

*Zond geophysical software*

# **Zond-IP 1D**

**User guide**

## ***Table of Contents:***

<b>Introduction</b>	<b>3</b>
<b>Registration</b>	<b>3</b>
<b>System requirements</b>	<b>3</b>
<b>Installation of software</b>	<b>3</b>
<b>Value definitions</b>	<b>4</b>
<b>Creation and opening of data file</b>	<b>4</b>
<b>Data file format</b>	<b>5</b>
<b>Interpretation results saving</b>	<b>7</b>
<b>The operating procedure with the program</b>	<b>7</b>
<b>Main Menu</b>	<b>7</b>
<b>Styles library</b>	<b>8</b>
<b>Main Menu toolbar</b>	<b>9</b>
<b>Main Menu functions</b>	<b>9</b>
<b>“Hot” keys</b>	<b>10</b>
<b>Program setup dialog</b>	<b>10</b>
<b>Data inversion</b>	<b>15</b>
<b>Objects</b>	<b>16</b>
<b>Model editor</b>	<b>16</b>
<b>Parameters table</b>	<b>18</b>
<b>Section</b>	<b>20</b>
<b>Pseudosection</b>	<b>21</b>
<b>Plot of profiling</b>	<b>21</b>
<b>Calculated and observed curve plot</b>	<b>22</b>
<b>Objects setup adjusting</b>	<b>24</b>

## **Introduction**

«Zond-IP» is designed to the one-dimensional interpretation of profile data for different modifications of vertical electrical sounding. Convenient interface and wide opportunities of data visualization allow deciding with maximal effect geological problems. «Zond-IP» presents comfortable tool for forward modeling and inversion of VES data. This product can be used for IBM PC compatible computer with OS Windows.

## **Registration**

- Click “Registration file” item of Main Menu for “Zond-IP” registration.
- When a dialog field appears, select file name.
- This file is transmitted to “license” address and personal Alfa-numeric ID code is fixed. Received ID-code is unique and it depends directly of HDD-serial number.
- Input password in “Registration” field.

Warning: Unregistered version is to demonstrate only.

## **System requirements**

«Zond-IP» would be installing on the PC with OS “Windows”. Minimal requirements for PC: Celeron-700 MHz, 128 Mb memory, screen 1024x 768, color mode 64K. (No change screen resolution is recommended when program is loaded)

## **Installation of software**

«Zond-IP» is delivered as two 3.5 FDD or CD or internet. “User Guide” is included too.

- Run «SETUP.EXE» for installation.
- Choose directory in «Install Zond-IP» as you would like.
- Shortcut group «Zond-IP» appears when installation finished.

For removing «Zond-IP» use «Master of installing/removing».

- Choose «Zond-IP» item.
- Press «Add/Remove» button.

### Value definitions

$Ro\_a$  – apparent resistivity.  $\rho_a = G \cdot \frac{\Delta U}{I}$ , where  $G$  - geometrical factor of electrodes array.

$Eta\_a$  - apparent polarisability.  $\eta_a = \frac{\Delta U^{IP}}{\Delta U^{DC}} \cdot 100\%$ , at percents.

Spacing:  $AB/2$  for Schlumberger, Wenner and symmetrical array;  $AM$  for pole-pole one;  $AO$  for pole-dipole one;  $O'O$  for dipole-dipole one.  $A, B$  – current electrodes,  $M, N$  – potential electrodes.  $O'$  – center of  $AB$  line.  $O$  – center of  $MN$  line.

Pseudodepth is rough depth of observation, concerned with  $G$  factor of electrodes array (spacing of array). Sounding point is centre of source line for Schlumberger, Wenner and symmetrical array, but sounding point is not determined for other sounding arrays (usually, position of stationary electrode is).

All geometric program values are considered at meters.

### Creation and opening of data file

For starting up «Zond-IP» create certain format data file, which contains geometrical information and observed data of apparent resistivity and polarisability. Usually, one profile corresponds to one file.

Using multielectrode arrays, it is necessary to mean, that as an element of the data in the program «Zond-IP» the sounding curve is considered.

Text data files have «\*.zlf» and «\*.zlp» - extension. See “**Data file format**” for detailed information.

For correct working, the data file cannot contain next elements:

- the number of spacings in curves less three.
- incorrect symbols for record separator ( TAB and SPACE use only ).

- absurd data values.

Desirably, total record number must be no more 5000 for one file.

Opening «\*.zlp» - file you would mean the data of previous interpretation model loads together with observed data.

## Data file format

Software presents universal data format which consists of information about array geometry, coordinates and sounding point relative elevations.

The file of the data should have ZLF extension.

Three first lines of file contain information about observed parameters common for whole profile.

**First line** contains next records shared symbols SPACE or TAB:

First record is reserved by software Zond-Lite.

Second record (0-4) is array type: “0” – Schlumberger, Wenner pole-dipole array.

“1” – dipole-axis array

“2” – pole-pole array

“3” – universal pole-dipole array

“4” – universal dipole-dipole array

Records sequence for different arrays:

“0” – 0 0

“1” – 0 1 Len\_dip, where Len\_dip – length of source dipole.

“2” – 0 2

“3” – 0 3 delt\_y dircosX dircosY, where delt\_y is the profile Y - offset, dircosX and dircosY – directional cosine of receiving line.

“4” – 0 3 Bx By delt\_y dircosX dircosY, where Bx и By – coordinates of second source electrode, delt\_y is the profile Y- offset. dircosX and dircosY – directional cosine of receiving line.

*Universal arrays.* Coordinates of first source electrode are zero point. The array spacings set in without taking offset for first source electrode. The observing is produced along X – axle, in positive direction. Directional cosines define the direction of receiving line regarding a profile. The profile data offset is produced in positive direction, along of Y – axle.

**Second line** contains values of spacings (half length of source line (0) /distance from first source electrode to center of receiving line (0, 3, and 4)/distance between dipole centers (1)). Its must be sorted in order grow up.

**Third line** contains value of spacing for receiving line.

If third line is absent, so the receiving line spacings are zero.

In case of segmented VES curves the second and third lines must be sorted next way:

The spacings of receiving line are placed segment to segment in series. The values of source line spacings must be sorted in order grow up in every segment.

