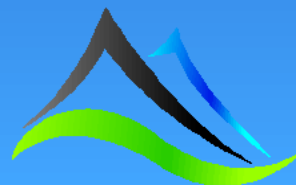


Iterative Gridding of Irregularly Spaced Data

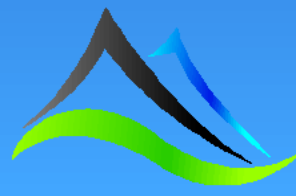
ExploreGeo Technical Note 7



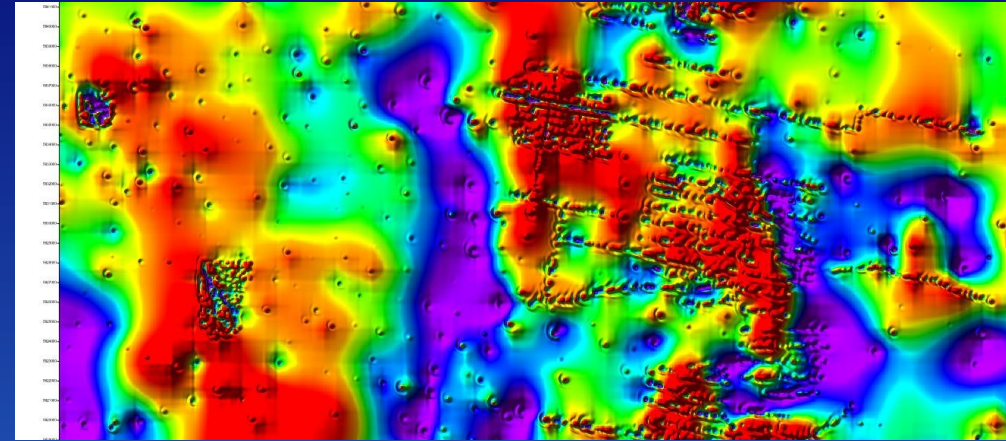
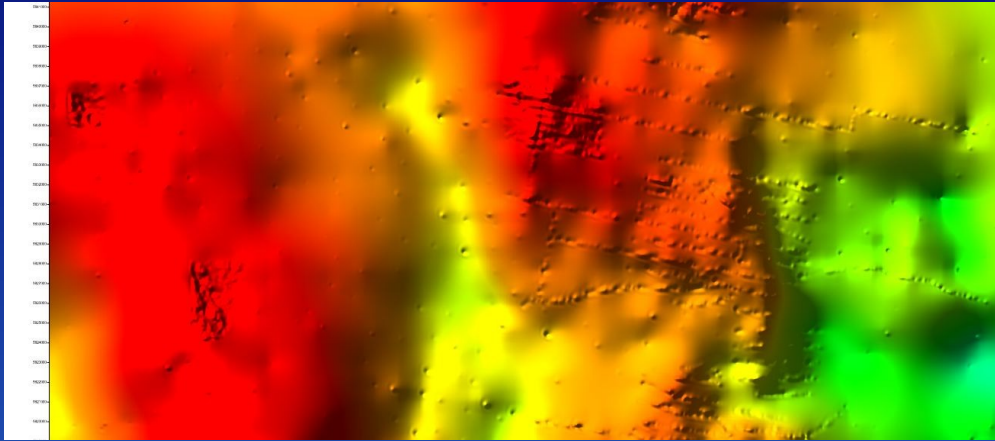
Explanation – Pt 1

Single-step gridding routines work well when applied to regularly spaced datasets, such as bi-directional spline gridding for magnetic data, or minimum curvature gridding for radiometric data. This single-step approach often does a poor job with irregularly spaced data such as gravity data because widely spaced stations produce artefacts due to excessive interpolation. Although other gridding techniques, such as kriging can reduce these artefacts, in practice their results often sub-optimal.

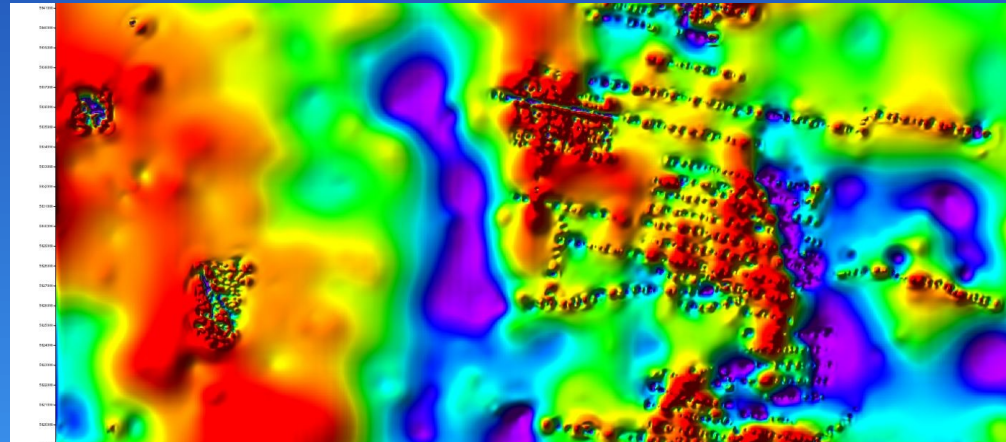
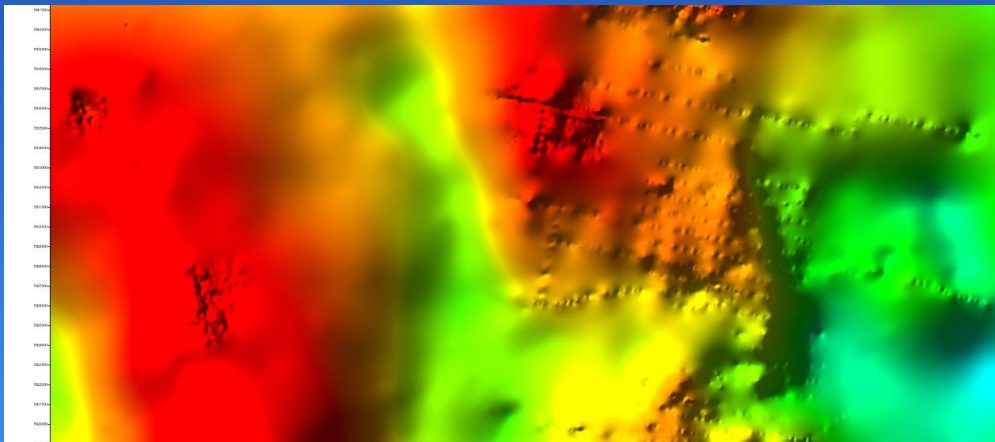
The next slide shows examples of a gravity dataset gridded with a minimum curvature algorithm in a single step, and then gridded iteratively. The dataset contains station spacings varying from 100m to 2km in five spacing population clusters.



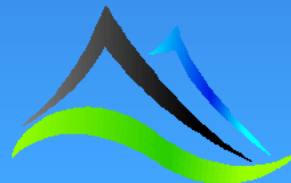
Explanation – Pt 2



Single-step minimum curvature gravity grid and first vertical derivative.



Iterative gridding gravity grid and first vertical derivative.



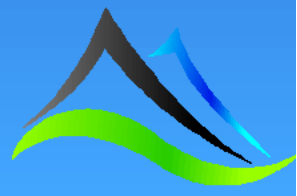
Explanation – Pt 3

Many iterative gridding methods have been devised but this technical note will outline two methods used by ExploreGeo. The first is called The Exclusion Method, and the second is called The Insert Method.

Each method has its pros and cons, but ultimately the one to use depends on the nature of the dataset. In particular the Exclusion Method performs better for datasets containing close spaced stations on isolated or wide spaced lines.

