Swiss Geophysical Commission

Project

Systematic Analysis of the Gravity Anomalies of Switzerland

Yearly Report 2008

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Warning

The present report is a short version of the original one, written in French, and delivered to the Swiss Geophysical Commission (SGPK) at the end of 2008.
The coordinates are the Swiss Cartesian coordinates with their origin at Bern with:

X = 600'000 and Y = 200'000

A copy of the original version can be obtained from the author or directly from the Swiss Geological Survey.

Summary

During 2008 the following works have been pursued.

Extraction of 12 new zones (each of 256 rows by 256 columns) covering the alpine and the pre-alpine zones.

Determination of 3 different regional anomalies (1^{ier}, 2^{ième} and 3^{ième} degree) and 3 corresponding residual anomalies of these 12 zones.

Application of the 3D Euler deconvolution on the residual anomalies and 3D representation of these results.

Development of a technique for the prolongation of the gravity anomalies from an uneven surface to a horizontal surface located above the highest point of the topography.

Application of the upward continuation technique on the data of the alpine and pre-alpine areas.

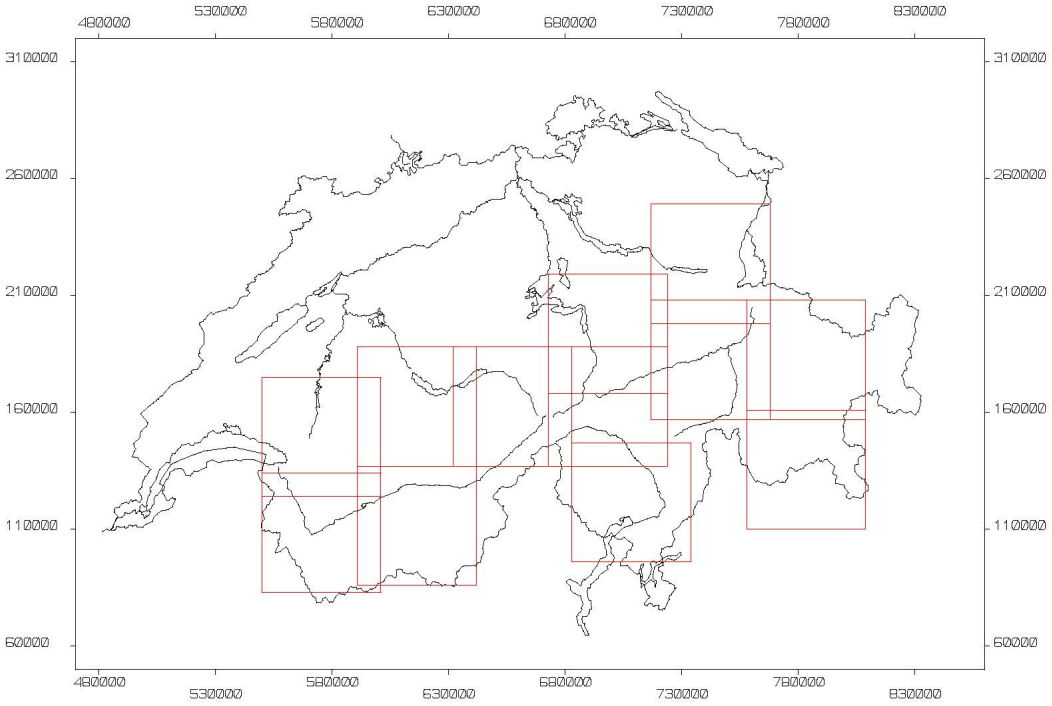
3D Euler deconvolution of the row and upward continued residual anomalies of the alpine and pre-alpine zones.

Preparation of the tectonic background (faults, axis and contacts) for the GIS system where the results of the 3D Euler deconvolution results were be plotted.

Inclusion of all the 3D Euler deconvolution solutions onto a Geographical Information System (Didger).

Preparatory work

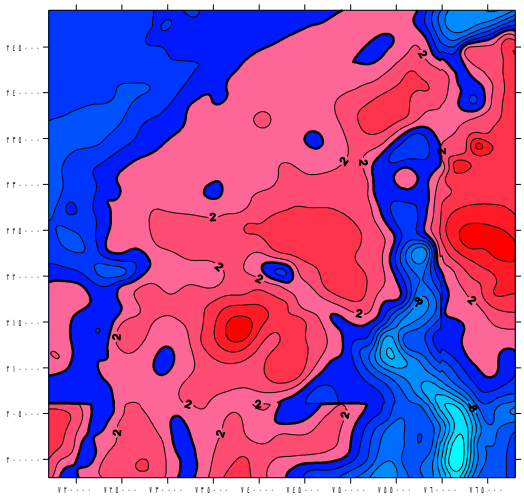
In order to best cover the alpine and pre-alpine areas 12 new grids were included in the global work. These twelve zones are shown in figure1.