1.0 5.0 9 15 9 15 25 40 25 40 100 200 100 200 500 900  
0.5 0.5 0.5 0.5 3 3 3 3 15 15 15 15 50 50 50 50

Using of complex observing systems, with changing point to point spacings system, you must write in second and third lines all unique profile pairs (source and receiving lines spacings), which appropriate the above rules.

Next lines contain information about every profile sounding point, united in the blocks described below.

### **The block of sounding station description**

**First line** is the start indicator of sounding point description block (must be contain symbol «{»).

**Second line** is the station name.

**Third line** is the sounding options.

First record is the profile coordinate of sounding point.

Second note is the relief elevation (positive value; minimal height is zero, other heights is calculated as elevation above it (in meters).

**Fourth and fifth lines** contain the actual observed data.

Ever line must begin by code-key shows to the program what kind of data used for observed data.

Code – keys control the kind of data are next:

«Ro\_a» – apparent resistivities.

«Eta\_a» – apparent polarisabilities.


If to code-key is added «\_w», it means setting of observed data weights.

The number and the order of notes in every lines must correspond the system of spacing (see second line) If the data of any spacing is absent the symbol «\*» must be added.

**Last line** is the end indicator of sounding point description block (must be contain symbol «}»)



The note of stations must have the same order as the profile layout (in order to coordinate grow up).



## Interpretation results saving

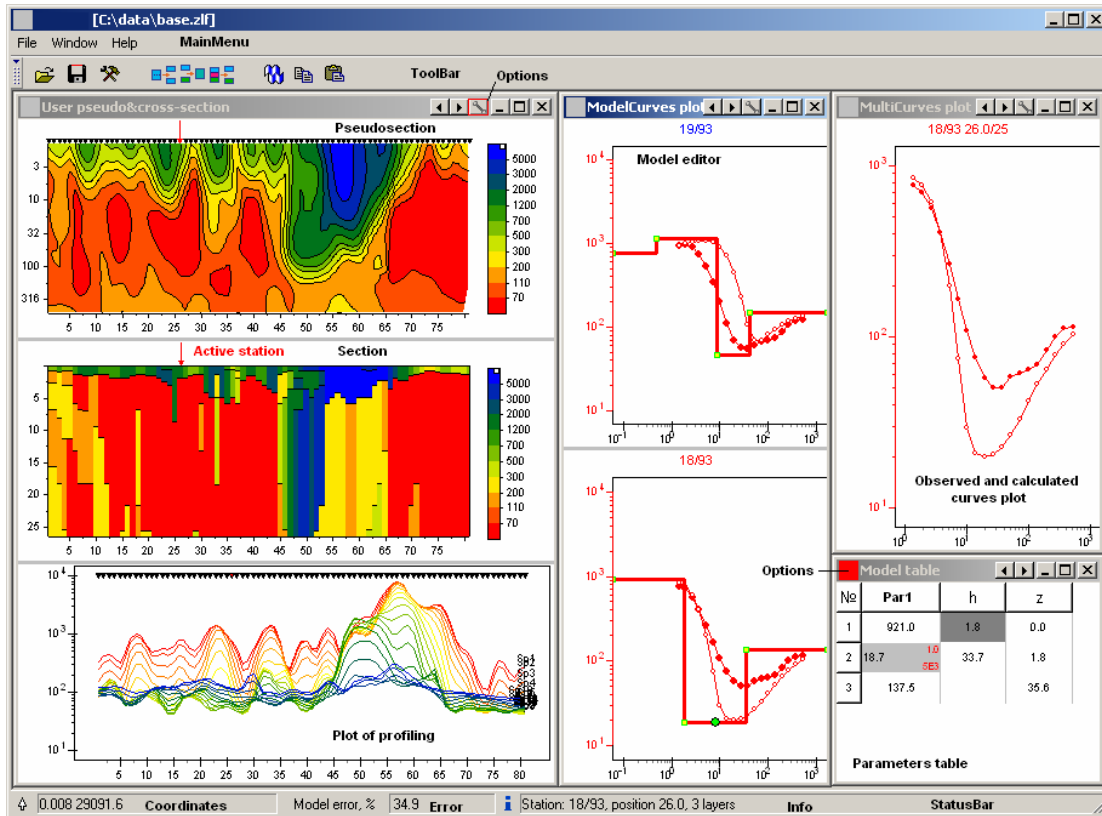
The result of profile data interpretation is saved in *Zond-IP project files* (extension \*.zlp). This file contains the file name with observed data, also set of parameters and limits for every sounding point. To save result, press  on the toolbar or “Save data” item in the Menu. If option autosave is ON, the result will be saved automatically in certain time. Also you can save calculated curves in “zlf” format.

## The operating procedure with the program

### Main Menu

As soon as data file «\*.zlf» is ready you can load it in with help button  or “Open data” in the Menu. After file loading is successfully finished functional buttons is activated. Short information appears in right section of status panel. It contains the description of first sounding station. Move the cursor over windows and you can see coordinates of window axes in left section of status panel which situated at the bottom of main window. Press button  of window caption bar (see in picture) and context menu appears. It allow to dialog (option “*Object name Setup*”) with every objects and to set the number of objects (option “Set <object name> number) for - **Model Editor** or **Calculated and observed curve graph**.

Buttons  and  change of the sounding station index.



## Styles library

The library contains four object configurations. Using “Standard”– user controls four windows simultaneously.

First windows share three parts. Left and middle parts contain the pseudosection and section of profile. Its share splitter for resistivity data and polarisability data.

Second window contain graphs (from one to three) for model editing.

Fourth window is the parameters table.

“Profile” style adds in first window the different Spacing profile curves.

In “User” style is used one window instead of two previous ones.










User selects parameter will represent every object himself.

“Interpretation” style is different from “User” optional window which contains calculated and observed curve graphs (from one to three).