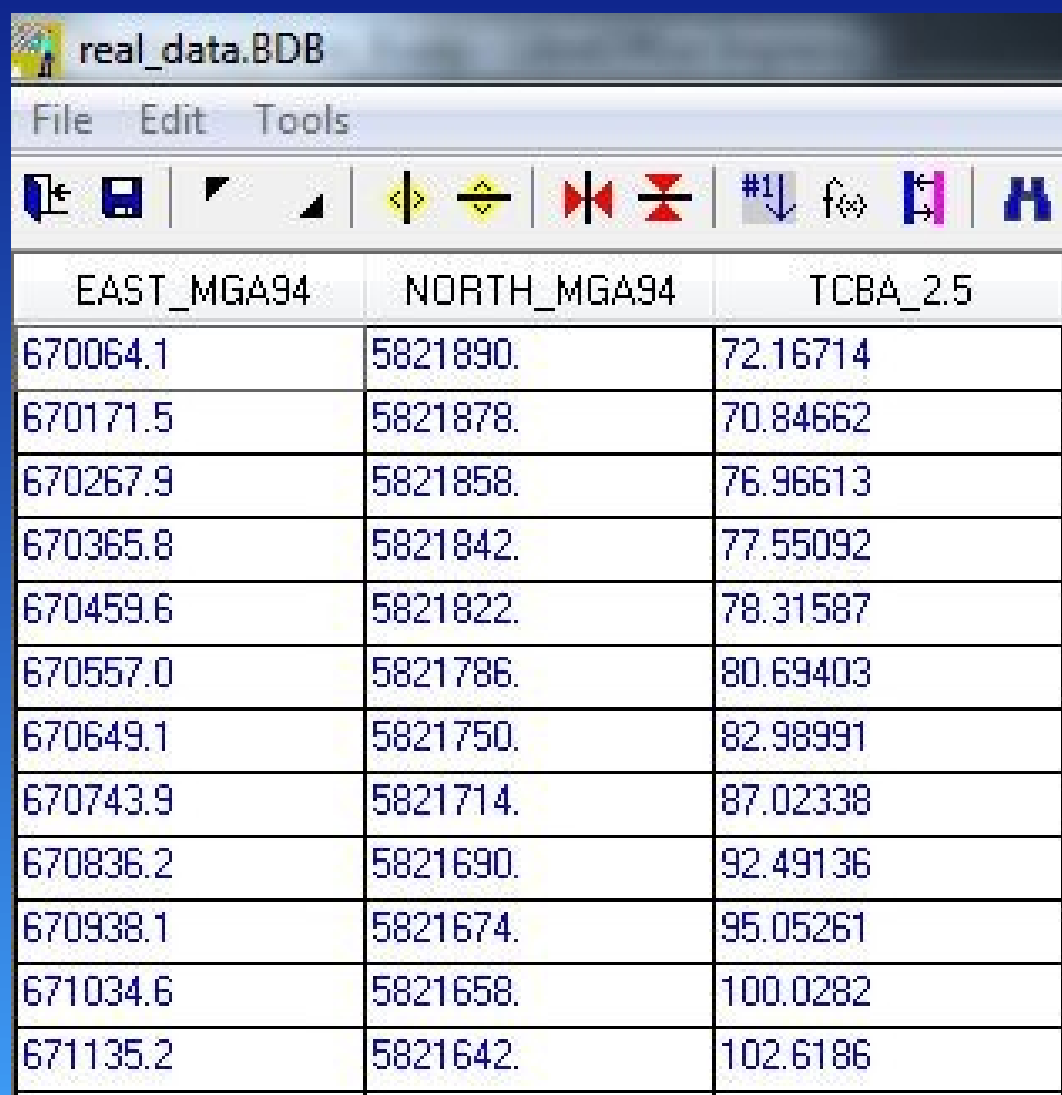
The following explanations assume that a database of Bouguer anomaly values have been calculated, terrain corrected if necessary and the appropriate density has been decided on.

All screenshots are taken from the ExploreGeo software DBaseO and GSGrid, or Golden Software's Surfer 13.

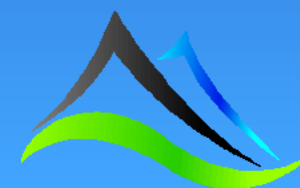


The Exclusion Method

For simplicity, create a database that contains only three fields; east, north, Bouguer gravity. Call this database “real_data.bdb”.

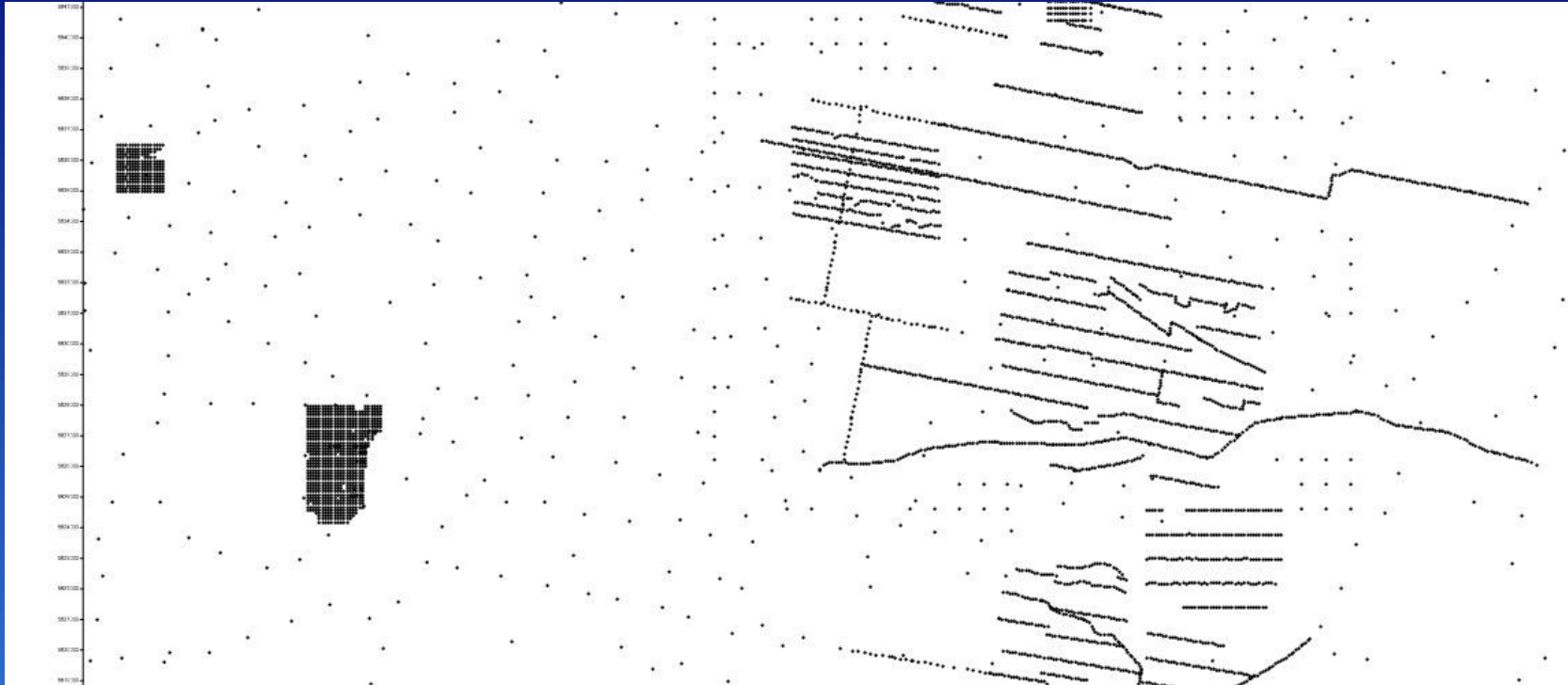


EAST_MGA94	NORTH_MGA94	TCBA_2.5
670064.1	5821890.	72.16714
670171.5	5821878.	70.84662
670267.9	5821858.	76.96613
670365.8	5821842.	77.55092
670459.6	5821822.	78.31587
670557.0	5821786.	80.69403
670649.1	5821750.	82.98991
670743.9	5821714.	87.02338
670836.2	5821690.	92.49136
670938.1	5821674.	95.05261
671034.6	5821658.	100.0282
671135.2	5821642.	102.6186



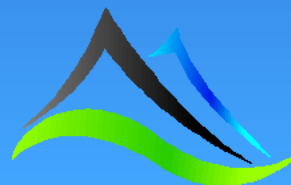
The Exclusion Method

Use this database to create a station posting to view in Surfer.



