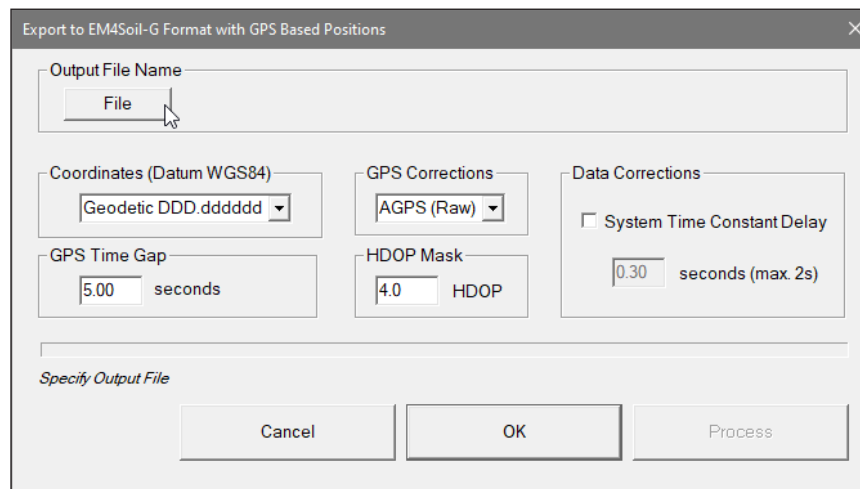


Figure 7.16 Export to EM4Soil-G Format with GPS Based Positions dialog

- **Output File Selection:**
  - Click the File button to open the **Select GXYZ** File window (Figure 7.17).
  - Specify or select a file name and click **Save**. The selected file name appears in the dialog, activating the **Proceed** button (Figure 7.18).

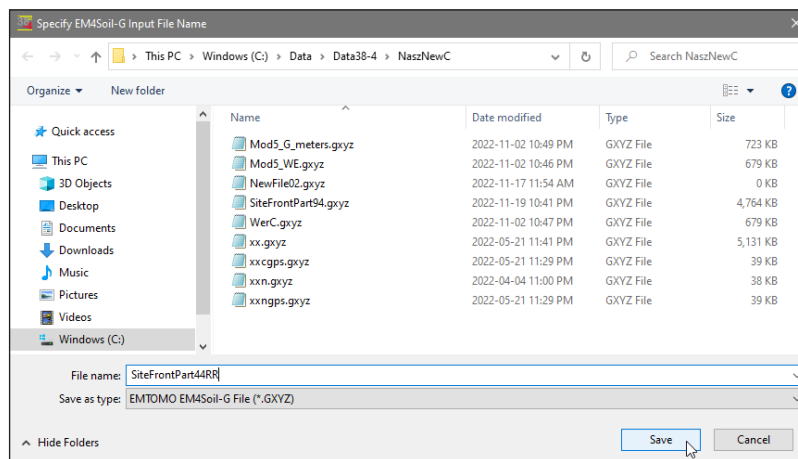


Figure 7.17 Select EM4Soil-G File Name dialog

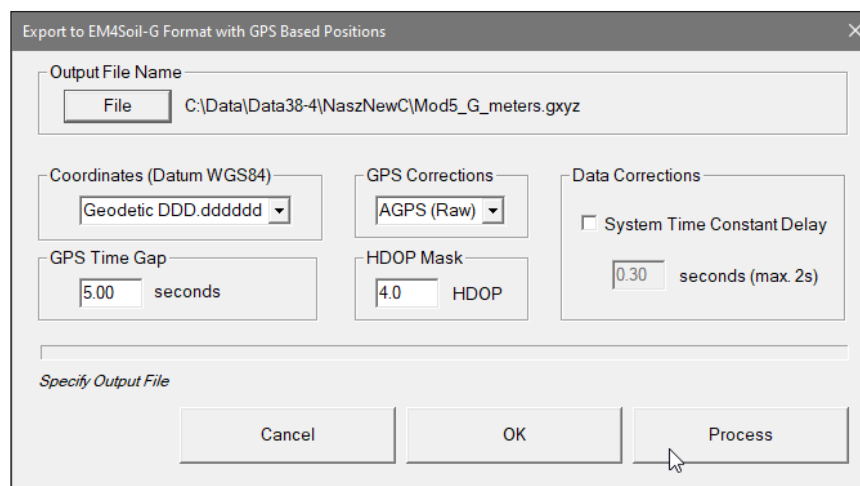


Figure 7.18 Export to EM4Soil-G Format with GPS Based Positions dialog after the export file name is specified