## Main Menu toolbar

The toolbar is intended for quick run the most used functions. The following table lists the buttons found in the tool bar with their corresponding functions (from right to left):

	Opens data file «*.zlf» or «*.zlp».
	Saves interpretation result or calculated curves.
	Runs setup dialog for program parameters.
	Unites two layers in one with summary thickness.
	Splits layer. Desired layer is divided by two layers with the same (in logarithmic scale) thickness.
	Deletes active layer.
	Runs data inversion for active point (left click) or for active and next (right click).
	Copies in buffer station model.
	Pastes model and uses it in this station (left click) or in the other next (right click).

## Main Menu functions

The following table lists the items found in the Menu with their corresponding functions:

File	Open data	Opens data file «*.zlf» or «*.zlp».
File	Save data	Saves interpretation result or calculated curves.
File	Program setup	Runs program parameters setup dialog.
File	Registration file	Creates registration file.
File	Registration	Inputs password for registration.
File	Exit	Exit from program.
Window	Tile vertical	Vertical windows order.
Window	Tile horizontal	Horizontal windows order.
Window	Zond “Standard”	Chooses “Standart” style.
Window	Zond “Profile”	Chooses “Profile” style.


Window	Zond “User”	Chooses “User ” style.
Window	Zond“Interpretation”	Chooses “Interpretation” style.
Help	About	About program.
Help	Context	Displays this manual.

### “Hot” keys

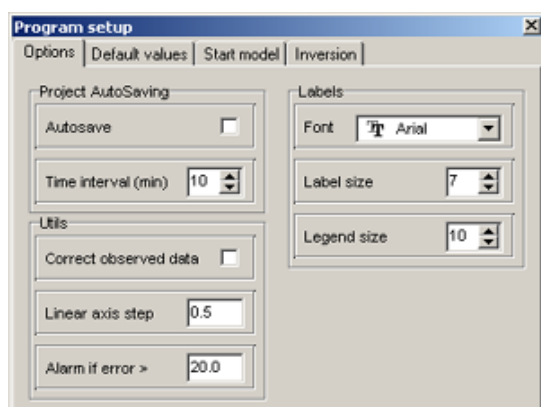
The following table lists the keys found in the keyboard with their functions:

[Space]	Runs data inversion for active station.
[S]	Splits layer. Desired layer is divided by two layers with the same (in logarithmic scale) thickness.
[M]	Unites two layers in one with summary thickness.
[D]	Deletes active layer.
->	Goes to the next station.
<-	Goes to the previous station.
[Escape]	Stops the inversion process.

### Program setup dialog

The Menu allows you to display the next tabs: **Options, Start model, Default values and Inversion.** The button of tool bar  runs this dialog.

#### Tab “Options”



#### ***AutoSaving***

This field allows enabling or disabling the autosaving mode.

*Time interval* - Sets the time interval for autosaving (in minutes). The file will save with name of opened file plus “Temp”.

*Autosave* - check ON, to enable autosave mode.

#### ***Labels***

Sets the parameters of font. *Font* - This field specifies the name of font (for mark on the axes, curves, etc).

*Label size* - Sets the size of font (for mark on the axes, curves, etc).

*Legend size* - Sets the size of font (for name of parameters).

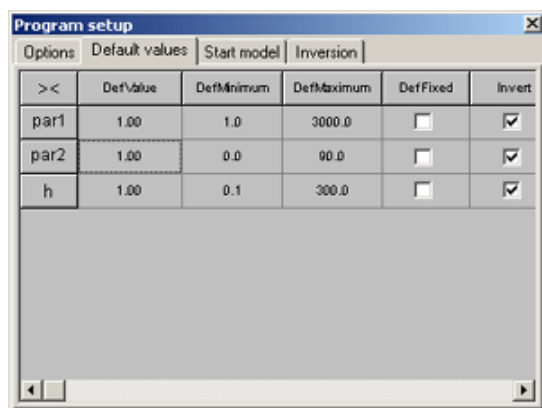
### **Utils**

Sets the data parameters. *Correct observed data* - Check ON, if you would change the observed data in case of over limited values. Polynomial interpolation is used to correct observed values.

*Linear axis step* - Sets the desired step for axis. This option is used for axes scaling.

*Alarm if error >* - Displays the dialog panel for confirmation of profile inversion, if station value of RMS error exceeds the set value.

### **Tab “Default values”**



><	DefValue	DefMinimum	DefMaximum	DefFixed	Invert
par1	1.00	1.0	3000.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>
par2	1.00	0.0	90.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>
h	1.00	0.1	300.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>

The given tab is intended for the task of the various parameters used at work with model.

The rows correspond to the parameters of layers (properties and thickness). The columns correspond to the below definitions.

First column [*DefValue*] values by default. (it is used for start model).

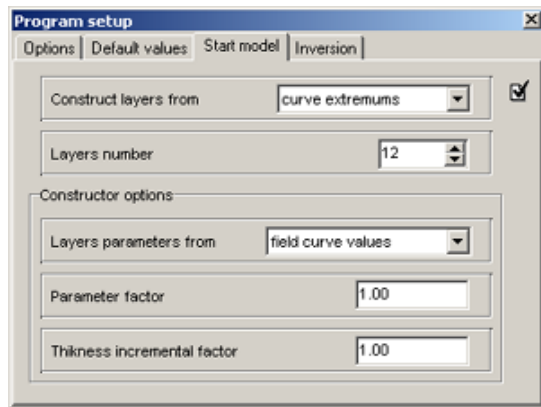
Second column [*DefMinimum*] value of parameters lower limit by default (it is used at fixing parameters).

Third column [*DefMaximum*] value of parameters upper limit by default (it is used at fixing parameters).

Fourth column [*DefFixed*] check ON if you would fix parameter after reading of observed data. When you load the project-file this option is off.

Fifth column [*Invert*] checks ON, if you would invert parameter when inversion is on.

## Tab “Start model”



The tab serves as the constructor of start model at reading the field data.

The field [*Construct layers from*] sets the algorithm which definite the layer boundaries position.

Value [*Curve extremums*] – positions of boundaries are determined from field curves (from extremums analyses).

Value [*equal log-dividing*] – dividing is made with uniform logarithmic step, from the minimal pseudodepth to maximal. The number of layers is set in a field [*Layers number*]. Value [*incremental factor*] – It means the default sets are used for layer thickness. The thickness of every next layer is equal the before layer thickness multiplying by [*Thickness incremental Factor*].