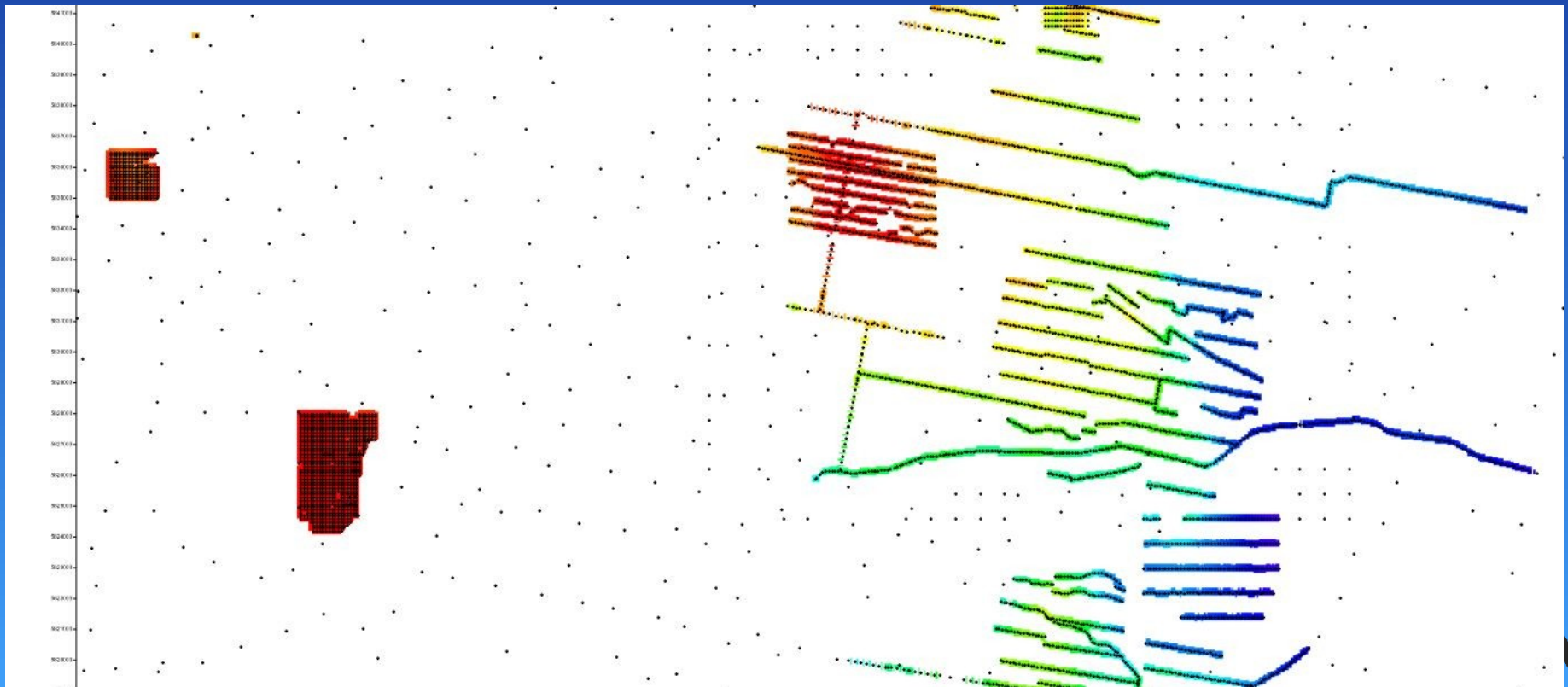
This can be used to see the extent of the various station spacings and to measure the distance between them so that gridding parameters can be calculated.

This particular dataset contains station spacings ranging from 100m to 2km.

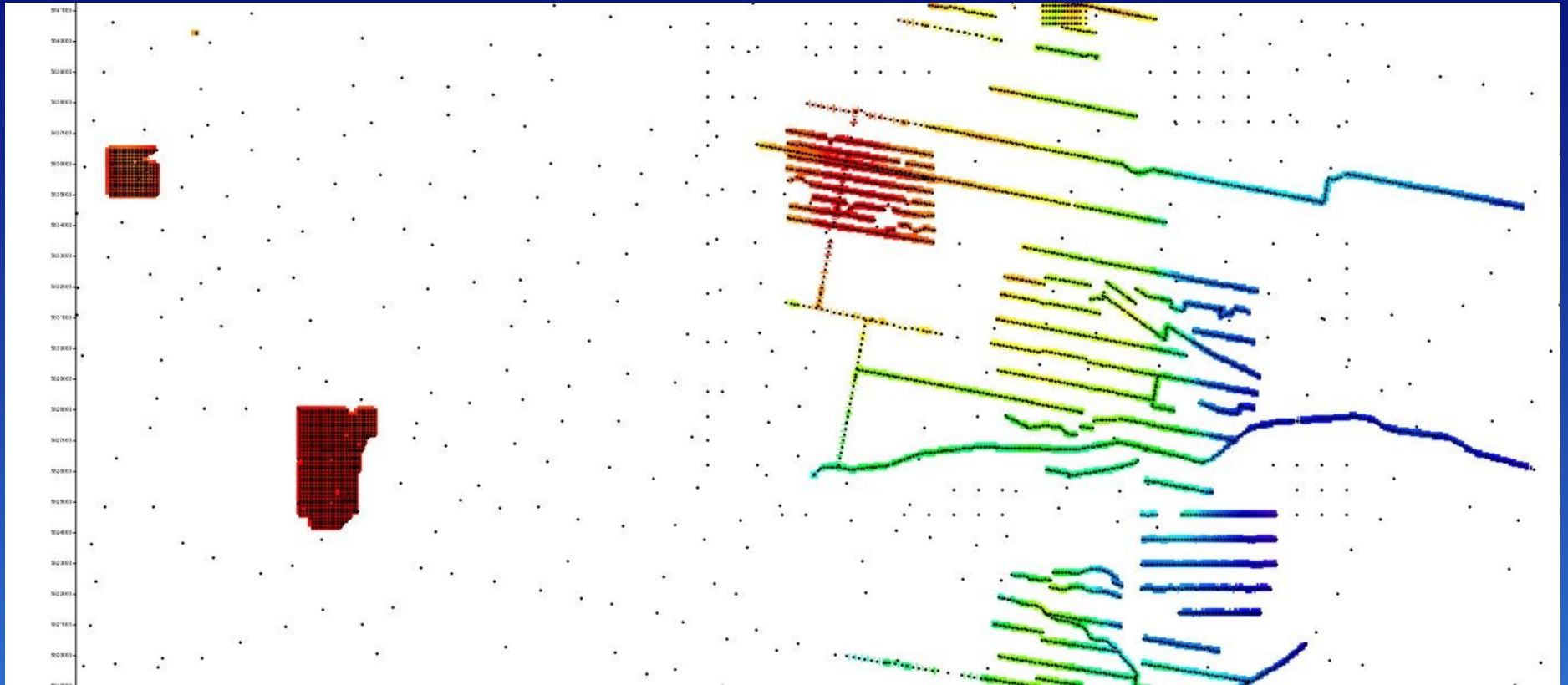


The Exclusion Method

Use minimum curvature gridding from DbaseO to create a series of grids roughly doubling in size each step from half the closest station spacing to about half the coarsest station spacing. The search radius and required number of valid points should be set so that as a minimum two stations within a search radius of at most twice the grid cell size are required to produce a valid non-null grid cell with the remainder of the grid being null.