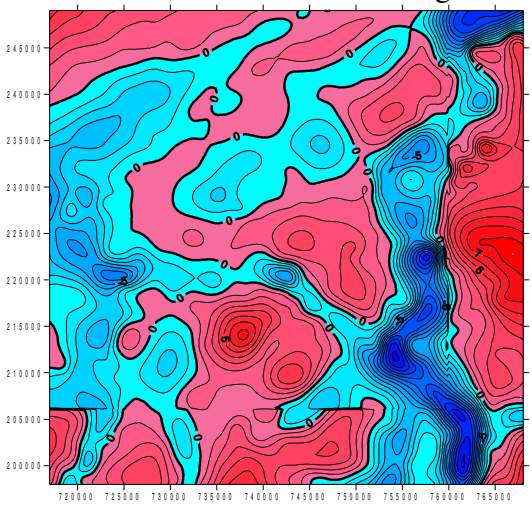
Location of the twelve new grids covering the alpine and pre-alpine areas.

On these zones three different regional and residual fields were computed. The residual fields were used for the 3D Euler deconvolution.

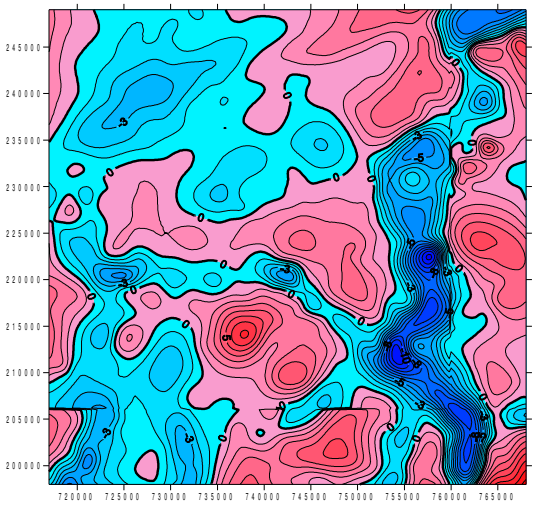
The following figures show the maps of the residual fields computed on these zones.



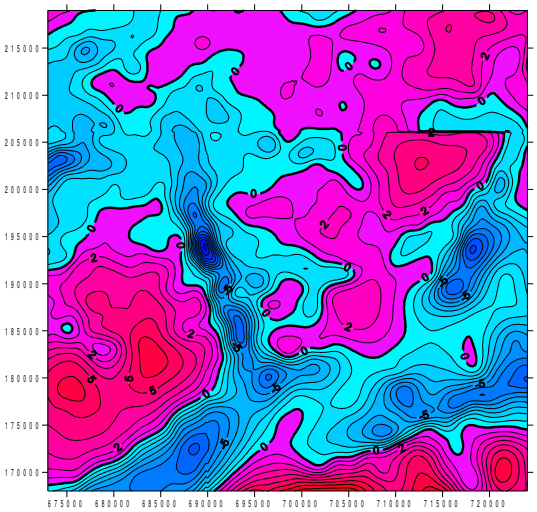
Zone12, residual field 1st degree.



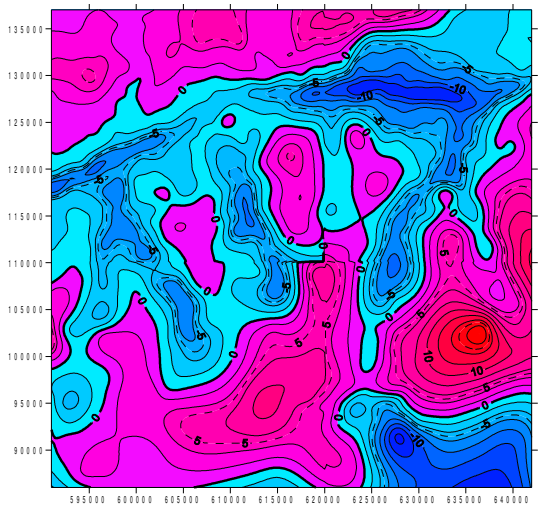
Zone12, residual field 2nd degree.



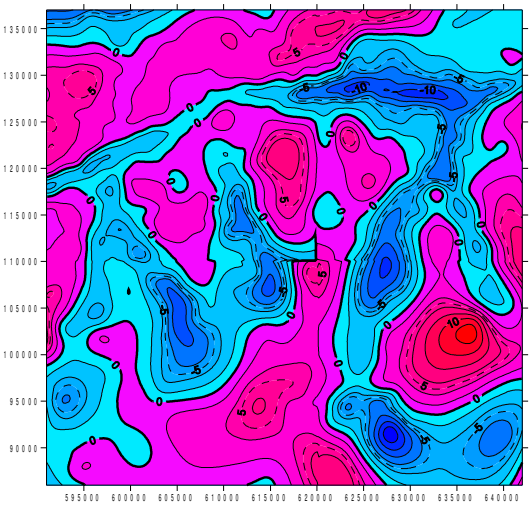
Zone12, residual field 3rd degree.