- Coordinates:
  - As with the GPS-based XYZ file option, choose between Geodetic (Latitude/Longitude in degrees) or UTM coordinates (in meters, feet, or US Survey feet) from the combo box labeled Coordinates (Datum WGS84) (Figure 7.19).
- GPS Time Gap, Corrections, and HDOP Mask:
  - Specify the GPS Time Gap in seconds, select the minimum acceptable GPS correction level from the provided options (Figure 7.20), and enter the HDOP Mask value (as described in Section 7.2).

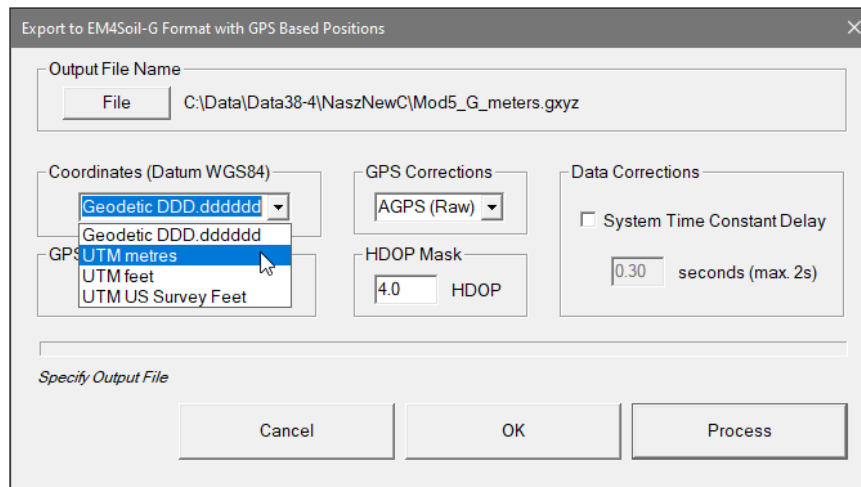


Figure 7.19 Selecting Coordinates in the Export to EM4Soil-G Format with GPS Based Positions dialog

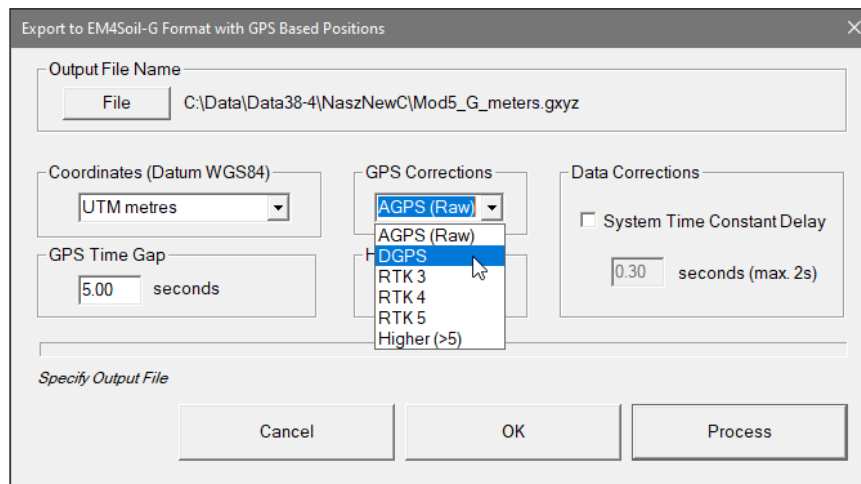
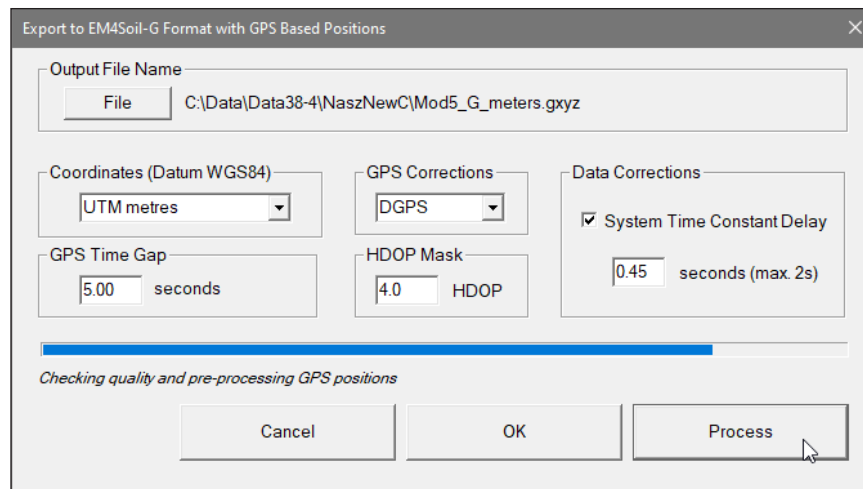