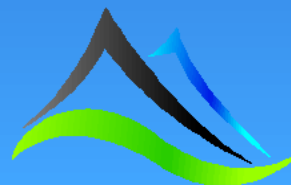


The Exclusion Method



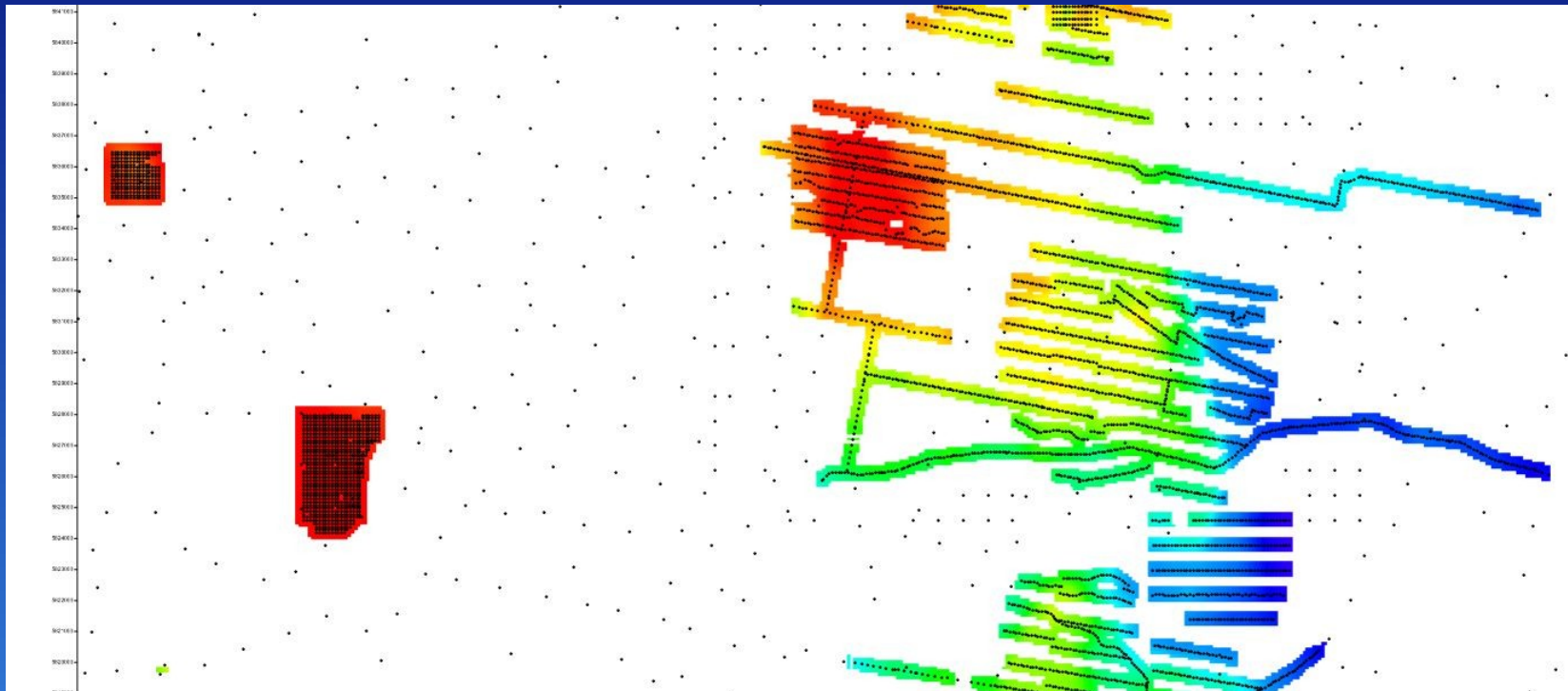
50m grid covering the 100m surveys to the west and road traverses to the east.

Note that full coverage is achieved over the two surveys to the west, and only the traverses have been gridded, with no non-nulls where stations do not exist.



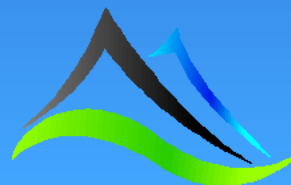
The Exclusion Method

Now a 100m grid will be created. The key point to note is that this grid must cover all of the stations covered by the previous grid.



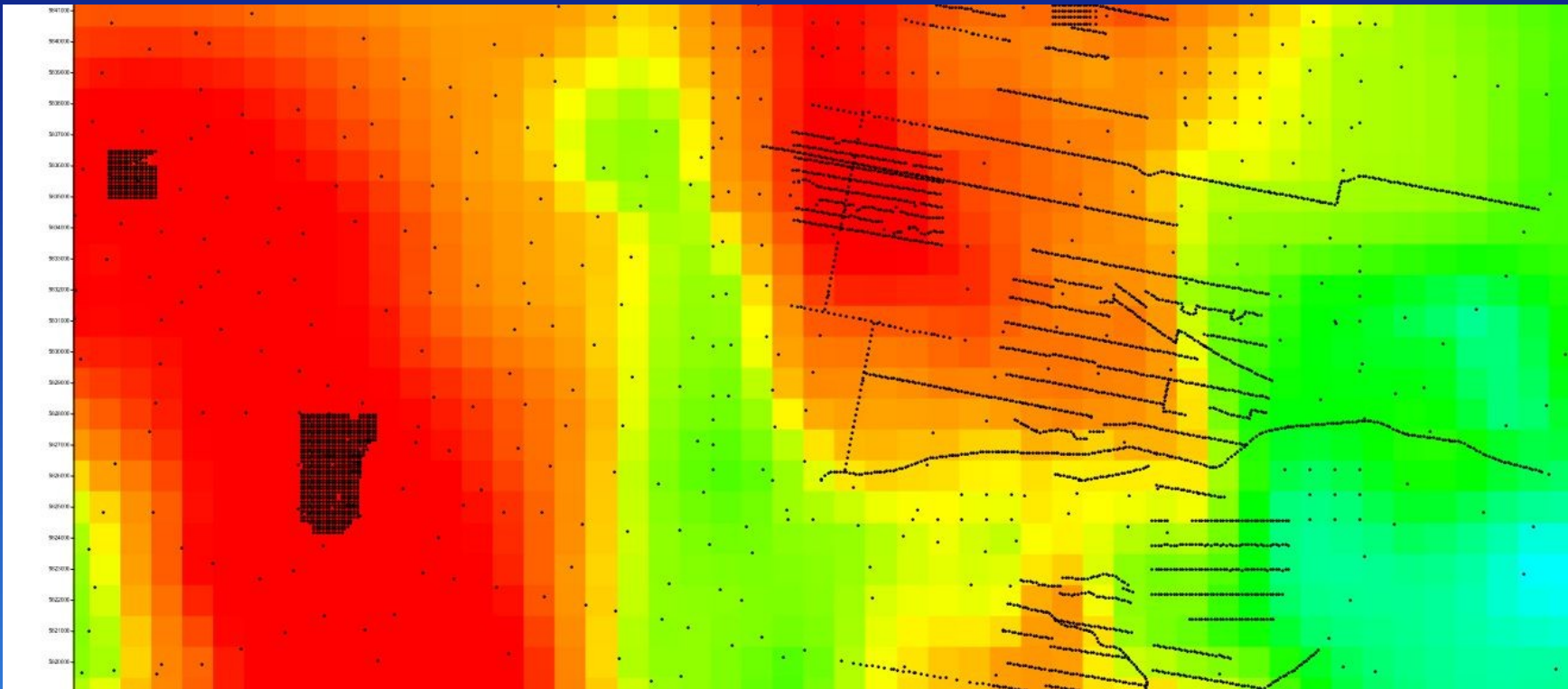
100m grid covering all of the stations gridded in the previous grid.