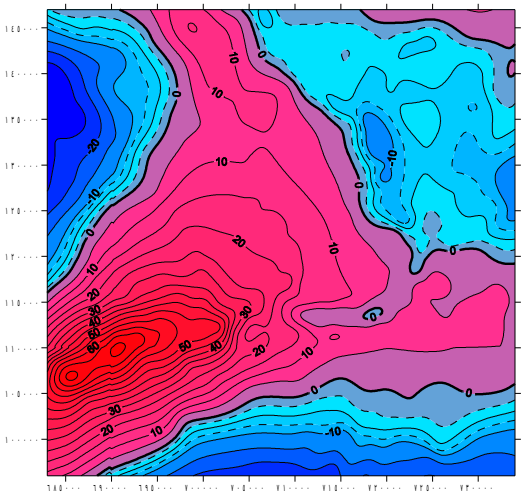
Zone13, residual field 1st degree.



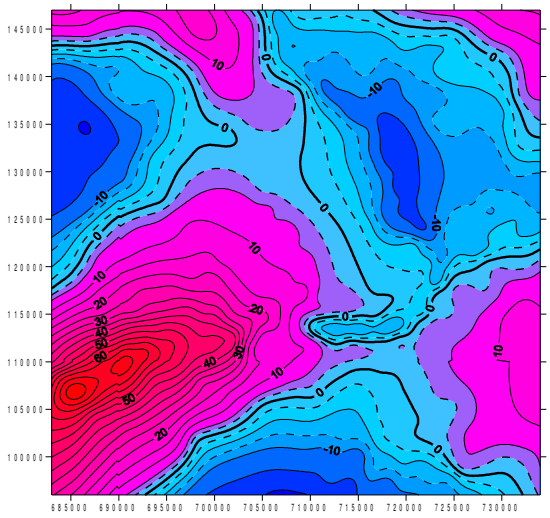
Zone 22, residual field 2nd degree.



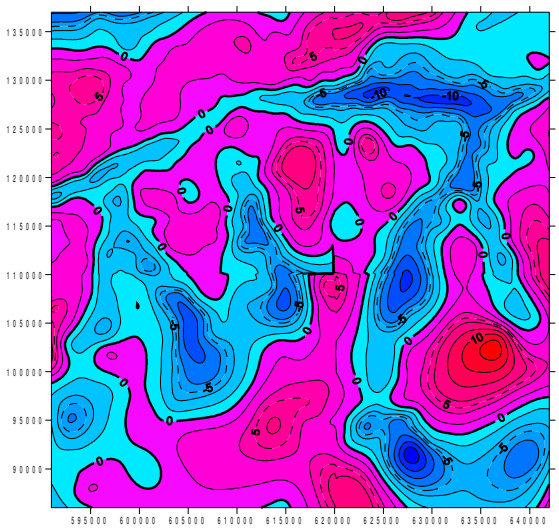
Zone22, residual field 3rd degree.



Zone 23, residual field 1st degree.



Zone 23, residual field 2nd degree.



Zone23, residual field 3rd degree.

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At this point it is necessary to remember that the Bouguer anomaly is located on the measurement points and not on the ellipsoid as many people think.

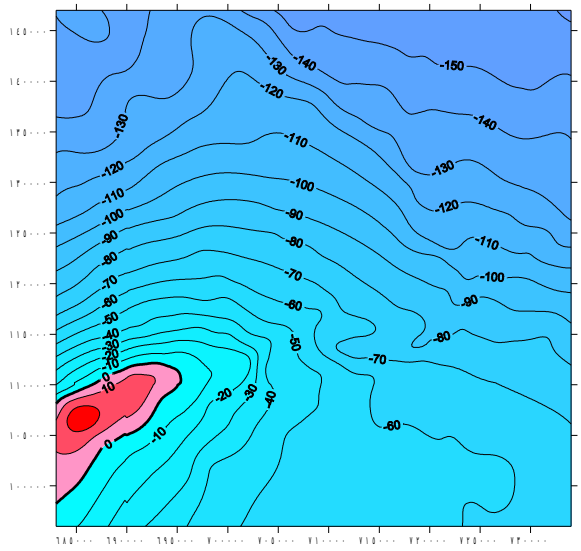
The measurement points define an uneven surface, not analytical, generally called support surface.

From this fact the horizontal and vertical gradients are deformed and the Bouguer anomaly became a function of X, Y and Z. Consequently the methods using the Fourier transform in two dimensions, like the Euler deconvolution, cannot be fully used because they could show very important distortions.