Figure 7.20 Selecting GPS Corrections in the Export to EM4Soil-G Format with GPS Based Positions dialog

- Data Corrections:
  - Include parameters for Correction for Coils Offsets and System Time Constant Delay (as described in Section 7.2).
  - Ensure the Time Stamp option is selected if the System Time Constant Delay correction is applied.



*Figure 7.21 Export to EM4Soil-G Format with GPS Based Positions dialog during creating gxyz file*

- Creating the File:
  - Once all parameters are specified, click the Proceed button. A progress bar appears (Figure 7.21) showing the completion percentage.
  - The generated GXYZ file can be used as input for the EM4Soil-G inversion program.





- O1 - Calibration factor - conductivity 0.50 m coils (current and former)
- O2 - Calibration factor - conductivity 0.75 m coils (current and former)
- O3 - Calibration factor - conductivity 1.00 m coils (current and former)
- O4 - Calibration factor - conductivity 0.88 m coils (current and former)
- O5 - Calibration factor - Inphase 0.50 m, (current and former)
- O6 - Calibration factor - Inphase 0.75 m, (current and former)
- O7 - Calibration factor - Inphase 1.00 m, (current and former)
- O8 - Calibration factor - Inphase 0.88 m, (current and former)
- O9 - Calibration factor - Inphase 0.50 m, (current and former, H mode)
- OA - Calibration factor - Inphase 0.75 m, (current and former, H mode)
- OB - Calibration factor - Inphase 1.00 m, (current and former, H mode)
- OC - Calibration factor - Inphase 0.88 m, (current and former, H mode)
- OD - Carrier Calibration factor - conductivity 0.50 m coils (current and former)
- OE - Carrier Calibration factor - conductivity 0.75 m coils (current and former)
- OF - Carrier Calibration factor - conductivity 1.00 m coils (current and former)
- OG - Carrier Calibration factor - conductivity 0.88 m coils (current and former)
- OH - Carrier Calibration factor - Inphase 0.50 m coils (current and former)
- OI - Carrier Calibration factor - Inphase 0.75 m coils (current and former)
- OJ - Carrier Calibration factor - Inphase 1.00 m coils (current and former)
- OK - Carrier Calibration factor - Inphase 0.88 m coils (current and former)
- OL - Carrier Calibration value - conductivity 0.50 m coils (in air, at vehicle, not)
- OM - Carrier Calibration value - conductivity 0.75 m coils (in air, at vehicle)
- ON - Carrier Calibration value - conductivity 1.00 m coils (in air, at vehicle)
- OO - Carrier Calibration value - conductivity 0.88 m coils (in air, at vehicle)
- OP - Carrier Calibration value - Inphase 0.50 m coils (in air, at vehicle)
- OQ - Carrier Calibration value - Inphase 0.75 m coils (in air, at vehicle)
- OR - Carrier Calibration value - Inphase 1.00 m coils (in air, at vehicle)
- OS - Carrier Calibration value - Inphase 0.88 m coils (in air, at vehicle)
- 10 - Line Feed character (ends each above record)

*(more detailed information about Calibration factors is provided below, under the Calibration subtitle).*

## Timer Relation

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	
*	Computer Time (Format HH:MM:SS.sss)																																					Time Stamp in ms (up to 10 digits)										10

Indicates relation between computer clock and the program timer. This record links timer in milliseconds and computer time (local time) in format HH:MM:SS.sss. This record is written to the file each time a new new line is entered.