Due to the larger search radius used, this grid now interpolates further than the previous 50m grid



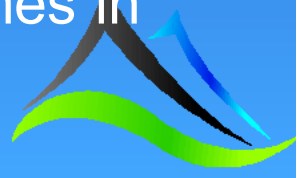
The Exclusion Method

This process is continued until a grid with no nulls is created. In this example, the 1000m grid was the first to have no nulls.



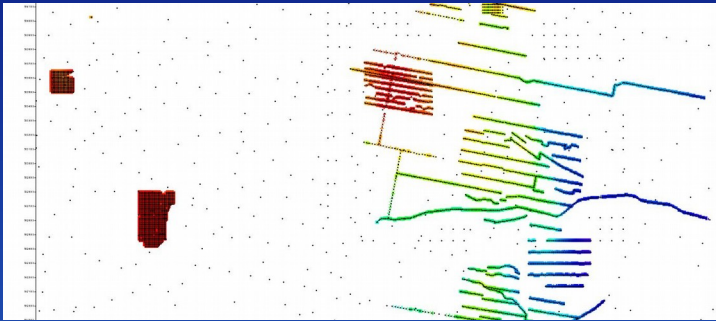
1000m grid showing full coverage of the dataset.

The grids that were created to reach this stage were 50m, 100m, 250m, 500m, and 1000m. The increment between grid cell sizes should be as small as possible but greater than or equal to 2 times in order to allow the interpolation to perform optimally.

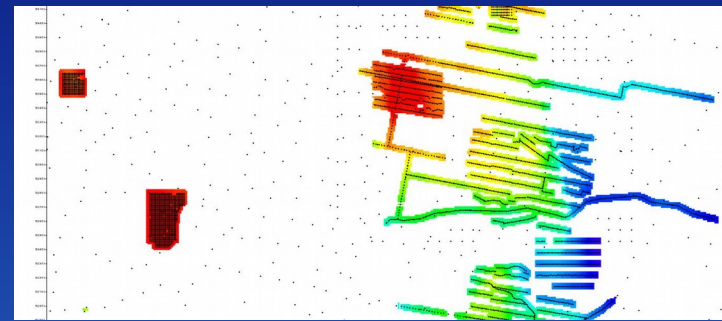


The Exclusion Method

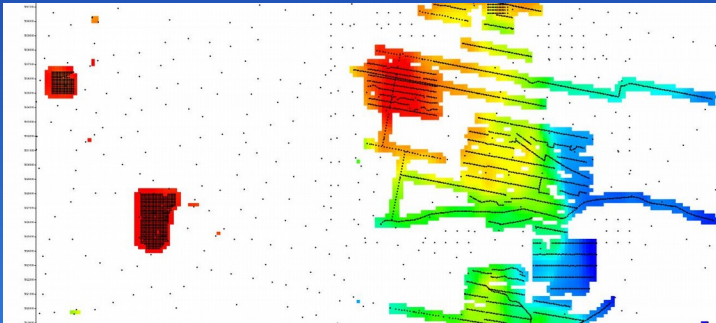
The five grids generated are shown here



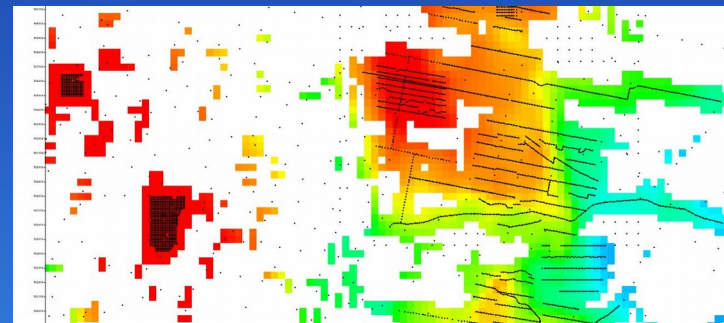
50m grid



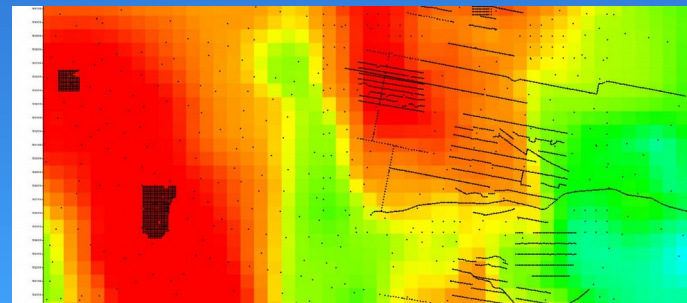
100m grid



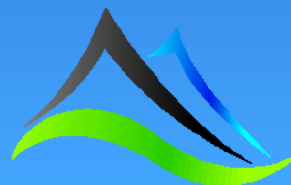
250m grid



500m grid



1000m grid



The Exclusion Method

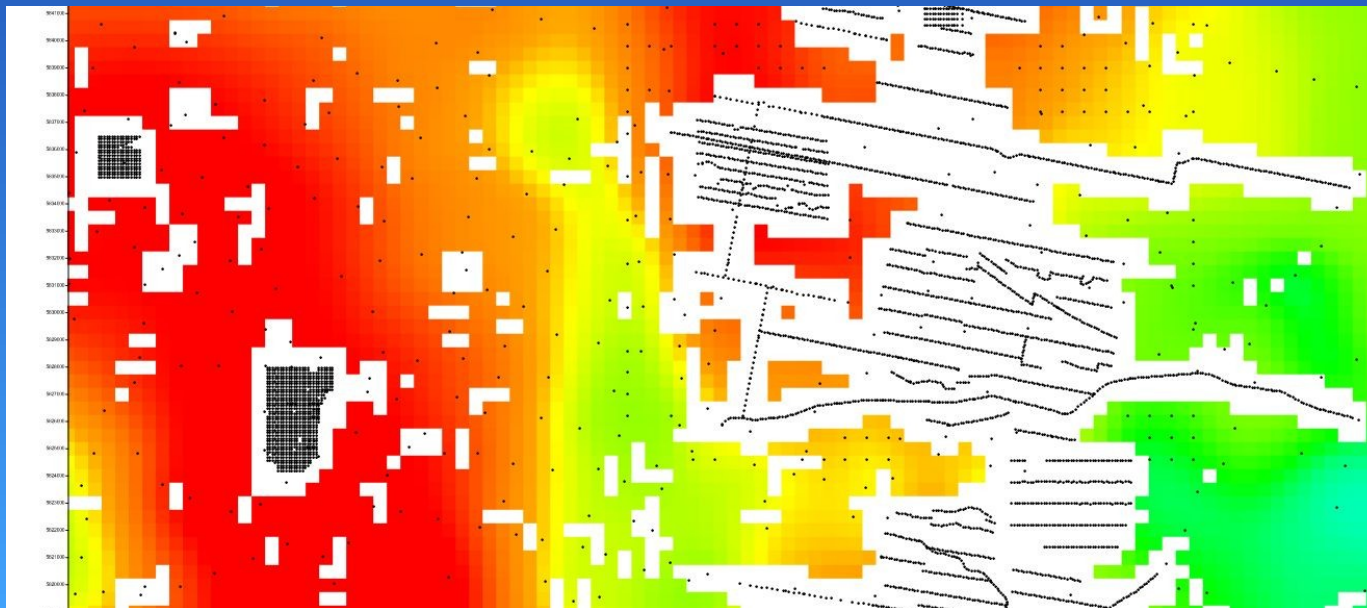
Starting with the largest cell-sized grid smoothly interpolate it to the next largest cell-sized grid. In this example we would interpolate the 1000m grid to 500m (1000m_500ms.grd).