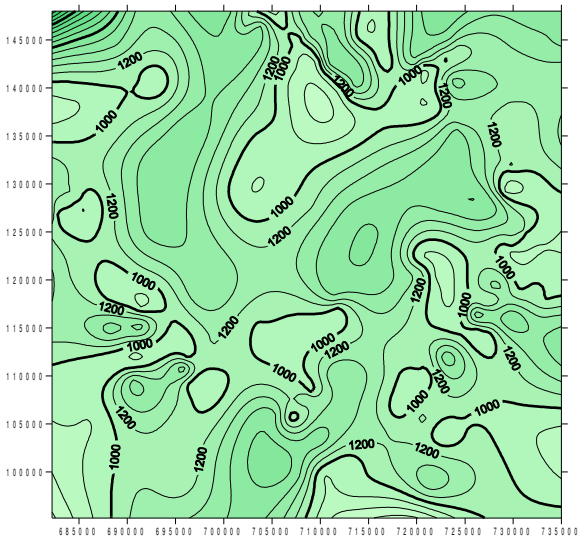
In order to avoid this problem it is "sufficient" to proceed to a vertical continuation of the anomaly from the support surface to a horizontal plane, located above the highest point of the topography. Then the anomaly became again a function of X and Y only.

In the frame of this project we developed an upward continuation technique based on the theory of the equivalent layer.

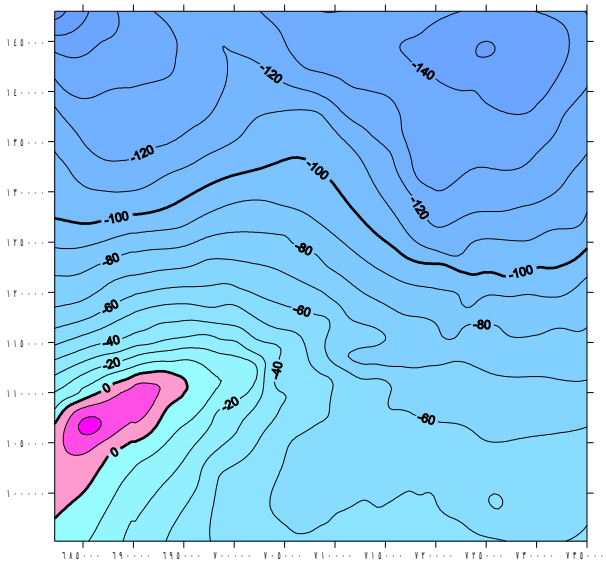
The following figures show, in form of maps of residues and upward-continued anomaly, examples of this method applied on zones of the Swiss Alps.



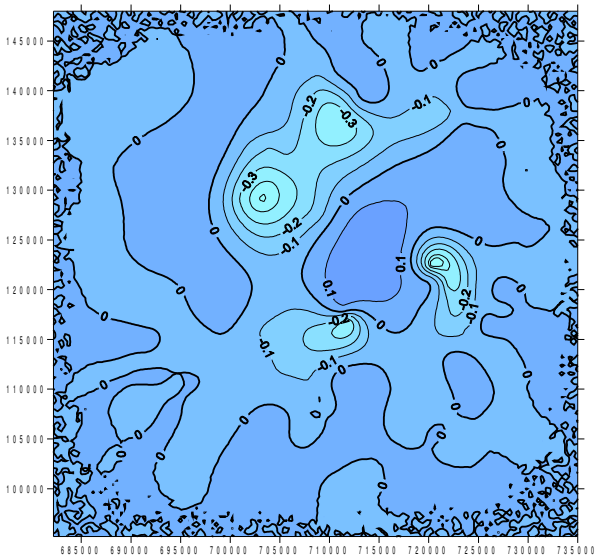
Bouguer anomaly.