[*Layers number*] sets maximum value of layers number.

[**Constructor options**] Contains the options intended for the task of start parameters of model.

The field [*Layers parameters from*] sets the algorithm which definite the layer parameters.

Value [*field curve values*] – parameters of layers are determined by means of interpolation field curves values.

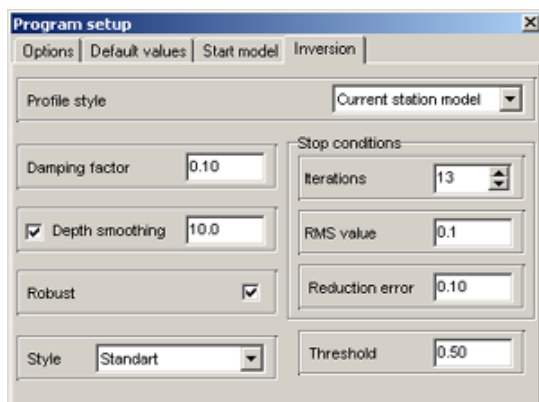
Value [*default values*] – for parameters of layers values by default are used.

Value [*median of field curve*] – parameters of layers are determined, how average value of field curves.

The field [*Parameter factor*] sets the factor which multiply by maximum of model parameters and divide by minimum of model parameters (usually 1 – 4). This factor increases the start model contrast. It is especially important, if the curves have not the asymptotes.

The field [*Thickness factor*] sets the factor which multiply by layers thickness (in mode “*Curve extremums*” or “*equal log-dividing*”) (usually 0.2 - 1) or this field sets the factor increases the ever next layers thickness (in mode *Thicknesses*>*default value*) (usually 1 - 5).

## Tab “Inversion”



The field [*Profile style*] sets the inversion style of profile interpretation.

Value [*Current station model*] – It means the active point model serves the inversion’s start model.

Value [*Start station model*] – It means the start point model serves the inversion’s start model for all points.

Value [*Previous station’s mode*] – It means the previous point model serves the inversion’s start model for next point.

The field [*Damping factor*] sets the starting value of damping factor. It depends of numerous parameters: the condition number of jacobian matrix, the signal – to – noise ratio of data and the number of model parameter definitions. It is an empiric factor. For noisy data or for smooth parameter distribution the damping factor must have the big value: 0.05 - 0.5; for precision measurements - 0.005 - 0.01.

**Stop conditions.** Data inversion is a nonlinear iterative process. This group of parameters sets the rules that stop the iteration.

The field [*Iteration number*] sets a maximum number of iterations for an iterative nonlinear inversion stop. If the inversion diverges, it will stop after the prescribed maximum number of iterations.

The field [*RMS value*] sets the minimal RMS error. The process of automatic interpretation stops when the set is achieved. The primary objective of inversion is to reduce data misfit between field measurements and calculated data of a reconstructed model. Measurement errors usually range from 0.01% to 0.05%. But do not forget about numerical errors and rounding errors. This number should be equal to or larger than percentage of noise estimate.

The field [*Reduction error*] – sets the value of reduction error (in percent %). The inversion stops when the value of reduction error is achieved for three sequential iterations. It is generally expected that data misfit, e.g. RMS error, be reduced from iteration to iteration. The first several iterations have a larger RMS error reduction than later iterations. When RMS error reduction is very small or RMS error increases, the inversion should be terminated.

The field [*Depth smoothing*] –check ON for depth smoothing. It sets the degree of model-depth smoothing. The more set values (1 to 10) then more averaging of layers parameters with depth are on. Since the resolution of this method decreases with depth, the damping factor used in the inversion least-squares method is normally also increased with each deeper layer. Use a larger value (>1) if the model shows unnatural oscillations in the parameter values in the lower sections.

The field [*Robust*] –check ON if the big errors in data are contained. Its may consist of the measure system faults.

The field [*Style*] – sets the type of data inversion.

*Value* [*Smooth*] is the inversion by least-square method with using the smoothing filter and with using the additional minimization of contrast. As result we have the most smooth parameters distribution. This type of inversion is recommended for the beginning interpretation. The number of model layers must exceed considerable the number of real-model layers. Desirably, the number of layers exceeds 10 layers and its thicknesses are fixed.

*Value* [*Standard*] is the inversion by least-square method with using the damping factor regularization. It allows receiving the model with sharp boundaries. Careless using this type of inversion leads to the results instability or to the RMS increasing. For the best results this method must be used as specify method after inversion with help of *Smooth*.

*Value* [*Focused*] is the inversion by least-square method with using the smoothing filter and with using the additional contrast focusing. As result we have the piecewise-smooth parameters distribution. It is the model which consists of layers with constant parameter. This type of inversion is recommended for the beginning interpretation. The number of model layers must exceed considerable the number of real-model layers. Desirably, the number of layers exceeds 10 layers and its thicknesses are fixed.

Careless using this type of inversion leads to the algorithm divergence and the instability models.

The field [*Threshold*] sets the maximum value contrast of neighboring layers. When the maximum value contrast is achieved the parameters of layers don't average. It is an empiric parameter. (0.001-1). When you select the least value you will have the algorithm divergence (you must increase this value). When you select the biggest value you have the smooth distribution.

The option *[Filter]* - is used in those versions of programs which use two and more types of parameters. Establishes how to construct the focusing filter.

Value *from parameter* - the filter for all types of parameters is constructed on model of the chosen parameter.

Value *from any* - the filter for each type of parameters is constructed on model of this parameter.

## **Observed data interpretation**


«Zond-IP» allows deciding the one dimensional forward modeling and inversion of VES. This program produces the inversion of layers properties and thickness. User can fix the parameters and set the limits of changing for these parameters. Also, user can set the weights of observed data.

The forward problem is solved with use of algorithm of a linear filtration, for the decision of inverse the method of Newton is used.

After reading of data file the interpretation mode is activated.

## **Data inversion**

This option is used to quick data inversion of one or all profile stations. Method of Newton is used for minimization of least-square deviation between the calculated and observed curves.