A reverse mask is then calculated. This operation creates a grid in which a grid is nulled by the non-nulls of a second grid.

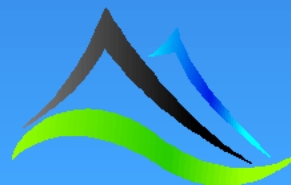
Grid 1: 1000m_500ms.grd

Grid 2: 500m.grd

Output grid: revmask_500m.grd

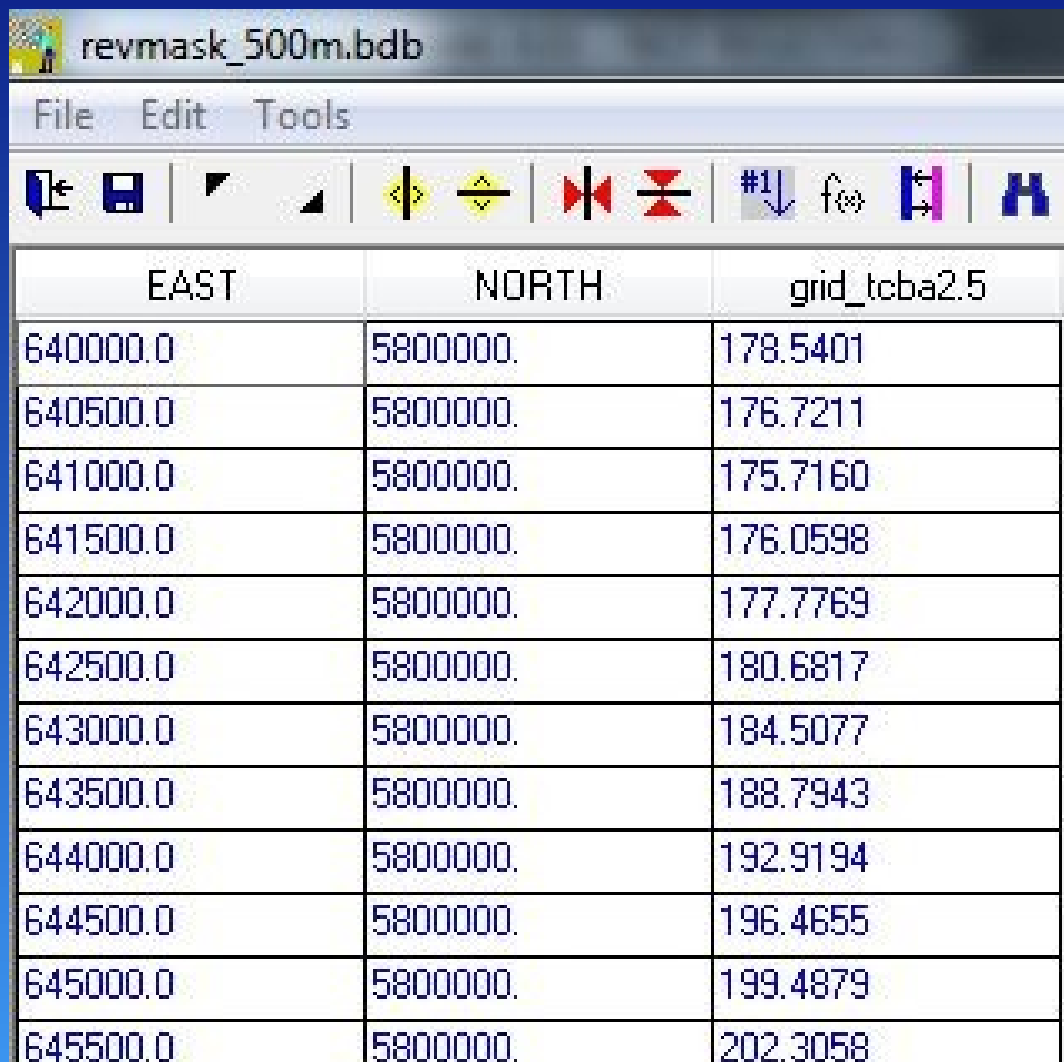


revmask_500m.grd

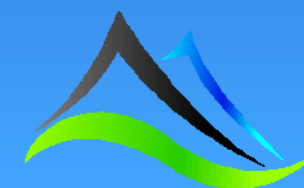


The Exclusion Method

revmask_500m.grd is then exported to a database of the same name.