Support surface



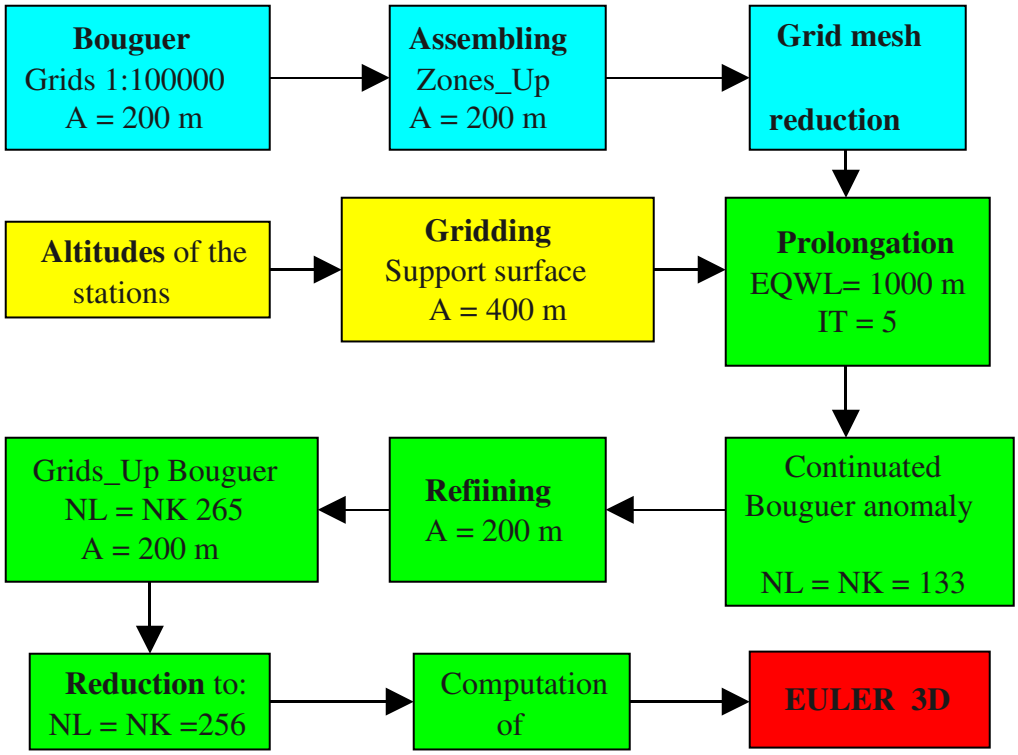
Bouguer anomaly upward continued



Residues

Results of the tests of the new method:

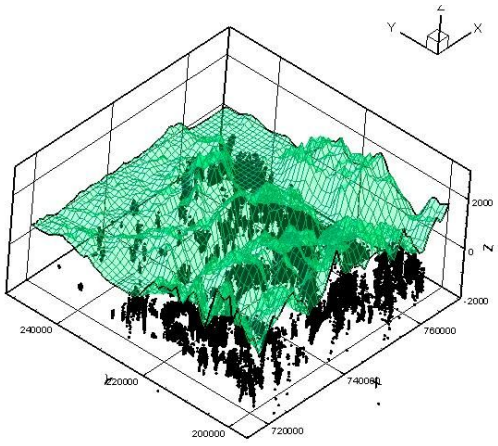
Flow chart of the upward-continuation procedure



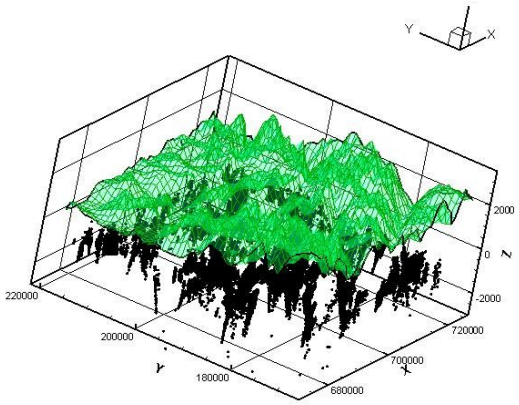
The following table shows the degree of the polynomial used for computing the residual anomalies of the alpine and pre-alpine zones submitted first to an upward-continuation and the to the 3D Euler deconvolution.

Zones	12	13	14	15	16	17	18	19	20	21	22	23
Degree	3	3	2	3	3	2	2	3	3	3	3	3

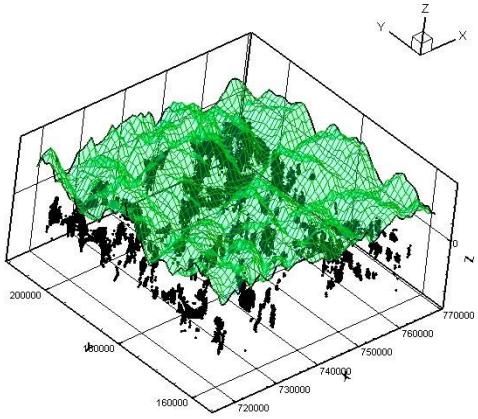
3D representation of the results of the 3D Euler deconvolution of the not upward-continued residual anomalies of the zones 12 to 23.