## Reading

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
T	Gn	1h 1l	2h 2l	3h 3l	4h 4l	5h 5l	6h 6l	7h 7l	8h 8l	9h 9l	10h 10l	11h 11l	12h 12l	13h 13l	14h 14l	15h 15l	16h 16l	17h																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			

- T - indicator T, t, or 2
- T - first reading at the EM38-4 (default for Auto mode)
- Gn - information byte, one character parameter,  
the ASCII number of this character indicates following:

Bit	Decimal	Value and Meaning		
7	128	0		<i>not used</i>
6	64	0		<i>not used</i>
5	32	0		<i>not used</i>
4	16	0		<i>not used</i>
3	8	0		<i>not used</i>
2	4	0		<i>not used</i>
1	2	Marker	= 1	<i>no marker</i>
			= 0	<i>trigger pressed</i>
0	1	0		<i>not used</i>

1h	-	higher byte of the 2's complement Hex number of Channel 1
1l	-	lower byte of Channel 1
2h	-	higher byte of the 2's complement Hex number of Channel 2
2l	-	lower byte of Channel 2
3h	-	higher byte of the 2's complement Hex number of Channel 3
3l	-	lower byte of Channel 3
4h	-	higher byte of the 2's complement Hex number of Channel 4
4l	-	lower byte of Channel 4
5h	-	higher byte of the 2's complement Hex number of Channel 5
5l	-	lower byte of Channel 5
6h	-	higher byte of the 2's complement Hex number of Channel 6
6l	-	lower byte of Channel 6
7h	-	higher byte of the 2's complement Hex number of Channel 7
7l	-	lower byte of Channel 7
8h	-	higher byte of the 2's complement Hex number of Channel 8
8l	-	lower byte of Channel 8
9h	-	higher byte of the 2's complement Hex number of Channel 9
9l	-	lower byte of Channel 9
10h	-	higher byte of the 2's complement Hex number of Channel 10
10l	-	lower byte of Channel 10
11h	-	higher byte of the 2's complement Hex number of Channel 11
11l	-	lower byte of Channel 11
12h	-	higher byte of the 2's complement Hex number of Channel 12
12l	-	lower byte of Channel 12
13h	-	higher byte of the 2's complement Hex number of Channel 13
13l	-	lower byte of Channel 13
14h	-	higher byte of the 2's complement Hex number of Channel 14
14l	-	lower byte of Channel 14
15h	-	higher byte of the 2's complement Hex number of Channel 15
15l	-	lower byte of Channel 15
16h	-	higher byte of the 2's complement Hex number of Channel 16
16l	-	lower byte of Channel 16
17b	-	one byte (one character) Channel 17
Time Stamp	-	time in ms from the Windows start (resets every 49.7 days). The time in milliseconds can be linked with the computer local time by using Times in line started by * (see Timer Relation).
10	-	Line Feed character

#### Channel Information

Channel 1	-	Conductivity for coil separation 1.00 m
Channel 2	-	Inphase for coil separation 1.00 m
Channel 3	-	Conductivity for coil separation 0.88 m
Channel 4	-	Inphase for coil separation .88 m
Channel 5	-	Conductivity for coil separation 0.50 m
Channel 6	-	Inphase for coil separation .50 m
Channel 7	-	Conductivity for coil separation 0.75 m
Channel 8	-	Inphase for coil separation 0.75 m
Channel 9	-	Not used
Channel 10	-	Not used
Channel 11	-	Not used
Channel 12	-	Not used
Channel 13	-	Real Time Inversion: Thickness of the first layer (optional)
Channel 14	-	Real Time Inversion: Conductivity of the first layer (optional)
Channel 15	-	Real Time Inversion: Conductivity of the second layer (optional)
Channel 16	-	Real Time Inversion: RMSE value (optional)
Channel 17	-	Real Time Inversion: Number of iterations (optional)

#### Conductivity Conversion

Use Channels 1, 3, 5, and 7 according to following formulas to obtain Conductivity readings in mS/m.

$$\text{Reading (Conductivity 0.50 m)} = (\text{Channel\_5} \times 5 / 1024 - 160) \times 8 + \text{O1} - \text{OD}$$

$$\text{Reading (Conductivity 0.75 m)} = (\text{Channel\_7} \times 5 / 1024 - 160) \times 8 + \text{O2} - \text{OE}$$

$$\text{Reading (Conductivity 0.88 m)} = (\text{Channel\_3} \times 5 / 1024 - 160) \times 8 + \text{O4} - \text{OG}$$

$$\text{Reading (Conductivity 1.00 m)} = (\text{Channel\_1} \times 5 / 1024 - 160) \times 8 + \text{O3} - \text{OF}$$

If Calibration is not to be included then O5 to O8 and OH to OK can be omitted.