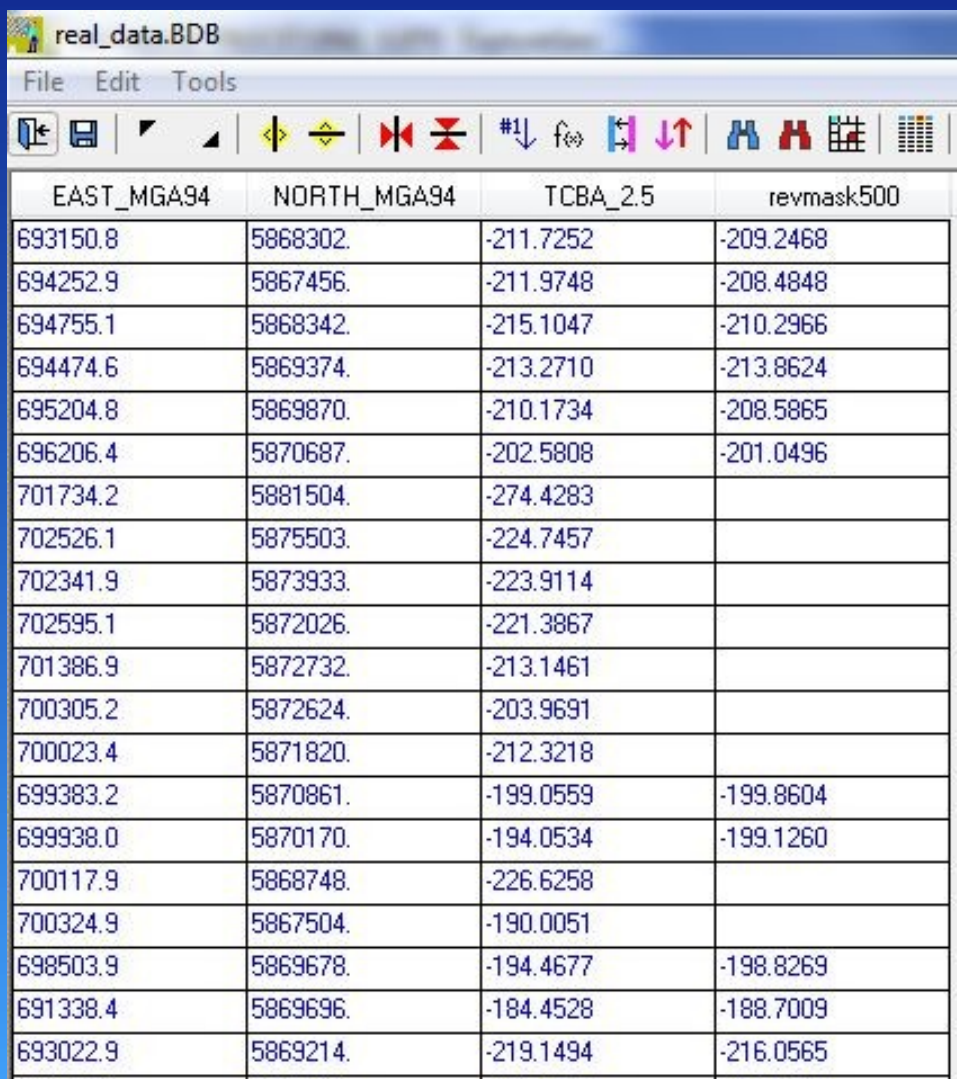


EAST	NORTH	grid_tcba2.5
640000.0	5800000.	178.5401
640500.0	5800000.	176.7211
641000.0	5800000.	175.7160
641500.0	5800000.	176.0598
642000.0	5800000.	177.7769
642500.0	5800000.	180.6817
643000.0	5800000.	184.5077
643500.0	5800000.	188.7943
644000.0	5800000.	192.9194
644500.0	5800000.	196.4655
645000.0	5800000.	199.4879
645500.0	5800000.	202.3058

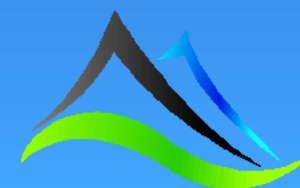


The Exclusion Method

Using DbaseO digitise revmask_500m.grd gravity values into field 4 of real_data.bdb so that any station in the database lying in a non-null grid cell is assigned a value.



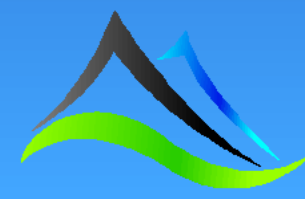
EAST_MGA94	NORTH_MGA94	TCBA_2.5	revmask500
693150.8	5868302.	-211.7252	-209.2468
694252.9	5867456.	-211.9748	-208.4848
694755.1	5868342.	-215.1047	-210.2966
694474.6	5869374.	-213.2710	-213.8624
695204.8	5869870.	-210.1734	-208.5865
696206.4	5870687.	-202.5808	-201.0496
701734.2	5881504.	-274.4283	
702526.1	5875503.	-224.7457	
702341.9	5873933.	-223.9114	
702595.1	5872026.	-221.3867	
701386.9	5872732.	-213.1461	
700305.2	5872624.	-203.9691	
700023.4	5871820.	-212.3218	
699383.2	5870861.	-199.0559	-199.8604
699938.0	5870170.	-194.0534	-199.1260
700117.9	5868748.	-226.6258	
700324.9	5867504.	-190.0051	
698503.9	5869678.	-194.4677	-198.8269
691338.4	5869696.	-184.4528	-188.7009
693022.9	5869214.	-219.1494	-216.0565



The Exclusion Method

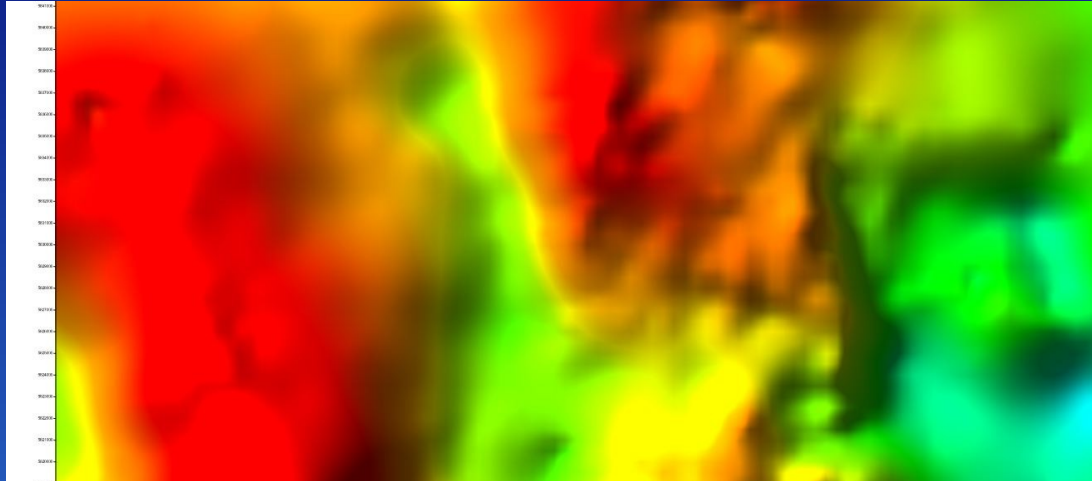
Use DbaseO to create a subset of this database on the condition that the values in field 4 are null (realdata_mask500m.bdb). This subset will contain only points not used to create revmask_500.grd.

Append realdata_mask500m.bdb and revmask_500m.bdb to create gridding_500.bdb. This database includes the observed data, excluding any data points which only contribute to the 1000m grid plus dummy data points in a grid elsewhere.



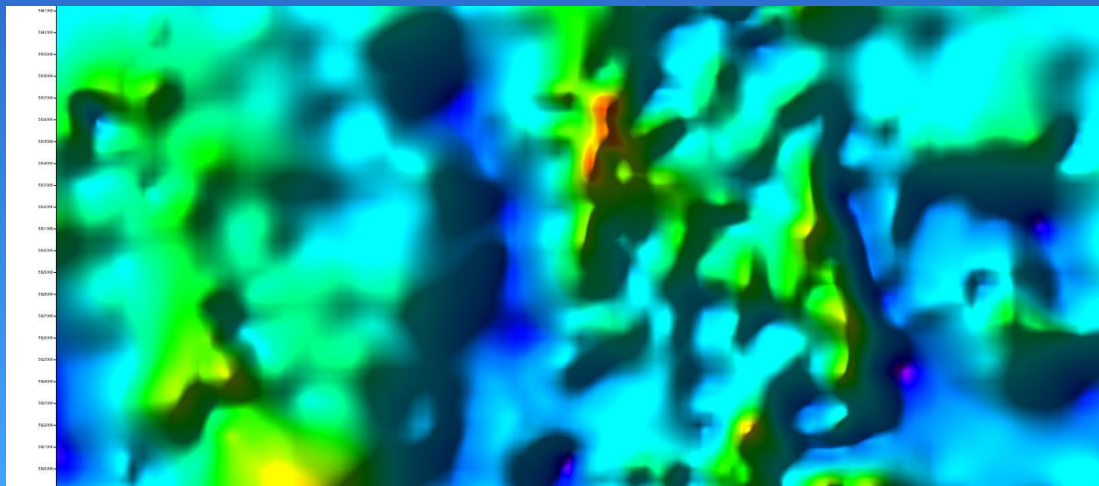
The Exclusion Method

Use gridding_500m.bdb to create 500m_it.grd.

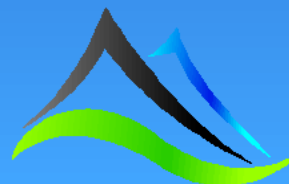


500m_it.grd

Create a first vertical derivative of this grid for QC purposes. Any stations that have been gridded incorrectly can be seen more clearly in a 1VD grid.