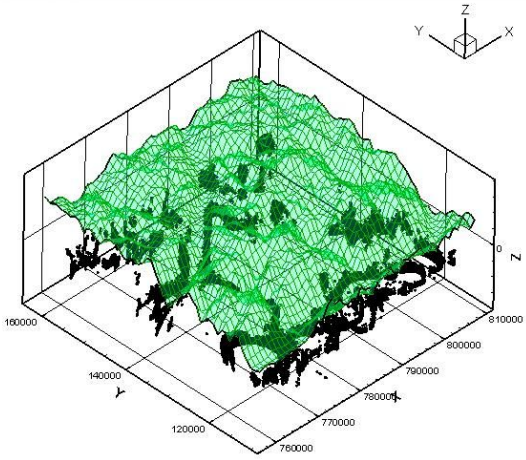
Zone 12



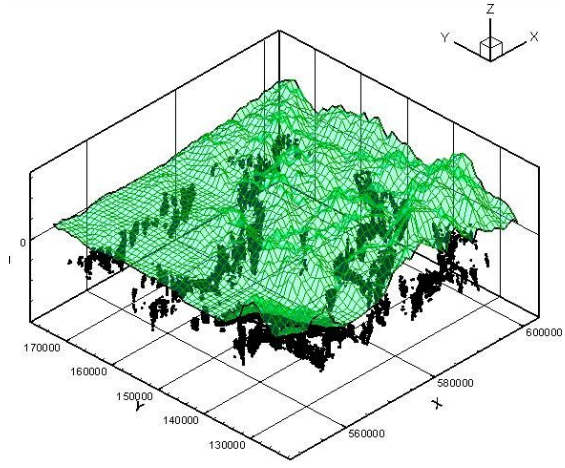
Zone 13

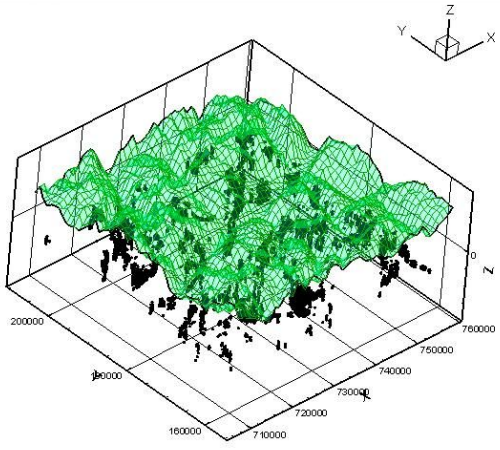


Zone 14



Zone 16





The results in their geologic context

The results of the 3D Euler deconvolution of the zones 1 to 11, not stripped of the quaternary effect are presented in figures 7a to 7k together with the most important tectonic features.

The results in green are those obtained from the residual fields of degree one, those in blue from the residual fields of degree two, those in red from the residual fields of degree three.

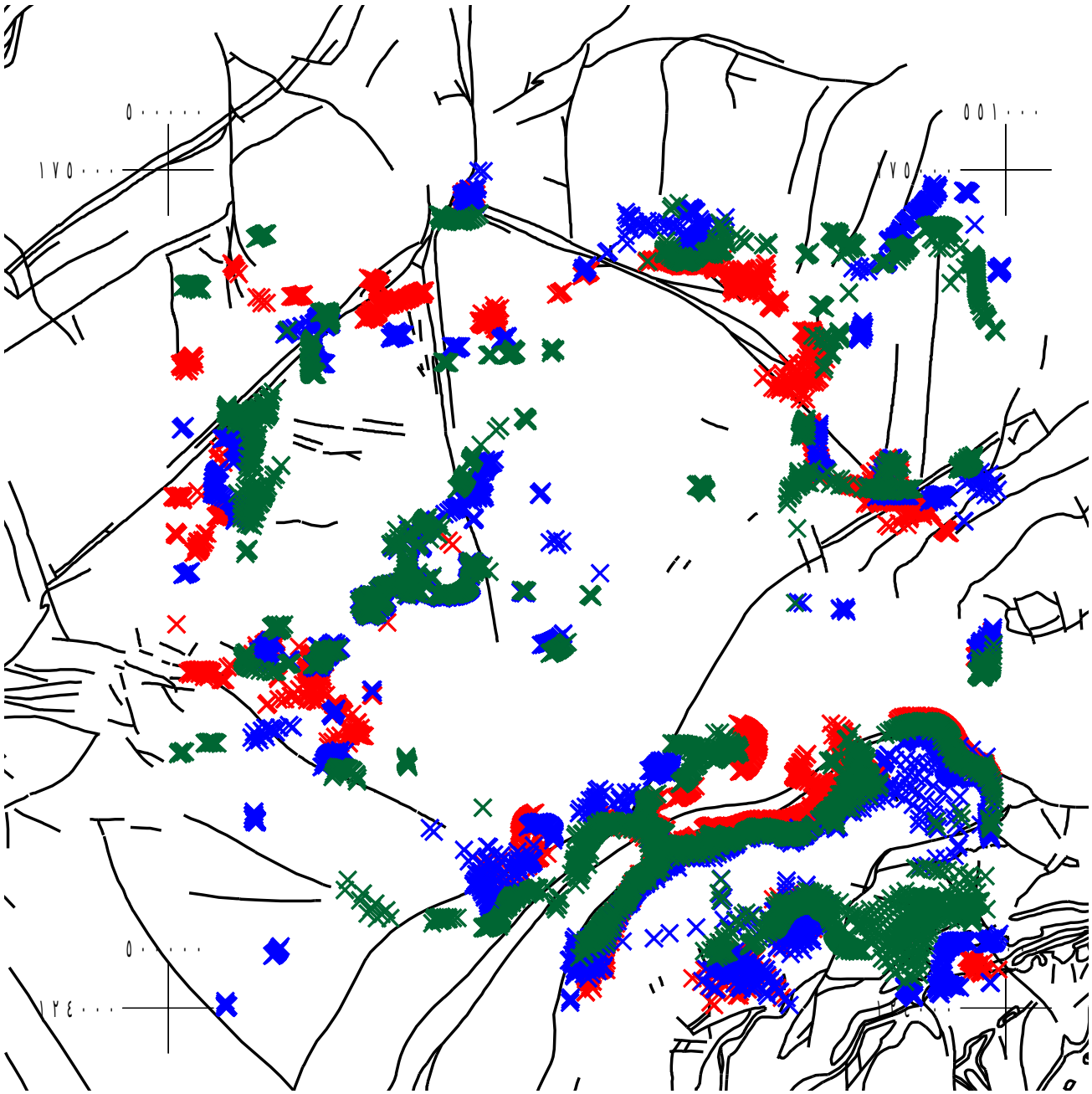
The same kind of representation is used for the stripped data