#### Inphase Conversion

- there are four possible scenarios depending on Inphase units used during data collection (see parameter IP in file header) and Inphase units needed after conversion

Use Channels 6, 8, 4, and 2 according to following formulas:

when Inphase units ppt were used during data collection (parameter IP=0)

to obtain Inphase readings in ppt.

$$\text{Reading (I/P 0.50 m)} = (\text{Channel\_6} \times 5 / 1024 - 160) \times 8 \times 0.00716 - \text{O5} - \text{OH}$$

$$\text{Reading (I/P 0.75 m)} = (\text{Channel\_8} \times 5 / 1024 - 160) \times 8 \times 0.0161 - \text{O6} - \text{OI}$$

$$\text{Reading (I/P 0.88 m)} = (\text{Channel\_4} \times 5 / 1024 - 160) \times 8 \times 0.0222 - \text{O8} - \text{OK}$$

$$\text{Reading (I/P 1.00 m)} = (\text{Channel\_2} \times 5 / 1024 - 160) \times 8 \times 0.0286 - \text{O7} - \text{OJ}$$

to obtain Inphase readings in mS/m

$$\text{Reading (I/P 0.50 m)} = (\text{Channel\_6} \times 5 / 1024 - 160) \times 8 - (\text{O5} + \text{OH}) / 0.00716$$

$$\text{Reading (I/P 0.75 m)} = (\text{Channel\_8} \times 5 / 1024 - 160) \times 8 - (\text{O6} + \text{OI}) / 0.0161$$

$$\text{Reading (I/P 0.88 m)} = (\text{Channel\_4} \times 5 / 1024 - 160) \times 8 - (\text{O8} + \text{OK}) / 0.0222$$

$$\text{Reading (I/P 1.00 m)} = (\text{Channel\_2} \times 5 / 1024 - 160) \times 8 - (\text{O7} + \text{OJ}) / 0.0286$$



when Inphase units mS/m were used during data collection (parameter IP=1)

to obtain Inphase readings in ppt.

$$\text{Reading (I/P 0.50 m)} = (\text{Channel\_6} \times 5 / 1024 - 160) \times 8 - \text{O5} - \text{OH}) \times 0.00716$$

$$\text{Reading (I/P 0.75 m)} = (\text{Channel\_8} \times 5 / 1024 - 160) \times 8 - \text{O6} - \text{OI}) \times 0.0161$$

$$\text{Reading (I/P 0.88 m)} = (\text{Channel\_4} \times 5 / 1024 - 160) \times 8 - \text{O8} - \text{OK}) \times 0.0222$$

$$\text{Reading (I/P 1.00 m)} = (\text{Channel\_2} \times 5 / 1024 - 160) \times 8 - \text{O7} - \text{OJ}) \times 0.0286$$

to obtain Inphase readings in mS/m

$$\text{Reading (I/P 0.50 m)} = (\text{Channel\_6} \times 5 / 1024 - 160) \times 8 - \text{O5} - \text{OH}$$

$$\text{Reading (I/P 0.75 m)} = (\text{Channel\_8} \times 5 / 1024 - 160) \times 8 - \text{O6} - \text{OI}$$

$$\text{Reading (I/P 0.88 m)} = (\text{Channel\_4} \times 5 / 1024 - 160) \times 8 - \text{O8} - \text{OK}$$

$$\text{Reading (I/P 1.00 m)} = (\text{Channel\_2} \times 5 / 1024 - 160) \times 8 - \text{O7} - \text{OJ}$$

If Calibration is not to be included then O5 to O8 and OH to OK can be omitted.

### Inversion Conversion

Following formulas are to be applied only if real time inversion was performed during data collection. It is indicated by the **IV** parameter in the file header.