500m_it_1vd.grd



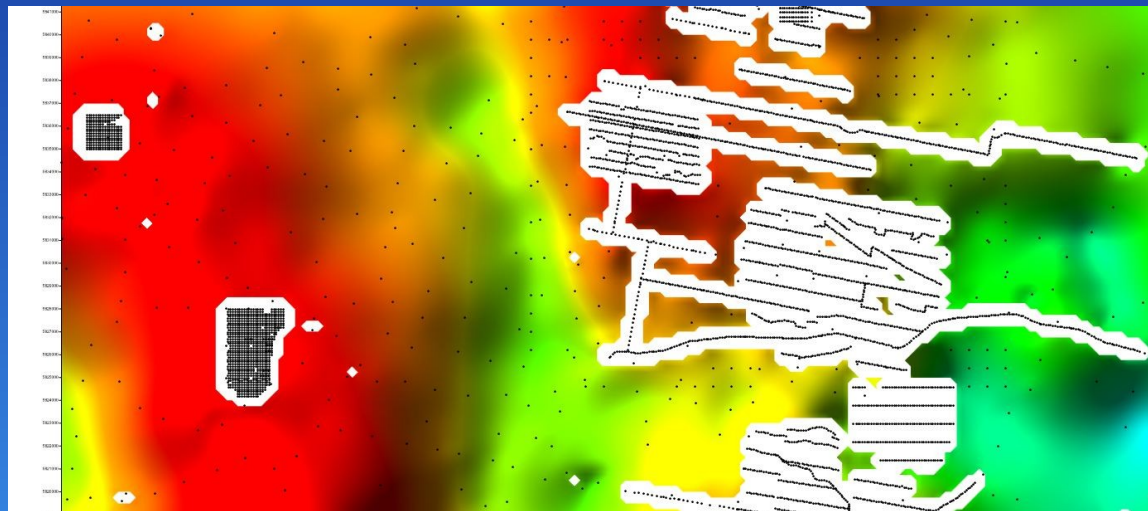
The Exclusion Method

Repeat the process by smoothly interpolating the iterative grid to the next largest cell-sized grid (500m_it_250ms.grd) and create revmask_250m.grd by using the reverse mask operation.

Grid 1: 500m_250ms.grd

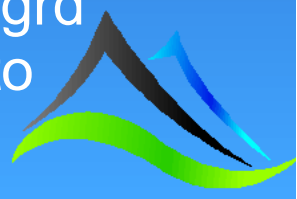
Grid 2: 250m.grd

Output grid: revmask_250m.grd



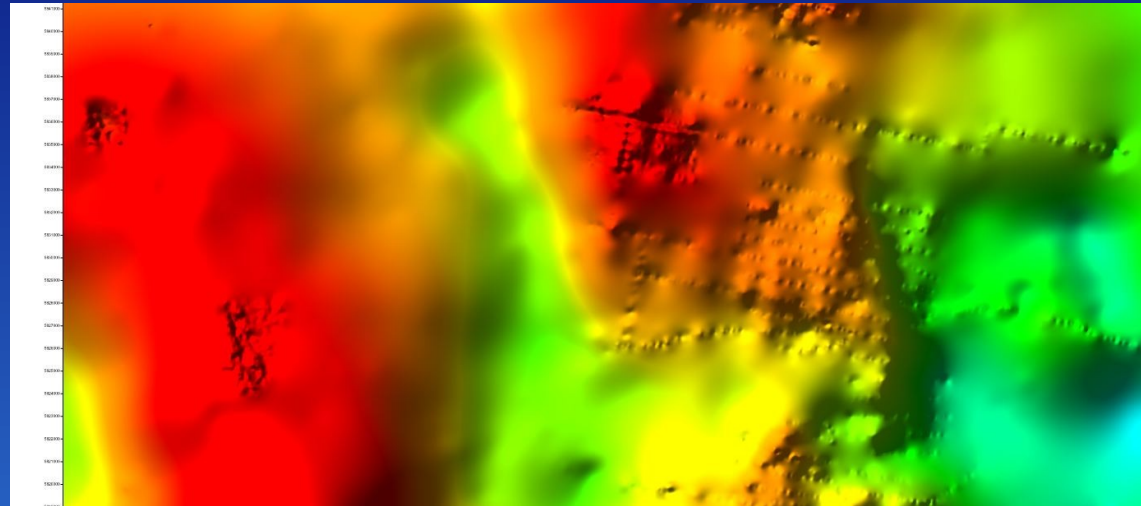
revmask_250m.grd

Using Gsgrid export this grid to a database (revmask_250m.bdb) and DbaseO to load real_data.bdb with points used in revmask_250m.grd so that realdata_mask250m.bdb can be created and appended to revmask_250m.bdb

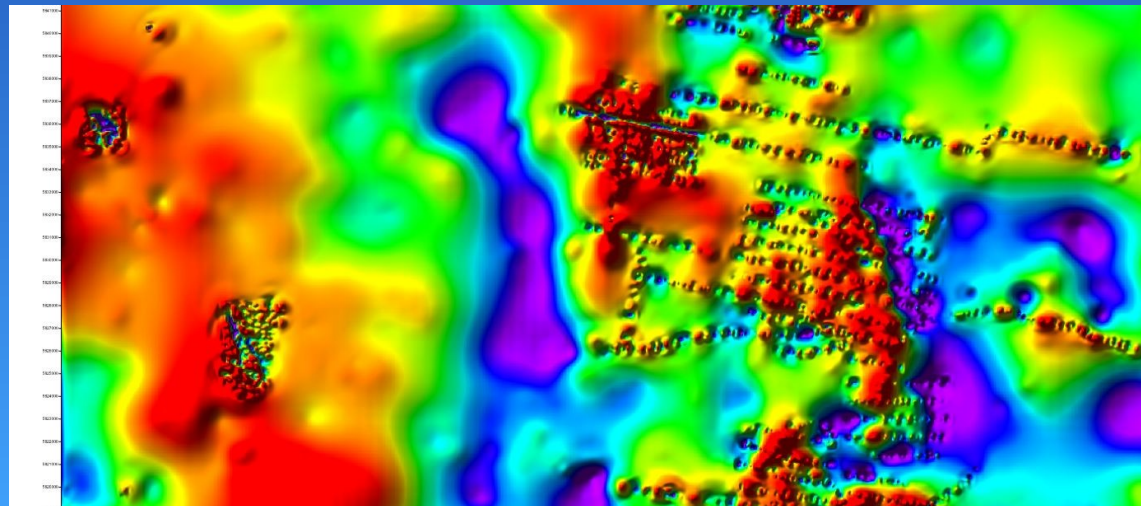


The Exclusion Method

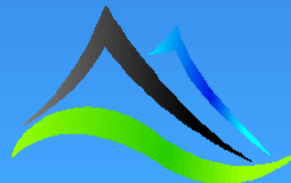
Repeat the aforementioned process until the 50m iterative grid has been created.



50m_it.grd



50m_it_1vd.grd



The Insert Method

The Insert Method is used on less complicated datasets and is much quicker as it involves fewer steps.

Gridding of the individual station spacings is done in the same way as in the Exclusion Method. The largest cell-sized grid is then smoothly interpolated down to the next largest cell-sized grid (eg. 1000m.grd is interpolated to 500m to create 1000m_500ms.grd).

The original 500m grid (500m.grd) is then inserted onto the interpolated grid (1000m_500ms.grd) to create 500m_it.grd.

This iterative grid is interpolated to the next largest cell-sized grid (250m in this example) and the process continues until the smallest cell-sized grid has been inserted onto the previous iterative grid.

This method is more prone to gridding artefacts in areas where data are acquired on relatively close stations but wide lines spacing such as road traverses.