The results of the 3D Euler deconvolution of the zone 12 to 23, **not** upward-continued are represented in the first set of figures together with the major tectonic features of the area.

The results of the 3D Euler deconvolution of the zone 12 to 23, upward-continued are represented in the second set of figures together with the major tectonic feature of the area.

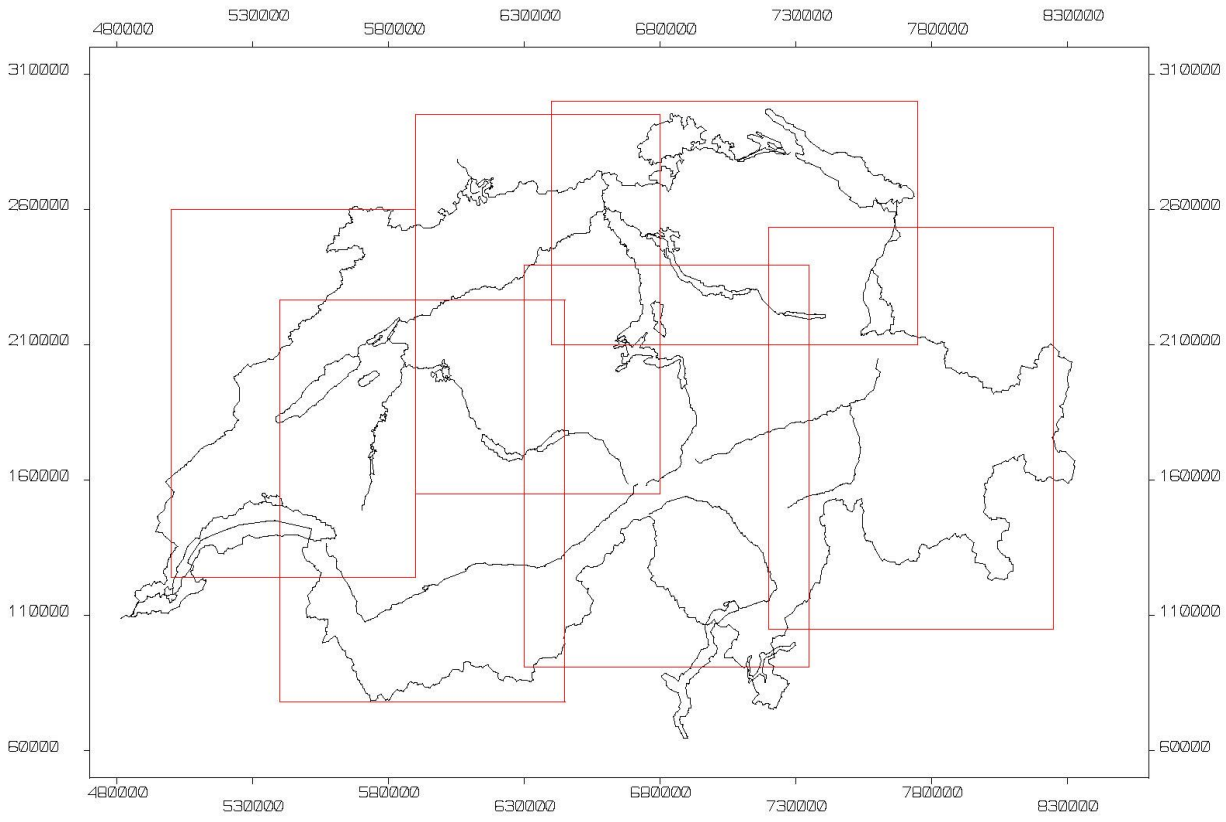
For these zones all the solutions are plotted on the same map.