If the real time inversion was not performed (IV=0) corresponding bytes for Channels 13 to 17 are filled by Spaces.

$$\text{Thickness Layer \#1 [metre]} = \text{Channel\_13} / 1000$$

$$\text{Conductivity Layer \#1 [mS/m]} = \text{Channel\_14} / 100$$

$$\text{Conductivity Layer \#2 [mS/m]} = \text{Channel\_15} / 100$$

$$\text{RMSE Value} = \text{Channel\_16} / 100$$

$$\text{Number of Iterations} = \text{Channel\_17}$$

(channel 17 it is one byte, ASCII number of corresponding character indicates number of iterations)

### Comment

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
C	Comment (max. 11 characters)																																										Time Stamp in ms (up to 10 digits)				10

### New Station

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
S	New Station (Format 11.2)																																										Time Stamp in ms (up to 10 digits)				10

### Calibration

Calibration values are always recorded as a block of 28 record, each record represents values for different component/coil separation as well as calibration object (instrument and carrier, if used). When Calibration is performed during data logging then record for each component/coil separation/dipole mode and carrier calibration contains two factors. Except of last 8 factors (OL to OS), the first value corresponds to the current calibration and the second, following value shows former calibration factor.

Calibration values indicated by labels **O9** to **OC** and **OL** to **OS** are provided for diagnostic purposes only, they are not used in conversion formulas.

If calibration procedure was performed at any stage of survey then calibration factors should be applied to all following EM38-4 readings, until next calibration is performed.

Calibration values placed in each Line Header repeat the latest calibration set of values. If Calibration procedure was not performed during the survey, factors may contain values from a former data files or all values are zeros, according to program settings.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48

O 1	Calibration for Q/P Coil 0.50m	Former Cal. for Q/P Coil 0.50m	10
O 2	Calibration for Q/P Coil 0.75m	Former Cal. for Q/P Coil 0.75m	10
... and similar records starting with <b>O</b> (from <b>O1</b> to <b>OS</b> , total 28 records), described below			
O S	Cal.Carrier Air I/P Coil 0.88m	Cal.Carrier Vehicle I/P Coil 0.88m	10

- O1 - Calibration factor - conductivity 0.50 m coils (current and former)
- O2 - Calibration factor - conductivity 0.75 m coils (current and former)
- O3 - Calibration factor - conductivity 1.00 m coils (current and former)
- O4 - Calibration factor - conductivity 0.88 m coils (current and former)
- O5 - Calibration factor - Inphase 0.50 m, (current and former)
- O6 - Calibration factor - Inphase 0.75 m, (current and former)
- O7 - Calibration factor - Inphase 1.00 m, (current and former)
- O8 - Calibration factor - Inphase 0.88 m, (current and former)
- O9 - Calibration factor - Inphase 0.50 m, (current and former, H mode)
- OA - Calibration factor - Inphase 0.75 m, (current and former, H mode)
- OB - Calibration factor - Inphase 1.00 m, (current and former, H mode)
- OC - Calibration factor - Inphase 0.88 m, (current and former, H mode)
- OD - Carrier Calibration factor - conductivity 0.50 m coils (current and former)
- OE - Carrier Calibration factor - conductivity 0.75 m coils (current and former)
- OF - Carrier Calibration factor - conductivity 1.00 m coils (current and former)
- OG - Carrier Calibration factor - conductivity 0.88 m coils (current and former)
- OH - Carrier Calibration factor - Inphase 0.50 m coils (current and former)
- OI - Carrier Calibration factor - Inphase 0.75 m coils (current and former)
- OJ - Carrier Calibration factor - Inphase 1.00 m coils (current and former)
- OK - Carrier Calibration factor - Inphase 0.88 m coils (current and former)
- OL - Carrier Calibration value - conductivity 0.50 m coils (in air, at vehicle)
- OM - Carrier Calibration value - conductivity 0.75 m coils (in air, at vehicle)
- ON - Carrier Calibration value - conductivity 1.00 m coils (in air, at vehicle)
- OO - Carrier Calibration value - conductivity 0.88 m coils (in air, at vehicle)
- OP - Carrier Calibration value - Inphase 0.50 m coils (in air, at vehicle)
- OQ - Carrier Calibration value - Inphase 0.75 m coils (in air, at vehicle)
- OR - Carrier Calibration value - Inphase 1.00 m coils (in air, at vehicle)
- OS - Carrier Calibration value - Inphase 0.88 m coils (in air, at vehicle)
- 10 - Line Feed character (ends each above record)

