GCH_gravinv: a MATLAB-based program for inverting gravity anomalies over sedimentary basins.

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USER GUIDE

<u>Description</u>

GCH_gravinv combines both Granser (1987) and Cordell & Henderson (1968) method for determining the depth to the basement of a sedimentary basin derived from inverting of gravity anomalies.The code is designed in Matlab environment (version R2013b) with an easy-to-use graphical interface (GUI) allowing the user the control of input parameters and thereafter displaying the results of the convergence between observed and calculated anomalies during the ongoing process. The GUI also provides additional options for the visualization of the output data either in 2D maps and cross-sectional view.

- Cordell, L. and Henderson, R.G., 1968. Iterative three-dimensional solution of gravity anomaly data using a digital computer. Geophysics 33, 596-601.
- Granser, H., 1987a. Three - dimensional interpretation of gravity data from sedimentary basins using an exponential density – depth function. Geophysical Prospecting 35, 1030 – 1041.

<u>Run the Code</u>: Locate the program code to the working space of matlab or vica versa the working space of matlab to the source directory of the code and thereafter type the name of the code to the command window of matlab.

By running of the GCH_gravinv program a simple graphical interface pops up covering the entire screen which. The configuration of the main GUI window is illustrated in Fig. 1. Here the left hand-side of the window includes the main control panel divided to two parts. The upper part enables the settings for the initial parameters and the criterion of the termination of the iterative procedure whereas the lower part allows the user to track between the resulting data and setting their visualization style. The remaining part to the right of the panel is the display area for the input/output maps or graphical plots.

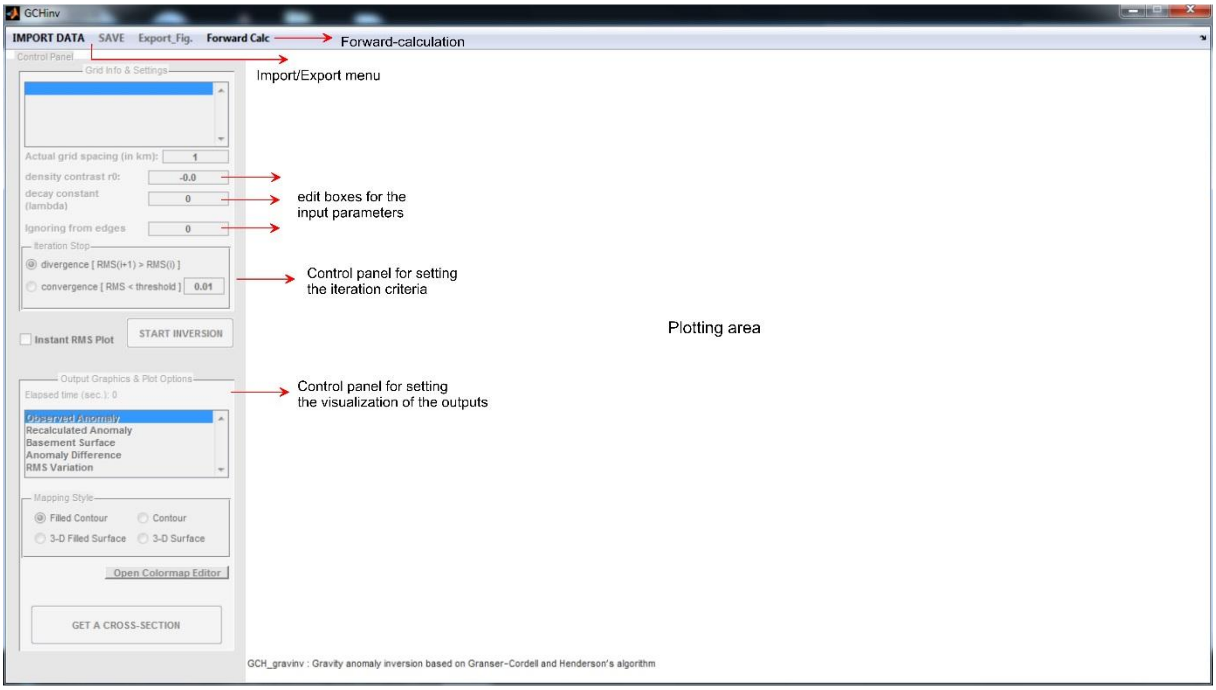

Figure 1. Main screenshot after first run of GCH_gravinv.