Press  on toolbar to invert the active sounding station data, right click selects the whole profile.

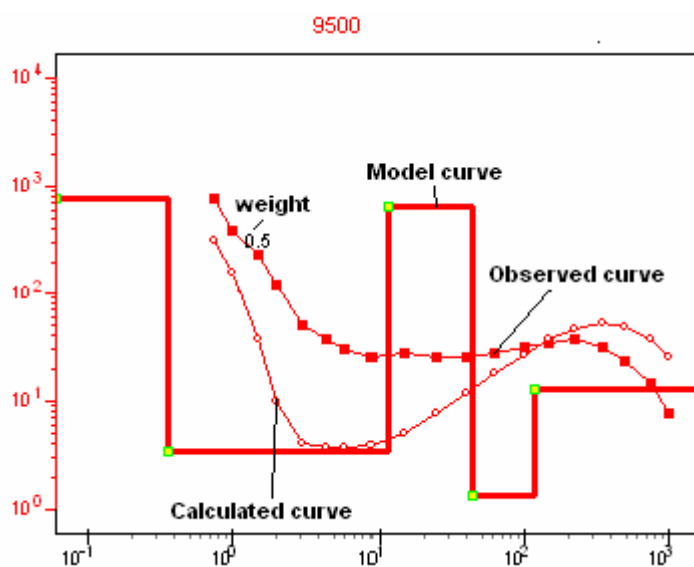
In the status bar you can see the information about divergence between calculated and observed curves. The inversion will finish when it achieves the set level or the number of iteration exceed maximal.

The inversion gives nonunique solution since calculated curves can be identical for several models. So, it is necessary to take into account the apriority information about geoelectrical section when you set the start model in inversion. If you have real apriority information about the geoelectrical section you must fix the known parameters or limit the changing of the known parameters in their field in start model.

## Objects

Interactive interpretation is made in the following objects: **Model editor**, **Section**, **Parameters table**, visualization in objects: **Pseudosection**, **Profiling plot**, **Calculated and observed curve plot**. These objects appear automatically after data is loaded.

### Model editor



The red stepping line is the dependence of the first parameter from the depth (left vertical axis corresponds it). The blue stepping line is the dependence of the second parameter from the depth (right vertical axis corresponds it). The red and blue curves with filled circles and squares are the observed curves for first and second type of observed data, depending from the pseudodepth.

The red and blue curves with empty circles and squares are the calculated curves for first and second type of observed data, depending from pseudo depth.

The left axis corresponds to the red curves. The right axis corresponds to the blue curves. The right axis is absent if one type of observed data is used to the program.

Graphic parameters of calculated and observed graphs can be installed in setup dialog.

The window can contain as many as three similar graphs allowing model editors of three neighbor's stations.

You can change parameters of model by mouse. Move cursor at the model curve (the shape of cursor must change) and left click after that you can drag the active part of curve.

You can change parameters of model by mouse. Move cursor at the model curve (the shape of cursor must change) and left click after that you can drag the active part of curve.



The green circle on the curve shows the active layer.

The alteration of curve's vertical sector location corresponds to the alteration of model geometry (thicknesses [right click] and depths of layer [left click]).

The alteration of curve's horizontal sector location corresponds to the alteration of model layer parameters.

When you double click in the object location, the following context menu appears:

Print preview	Runs the dialog of printing.
Parameter1 name display	Displays or hides the graph of model first parameter.
Parameter2 name display	Displays or hides the graph of model second parameter.
Data1-m name display	Displays or hides the observed curves or calculated curves for this type of measurements.
Left axis Parameter1-n name	Displays the active parameter for left axe.
Right axis Parameter1-n name	Displays the active parameter for right axe.

When you right click in the observed curve points, the following context menu appears and you can set the weight of observed data:

Good point	Sets weight 1 for active point.
Bad point	Sets weight 0.5 for active point.
Very bad point	Sets weight 0 for active point.
Good points >>	Sets weight 1 for active point and all points to right of it.
Bad points >>	Sets weight 0.5 for active point and all points to right of it.
Very bad points >>	Sets weight 0 for active point and all points to right of it.
Good points <<	Sets weight 1 for active point and all points to left of it.
Bad points <<	Sets weight 0.5 for active point and all points to left of it.
Very bad points <<	Sets weight 0 for active point and all points to left of it.

The data weights are very important for the model parameters inversion. The point weight is calculate by the next way:  $\text{Point weight} = 1 - \text{dispersion} / (\text{observed value})$ . The data weight can be set in the data file and it is saving in the project file.

## Parameters table

This window allows you to edit the model parameters by keyboard. The table contains  $n+3$  columns ( $n$  – the number of medium properties). Every table row contains the only one layer parameters.

First column contains the layer index. Next  $n$  columns contains physical properties of layers. Penultimate column contains the thicknesses of layers.

The last column contains the depths of layers (with the taking account of station altitude).

No	par 1	par 2	h	z	
1	47.1	1.0 3E3	10.2	11.0	3.0
2	4.7	1.0 3E3	7.9	178.8	14.0
3	70.2	1.0 3E3	8.7	192.7	

The cell is silver when the limits of parameter alteration are set. The cell is dark gray when the parameter value is fixed.

When you right click in the table cell, the following context menu appears. The item of context menu serves the current parameter of all layers, if you right click in the cell of first row.

The item of context menu serves all parameters of active layer if you right click in the cell of first column.

Lock	Fixes parameter.
Free	Frees parameter.
User limits	Sets user's limits for the parameter.
Default limits	Sets default limits.
Default values	Sets default values.
Lock >>>	Fixes the parameter of current model and all next models.
Free >>>	Frees the parameter of current model and free the all next models.
User limits >>>	Sets user's diapasons for the parameter of current model and all next models.
Default limits >>>	Sets the default limits in current model and all next models.
Default values >>>	Sets the default values in current model and all next models.

The default values are set in the program setup dialog.

When you right click in upper left corner of window, the following optional context menu appears:

Data precision	Sets the data precision of table.
Display limits	Shows or hides the parameter limits.
Correlation matrix	Shows correlation matrix and confidence limits of model's parameters.
Return to start model	Returns to start model. The model constructs by algorithm of setup dialog.
Save table to file	Saves model in file.
Correlation plot	Shows correlation plot window.
Layers summarization	To cause dialogue of layers summarization. Dialogue allows to set threshold value of contrast at which the next layers are united in one.

