P10-10 ABOUT THE INFLUENCE OF THE VERTICAL GRADIENT OF THE ANOMALOUS MASSES UPON THE VALUES OF THE GRAVITY FIELD, REDUCED TOWARDS A PLANE

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1) Introduction

The measured relative values of the gravity field are reflecting the influence of the density non-uniformity $\mathbf{g}_\sigma$ for a concrete altitude **h** and the specific conditions of the point of measurement $\delta\mathbf{g}_\Sigma$ altitude, density of the intermediate layer, terrain characteristic and geographic latitude.

$$\mathbf{g} = \mathbf{g}_\sigma(\mathbf{h}) + \delta\mathbf{g}_\Sigma \tag{1}$$

After introducing the corrections $\delta\mathbf{g}_\Sigma$ - the free-air correction, the Bouguer correction, the terrain correction and the latitude correction, the values of all points are reduced towards one and the same conditions and is remaining only the influence of the density non-uniformity. However, after this processing is remaining the influence of the density non-uniformity for the real (**h**), but not the reduced ($\mathbf{h}_o$) altitude of each specific point :

$$\mathbf{g}_{red}(\mathbf{h}_0) = \mathbf{g}_\sigma(\mathbf{h}) \tag{2}$$

The evaluation of the deviations of the values reduced towards altitude $\mathbf{h}_o$ from altitude **h** ($\mathbf{h}=\mathbf{h}_o+\mathbf{H}$) compared with the real values $\mathbf{g}_r(\mathbf{h}_o)$ of the gravity field caused by the density non-uniformity for the altitude $\mathbf{h}_o$ is of a theoretical and practical interest. These deviations are caused by the “residual” vertical gradient of the anomalous masses, that are present in the layer with thickness **H** - the altitude difference towards the level of reduction $\mathbf{h}_o$.
It is convenient to present these deviations as the relative values δ :

$$\delta = \frac{\mathbf{g}_{red}(\mathbf{h}_o) - \mathbf{g}_r(\mathbf{h}_o)}{\mathbf{g}_r(\mathbf{h}_o)} \tag{3}$$

The deviations evaluation defined by expression (3) is necessary as a precondition during the discussion of the following basic questions :

- Confirming the necessity to start from the real physical plane, on which the measurements have been performed in the process of solving the inverse gravity problem.
- Evaluating the mistakes caused by the anomalous vertical gradient during the computation of different gravity field transforms.
- Taking into account the influence of the anomalous vertical gradient during the estimation of the intermediate layer density using gravity data.

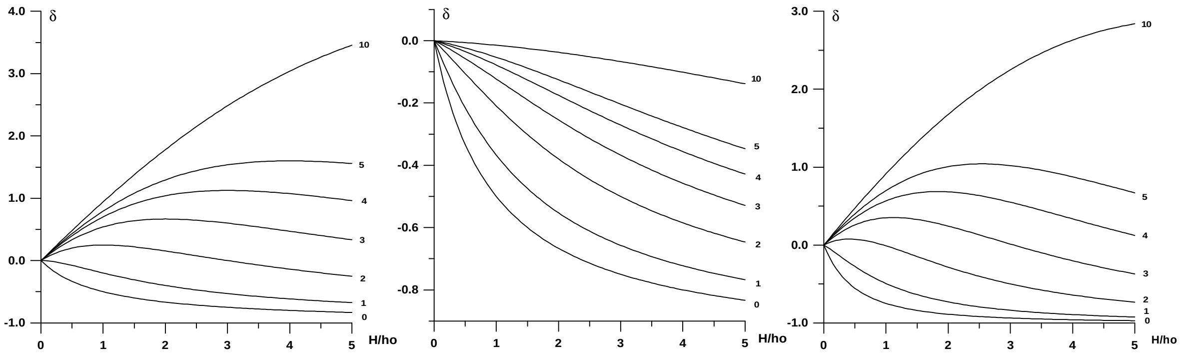
The subject of the studies revealed in the present work is the evaluation of the relative deviations defined by expression (3) for some simple shaped bodies (2-D geometry) and the influence of these deviations upon the computation of different gravity field transforms.

2) Relative deviations of the reduced gravity field values for some simple shaped bodies

The relative deviations, in fact, are presenting relative mistakes in the reduced gravity fields. The calculations for the following simple shaped bodies are presented :

- A sphere with anomalous mass **M** and depth $\mathbf{h}_o$ towards the level of reduction, along the profile **X**, that is passing through the projection of the sphere's centre on the plane and is starting (x=0) from this projection.
- A horizontal rod with anomalous mass for a discrete length λ and depth $\mathbf{h}_o$ towards the level of reduction, along the profile **X**, that is crossing perpendicularly the projection of the rod on the plane and is starting (x=0) from this projection.
- A vertical rod composed by an infinite set of material points with anomalous mass for a discrete length λ, starting from a depth $\mathbf{h}_o$ from the level of reduction and having an infinite spread in depth. The profile **X** is passing through the projection of the rod on the plane and is starting (x=0) from this projection.

The obtained relative deviations for these models (sphere, horizontal rod and vertical rod) as a function of the normalised terrain altitude differences $\mathbf{H/h}_o$ are presented respectively on Fig.1 . The curves have as a parameter the normalised values $\mathbf{X/h}_o$.



a b c

Fig. 1. The relative deviations for the models of sphere (a); horizontal rod (b) and vertical rod (c) as a function of the normalised terrain altitude differences $\mathbf{H/h}_o$. The curves have as a parameter the normalised values $\mathbf{X/h}_o$.

3) Conclusions

The summarised analysis of the performed studies is showing, that the quantity interpretation should not be performed from the level of reduction, which is substantially different, regarding the altitude differences, from the real physical plane. Mistakes caused by the "residual" vertical gradient are not introduced only in the case when the interpretation is performed towards the real physical plane on which the measurements are performed.

It has to be mentioned that while it is possible to exclude the mistakes caused by the anomalous vertical gradient in the case of quantity interpretation, these mistakes will always be present in the applied transforms of the observed gravity field.

References

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