Required data and formats

After the first run of the program, loading the input residual gravity data set is provided by the interactive **"Import Data"** menu. This allows the user an optional load in two types for the format of the data; a grid [*.grd : (Surfer 6 text grid or Surfer 7 Binary grid format)] file ; or an equal spaced xyz column wise data [*.dat ; (x:east direction, y: north direction)] where as both are compatible with Golden Software Surfer formats (Fig 2).

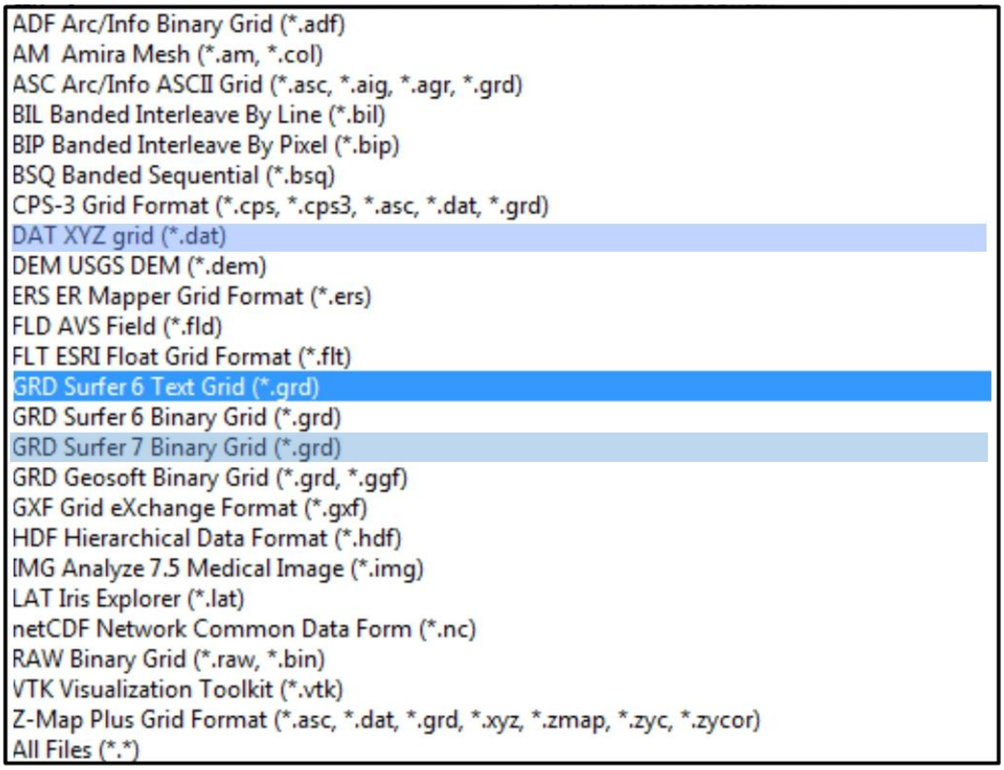

Figure 2. Formats for the gridded input gravity data set required in GCH_gravinv.

The algorithm accepts square as well as rectangular input grids. The number of grid nodes in the east and north direction can be both odd and even. The code stores the input data as well as its grid information to a temporary *.mat file and retrieves them at every start of an iterative process or by a call for its display. After a successful data loading the information about the active input grid is shown at the uppermost of the control panel. The other required parameters such as the density contrast and the decay rate needs also to be entered to their related edit boxes. The units of the gravity anomalies are mGal, the densities in g/cc and distances are in km.