### GPS Data Message Records

Each GPS record (GGA Message) is broken in to several 46 characters strings and placed in the EM38-4 data file which contains 48 characters long records, including one character indicator and line feed at the end of each record. The GPS sequence starts at the line which contains character @ as the first character, then records that contain continuation of the same message start with

character #. The GPS sequence ends with a line starting with the character !. The last line contains logger time stamp in milliseconds for given GPS reading. A sample of the GPS message written in EM38-4 format is given below.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
@	S	G	P	G	G	A	,	h	h	m	m	s	s	.	s	s	,	d	d	m	m	.	m	m	m	m	,	N	,	d	d	d	m	m	.	m	m	m	m	,	W	,	n	,		10	
#	q	q	,	p	p	.	p	,	s	a	a	a	.	a	a	,	u	,	±	x	x	x	.	x	,	M	,	s	s	,	a	a	a	*	c	c	CR	LF							10		
!																																						Time Stamp in ms (up to 10 digits)					10				

The GPS sequence may contain 2 to 3 records, depending on number of decimals. Component of the GGA message may differ in length, however they are placed in the same number of columns. Refer to Appendix B (section B.2) for definition of each component of GGA data message.

## A.2 Example of Data File in EM38-4 (384) Format

The EM38-4 data file records are saved in binary format, therefore the file may have different shape when displayed or printed, depending on particular video or printer settings.

```

EM38-4 W101GPS000010121 1
H Gralowcar 5.000 0.470
L1
B 0.00
AS 1.000
Z02112020 15:59:34
01 1.321 5.853
02 1.883 4.279
03 7.280 11.021
04 -30.033 -27.777
05 -2.072 -2.635
06 -1.415 -1.334
07 8.288 7.583
08 1.361 1.475
09 -0.047 0.027
0A 0.140 0.027
0B 0.092 0.076
0C 0.125 -0.019
0D -2.820 0.000
0E 8.951 0.000
0F 5.275 0.000
0G 17.764 0.000
0H 0.587 0.000
0I 1.404 0.000
0J 4.507 0.000
0K 2.800 0.000
0L 0.000 0.000
0M 0.000 0.000
0N 0.000 0.000
0O 0.000 0.000
0P 0.000 0.000
0Q 0.000 0.000
0R 0.000 0.000
0S 0.000 0.000
*15:59:34.267 74474515
X$STARTED 74582296
T_Î«[...h'7,]g%[]f~x_ Å Å_p \_zDA 74582390
T_Î«[...d'7,^g#[i~Ö_ Æ Æ_d-ê_ Pp_ 74582593
T_Ö«r...[',fg&[]e~x_ Å Æ_h_»_ iJ^2_ 74582781
T_Ö«h...c':,dg []b~Ö_ Å Æ_n~_vD/_ 74582984
@$GPGGA,154919.00,4314.3667005,N,08030.4043676
#,W,2,14,1.0,266.371,M,-35.220,M,12.0,0138*4F
! 74583015
@$GPGSA,M,3,10,13,15,18,20,23,24,,,,,1.8,1.0,
#1.5,1*24
! 74583015
T_Ö«e...b';,eg []j~Û_ Å Æ_n_Š_wD@_ 74583171
T_à«w...c'? ,cg []a~Ö_ Å Æ_a_Î_i9ð_ 74583375
T_â«p...g';,dg []b~Ö_ Å Æ_s_*^3=_ 74583578
T_è«z...l'>,eg []j~Î_ Å Æ_X_Î_i/V_ 74583765
T_ê«p...v'=,gg []d~Î_ Å Æ_Z_ß_o.¡_ 74583968
@$GPGGA,154920.00,4314.3666975,N,08030.4043633
#,W,2,14,1.0,266.351,M,-35.220,M,13.0,0138*48
! 74584031
@$GPGSA,M,3,10,13,15,18,20,23,24,,,,,1.8,1.0,
#1.5,1*24
! 74584031
T_þ«t...n'<, \g []b~Í_ Å Æ_Z_}~n/a_ 74584171
T_ÿ«m...l'C,cg []g~Ê_ Å Æ_U_Î_a3>_ 74584359
T_Ü«h...g'? ,cg []d~Î_ Å Æ_f__u6i_ 74584546
.....

```