The main diagonal of correlation matrix contains 1. The parameters which corresponding to the non - diagonal members has the different influence to sounding curve. If the modules of non - diagonal members are a lot less then 1, then corresponding parameters are specified with a little error. If the modules of matrix elements are closely 1, then parameters are indefinite together. In this case you must fix the one from equivalent parameters for maximum precision of result, if you have got the independent information about it. In case of high correlation of neighboring layers parameters you can fix one from correlatable parameters or you can unite this layers e.g. to do the simple model.


Confidence intervals are the criteria of reliability for the parameters definition and it is link with integral sensitivity of layer parameters. In case of large confidence interval are thought that the parameter values are not reliable. The correlation map of pair parameters represents the plan of a discrepancy (at percents) between the theoretical data for the current and changed model.

The analysis of correlation dependence promotes successful revealing of equivalence between two parameters.

The colorbar establishes a ratio between discrepancy value and the certain color.

The field [p1] - establishes type of the first parameter for which the analysis of correlation dependence must be made (next field - index of layer).

The field [p2] - establishes type of the second parameter for which the analysis of correlation dependence must be made (next field - index of layer).

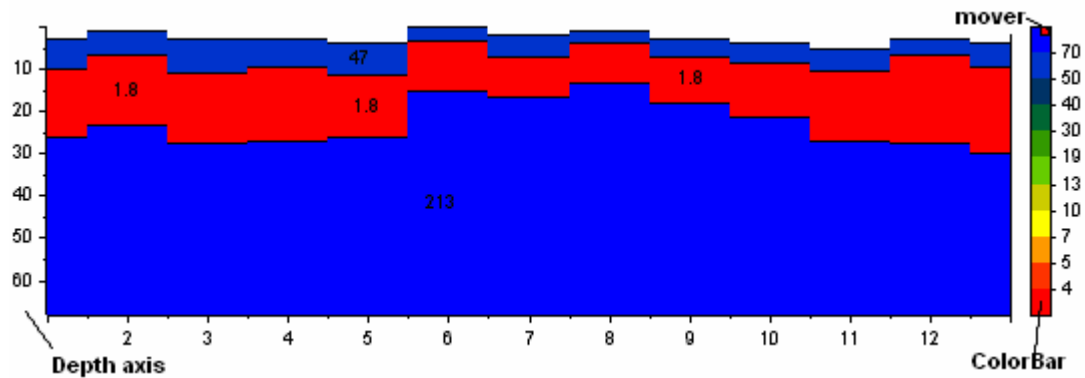
Press  - to build the correlation map.

## Section

Section serves to display the models parameters along a profile, as the profile section.

Construction is made in axes: coordinate on a profile, the depth. The color bar sets a relation between displayed parameter value and color.

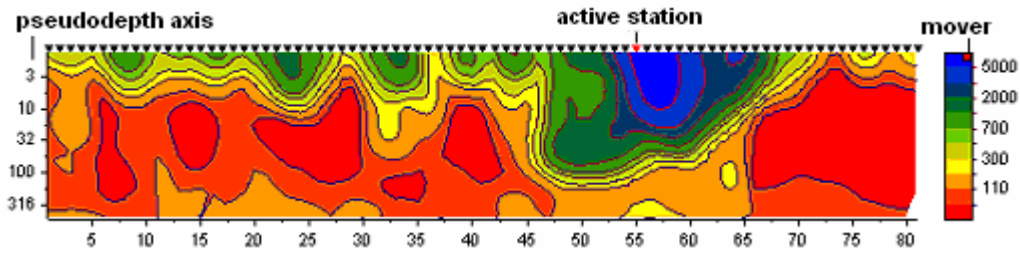
If the cursor is situated on the geoelectrical section the layer is allocated by rectangle. The form of cursor is changed when it locates on the boundary between layers and you can edit the boundary's position. For that you must drag active boundary in to desired position. If you do it with pressed right button the underlying boundaries move together with selected boundary. If you want to alter the maximal value of vertical axis you must right click in the top to decrease or in bottom to increase. The size and position of color bar can be altered by dragging the mark on color bar with pressed right or left button.



When you double click on the object, the following context menu appears

Log vertical scale	Use the logarithmic scale for vertical axe.
Log data scale	Use the logarithmic scale for color bar.
Display labels	Displays parameters values in the layers
Display Color Bar	Displays the color bar.
Refresh section	Redraws section.
Parameter 1-n name display	Displays the section for current parameter.

## Pseudosection



Pseudosection serves to display the observed values along a profile, as the contours map.

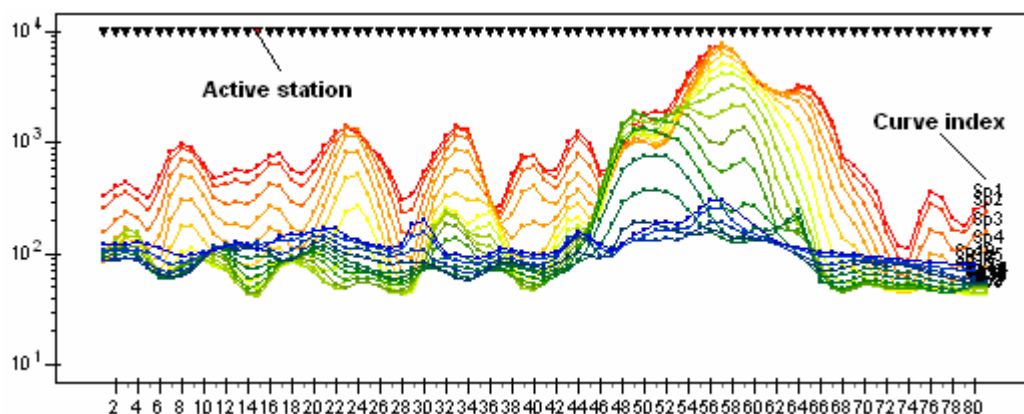
Construction is made in axes: coordinate on a profile, the logarithm of pseudo-depth. The color bar sets a relation between displayed parameter value and color.