Inversion procedure and storing the outputs

Before starting the algorithm, the user has the option for defining the behavior of the termination of the iteration procedure. The one is the divergence-mode which the iterative procedure terminates when the root mean square error (RMS) between the observed and calculated data at any step of the iteration has been increased according to the previous step. And another is by setting a convergence criterion which the iteration stops when the RMS is lower than the pre-assigned value. In all cases, however, the iterative procedure ends when the user-defined maximum number of iterations has been accomplished. An instant plot of the obtained RMS values during the ongoing iteration steps can be displayable by checking the related radio button available in the GUI. As an optional preference, to avoid edge effects, some near-edge data may be cut off by editing the “Data ignoring” field box. Then the RMS are calculated except the ignored data enclosed to the edges. But note that cutting is not always necessary due to edge effects are very small. Although using an input gravity data set larger than the area of interest could be an alternative reasonable solution to avoid such effects.

After the user confirms the inputs, the code first calculates the initial approximations of the depths to basement with exponential density contrast variation using Equation (4) and goes through with the iterative procedure. During this, two independent background functions are called consecutively which the one is for the forward FFT based computation of the gravity effect achieved using Equation (3) and the other for the next updating of the model depths using Equation (5) in space domain but also for the control of the convergence and command on the termination when the user defined criterion is achieved.

Finally, the function stores the output data of the inverted basement depth, the gravity response due to the calculated model depths, the differences of the gravity between the observed and computed ones and the RMS vector calculated at each iteration step. Plottings of the outputs can be guided from the lower part of the control panel of the GUI with some optional view styles. The colormap tool enables the user to alter the color zones interactively, by setting the color limits of the map to specified minimum and maximum values. All of the output data can be stored by a user defined name either to a *.mat file comprising the complete outputs or to seperated files of *.grd format for the maps and *.dat format for the RMS vector. Exporting of a current figure is also available.
The Gui includes also a menu button for the task of a Forward-Calculation which terminates with an output map of the gravity inverted from the input depth model and density parameters. After proceeding, the user has the option to switch between the depth and gravity maps. The resulting map can also be saved as a grid file format compatible with Surfer program (Fig. 3)

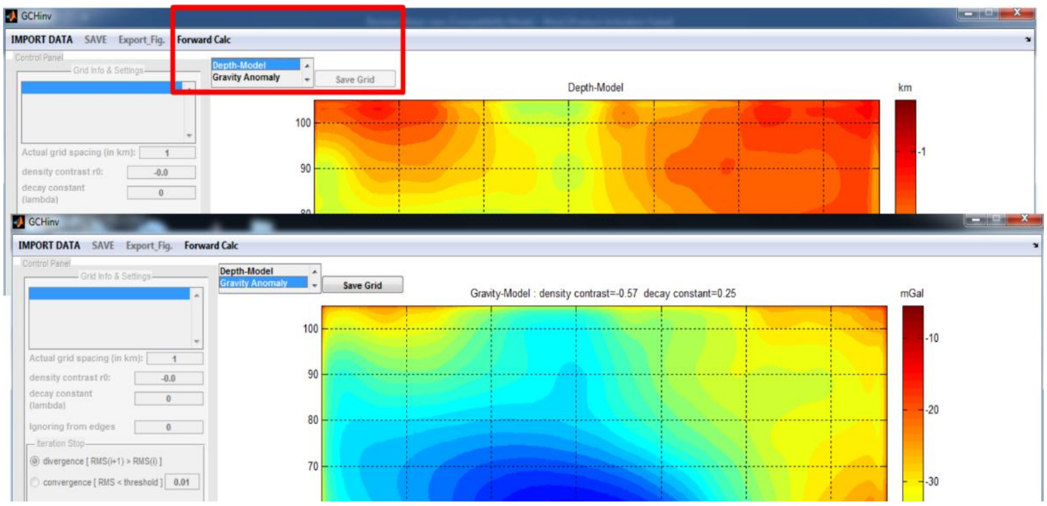

Figure 3. Screen shots after Forward-Calculation menu.