The results of the 3D Euler deconvolution of the zones 1 to 11 not stripped from the effect of the quaternary sediments.



Solutions of the 3D Euler deconvolution, of zone # 23, upward-continued, plotted together with the major tectonic features.

For a representation onto the background of the Swiss tectonic map at scale of 1/500^000, the territory has been divided in six zones with a small overlapping. The sizes of these zones were chosen in such a way that they could be printed in A4 format.
This partition is shown in the figure below.

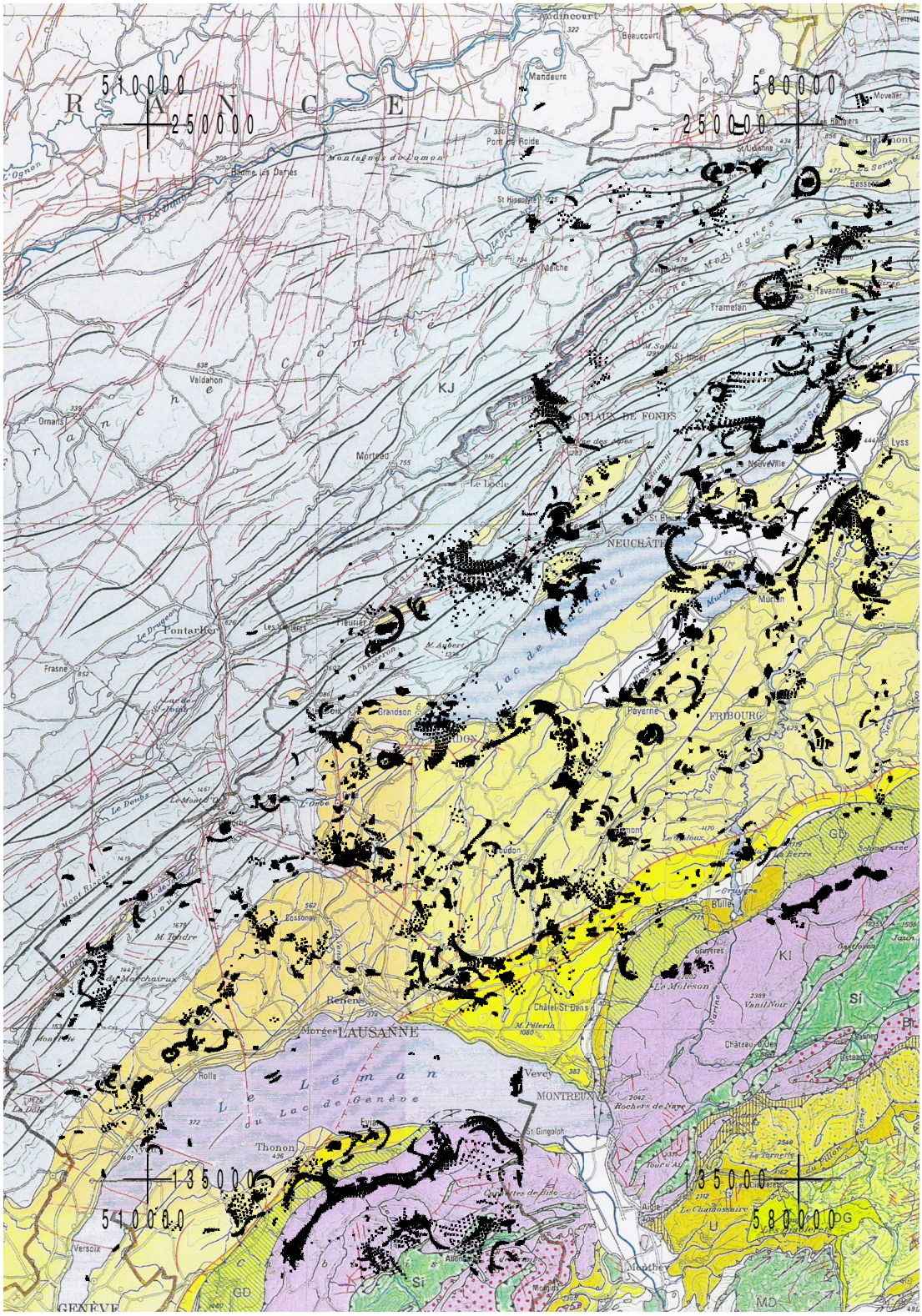


Location of the zones used for the representation with the tectonic underground

The results are presented in two parts, each having two groups of data. The first part involves the zone I to III, covering le Molasse Basin and the Jura Mountains (equivalent to the zones 1 to 11).

The first group contains the results obtained with the not-stripped residual fields while the second group contains the results from the stripped residual fields.

The second part covers the Alps and the Pre-Alps with in the first group the results obtained with the residual fields not upward-continued while the second group contains the results from the upward-continued fields



Solutions of the 3D Euler deconvolution of the zone # I, residual anomaly not stripped.