The size and position of color bar can be altered by dragging the mark on color bar with pressed right or left button.

When you double click on the object, the following context menu appears:

Log data scale	Use the log scale for color bar.
Display labels	Displays labels of measurement points.
Display ColorBar	Displays color bar.
Data1-m name display	Displays the pseudosection for active parameter.

## Plot of profiling



This object serves for displaying the graphs of profiling (calculated and observed) for different pseudodepth (spacing/ period/ time of decay). The color of curve suits the certain pseudodepth.

The calculated curves are represented by solid lines. The observed curves are represented by solid with circles in the measurement points. Certain color suits the every curve; it is set in the setup dialog panel. Labels in the observed curves mean the values of pseudodepth for which the curves are constructed.

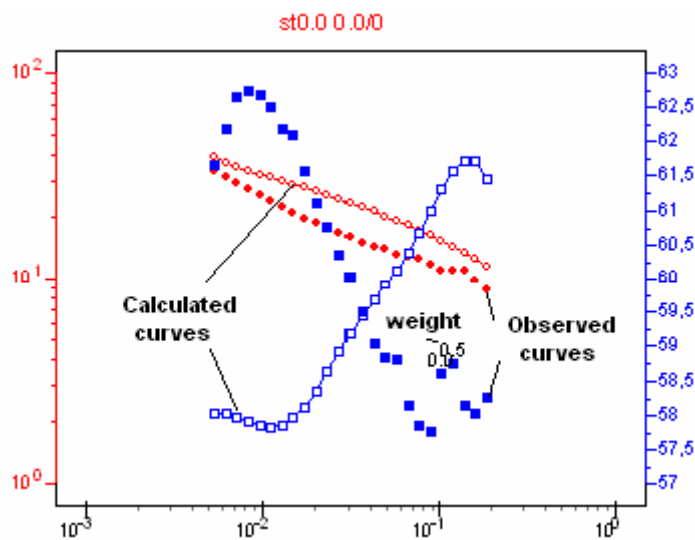
Graphic parameters of observed and calculated curves can be set in the setup dialog panel.

If you left click on the curve the other curves disappear and appear again after upping the mouse button. You can shift all graphs vertically by mouse dragging.

When you double click on the object, the following context menu appears:

Display observed	Displays observed curves.
Display calculated	Displays calculated curves.
Display legend	Displays curves marks.
Linear scale	Displays the curves in linear scale.
Log scale	Displays the curves in the logarithmic scale.
LogLinear scale	Displays the curves in the loglinear scale.
Имя параметра display	Displays graphs of current parameter.

### Calculated and observed curve plot



The window contains one, two or three similar plots. The red curve and the blue curve with filled circles and squares are calculated curves of the first and second type measured data in depending of the spacing/period/time of

decay.

The red and blue curves with empty circles and squares are the calculated curves for first and second type of observed data in depending of the Spacing/period/time of decay.

The left axis corresponds to red curve; the right axe corresponds to the blue curve. If the program operates one type of observed values the right axe is absent.

Graphic parameters of observed and calculated graphs can be set in the setup dialog.

When you double click on object, the following context menu appears.

Print preview	Runs the dialog of printing.
Display point weights	Displays weights of observed data.
Data1-m name Linear scale	Displays curves in the linear scale.
Data1-m name a Log scale	Displays curves in the logarithmic scale.
Data1-m name LinLog scale	Displays curves in the loglinear scale.
Data1-m name display	Displays curves of current type.

When you right click on the points of observed curves, the following context menu appears and you can set the weight for observed data.

Good point	Sets weight 1 for active point.
Bad point	Sets weight 0.5 for active point.
Very bad point	Sets weight 0 for active point.
Good points >>	Sets weight 1 for active point and all points to right of it.
Bad points >>	Sets weight 0.5 for active point and all points to right of it.
Very bad points >>	Sets weight 0 for active point and all points to right of it.
Good points <<	Sets weight 1 for active point and all points to left of it.
Bad points <<	Sets weight 0.5 for active point and all points to left of it.
Very bad points <<	Sets weight 0 for active point and all points to left of it.

The data weights are very important for the model parameters inversion. The point weight is calculate by the next way:  $\text{Point weight} = 1 - \text{dispersion} / (\text{observed value})$ . The data weight can be set in the data file and it is saving in the project file.

## Objects setup adjusting

### Tab Pseudo-section



This tab serves to setup the parameters of pseudosection.

#### ***Box margins***

The field [*Left margin*] sets the margin (in pixels) of picture from window's left edge.

The field [*Right margin*] sets the margin (in pixels) of picture from

window's right edge.

The field [*Top margin*] sets the margin (in pixels) of picture from window's top edge.

The field [*Bottom margin*] sets the margin (in pixels) of picture from window's bottom edge.

#### ***Fill&Line colors***

Next options [*Min contour*], [*1/3 contour*], [*2/3 contour*] and [*Max contour*] set the interpolation array of colors from [*Min contour*] to [*Max contour*] via [*1/3 contour*] and [*2/3 contour*]. This color palette is used to paint the space between the neighbor isolines.

The field [*Num levels*] defines the number of isolines. The levels are set by constant linear or logarithmic step in depending of data type.

Next options [*Min isoline*] and [*Max isoline*] set the interpolation array from [*Min contour*] to [*Max contour*]. This color palette is used to paint the isolines.

Option [*Isolines*] – check ON to paint the isolines.

#### **Область *User data limits***

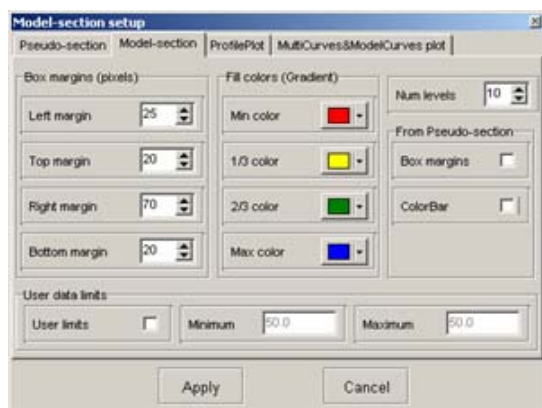
The option [*User limits*] - specifies to the program, to use the minimal and maximal values of the data or to use values of fields [*Minimum*] and [*Maximum*] at the creation of isolines.

The field [*Minimum*] - sets the minimal value at the creation of isolines.

The field [*Maximum*] - sets the maximal value at the creation of isolines.



## Tab Model – section



This tab serves to setup of section parameters.

### ***Box margins***

The field [*Left margin*] sets the margin (in pixels) of picture from window's left edge.

The [*Right margin*] sets the margin (in pixels) of picture from window's right edge.

The field [*Top margin*] sets the margin (in pixels) of picture from window's top edge.

Поле [*Bottom margin*] sets the margin (in pixels) of picture from window's bottom edge.

### ***Fill colors***

Next options [*Min colour*], [*1/3 colour*], [*2/3 colour*] and [*Max colour*] set the interpolation array of colors from [*Min colour*] to [*Max colour*] via [*1/3 colour*] and [*2/3 colour*]. This color palette is used to paint the layers.

The field [*Num levels*] defines the number of levels. The levels are set by uniform linear or logarithmic step in depending of data type.

### ***User data limits***

The option [*User limits*] - specifies to the program, to use the minimal and maximal values of the parameters or to use values of fields [*Minimum*] and [*Maximum*] at the creation of a color scale.

The field [*Minimum*] - sets the minimal value at the creation of a color scale.

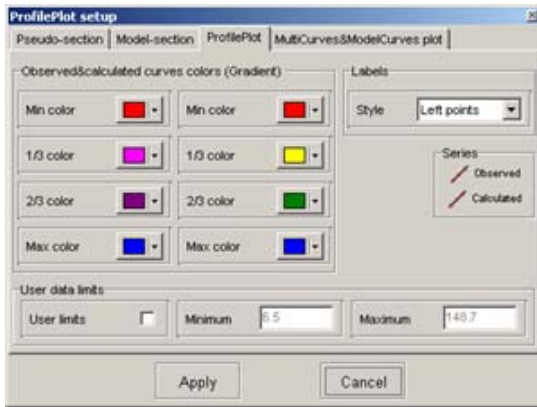
The field [*Maximum*] - sets the maximal value at the creation of a color scale.

### ***From pseudosection***

Option [*Box margins*] sets to use the values of field [*Box margins*] which relate to the pseudosection.

Option [*ColorBar*] sets to use the values of field [*Fill colors*] which relate to pseudosection.

## Tab ProfilePlot



This tab serves to setup of **profiling graph** parameters.

### ***Observed&calculated curves colors***

Next options [*Min colour*], [*1/3 colour*], [*2/3 colour*] and [*Max colour*] set the interpolation array of colors from [*Min colour*] to [*Max colour*] via [*1/3 colour*] and [*2/3 colour*]. This color palette is used

to paint the graphs.

### ***User data limits***

The option [*User limits*] - specifies to the program, to use the minimal and maximal values of the data or to use values of fields [*Minimum*] and [*Maximum*] at scaling an axis.

The field [*Minimum*] sets the minimal value of axis.

The field [*Maximum*] sets the maximal value of axis.

### ***Labels***

The field [*Style*] defines how to display the labels on the graph.

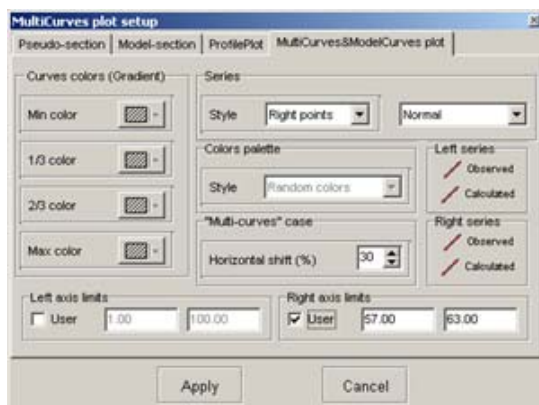
Value “*Left points*” - the labels are situated on the left of graphs.

Value “*All points*” - the labels are situated from point to point.

Value “*Right points*” - the labels are situated on the right of graphs.

When you press the buttons [*Observed*] and [*Calculated*], the setup dialog of graphic parameters for observed and calculated curves appears.

## **Tab MultiCurves & ModelCurves plot**



### ***Curves colors***

This field is enabled if you set *Gradient colors* in *Colors palette/ Style* mode.

Next options [*Min colour*], [*1/3 colour*], [*2/3 colour*] and [*Max colour*] set the interpolation array of colors from [*Min colour*] to [*Max colour*] via [*1/3 colour*] and [*2/3 contour*]. This color palette is used to paint the graphs.

### ***Labels***

The field [*Style*] defines how to paint the labels on the graph.

*Value* “*Left points*” - the labels are situated on the left of graphs.

*Value* “*All points*” - the labels are situated from point to point.

*Value* “*Right points*” - the labels are situated on the right of graphs.

### **“Multi-curves” case**

The field [*Horizontal shift*] sets the shift between neighbor curves. (in percent of logarithmic decade)

**The above options are used in that Zond1D programs which use mixed sounding (spacing – frequency, etc.) where it displays some graphs in one time.**

### ***Left/Right axis limits***

The option [*User limits*] - specifies to the program, to use the minimal and maximal values of the data or to use values of fields [*Minimum*] and [*Maximum*] at scaling an axis.

The field [*Minimum*] sets the minimal value of axis.

The field [*Maximum*] sets the maximal value of axis.

The field [*Normal*] defines the representation type of observed data in depending of its dispersion.

*Normal* - there are the observed data.

*Error bars* – there are statistical gates which calculates correspond to data dispersion.

*MinMax curve* – there are two curves which calculate correspond to data dispersion.

*Curve+dispersion* – there are the data and its dispersion.

### ***Left/Right Series***

When you press the buttons [*Observed*] and [*Calculated*], the setup dialog of graphic parameters for observed and calculated curves appears.