Geophysical Research Abstracts, Vol. 8, 07351, 2006
SRef-ID: 1607-7962/gra/EGU06-A-07351

Importance of lateral viscosity variations for a modeling of geoid and dynamic topography

I. Rogozhina (1), M. K. Kaban (1), V. Trubitsyn (1,2), M. Rothacher (1)

(1) GeoForschungsZentrum, Potsdam, Germany, (2) Inst. of Physics of the Earth, Moscow, Russia (valmont@gfz-potsdam.de / Phone: +49-331-2881178)

The lateral viscosity variation effect turned out to be a kind of the byword in geosciences more than 10 years ago, but even nowadays it is hardly possible to say that this problem has been completely solved. A number of questions have still not been investigated. Our 3D-viscosity model was created mainly to estimate the effect of lateral viscosity variations for dynamic topography and geoid, but its influence on mantle velocities and stress distribution also plays an important part in our study.

As a basis we employ a combination of three techniques, namely, a spherical harmonic method, a direct method for the solution of differential equation systems with arbitrary functions for density and radial viscosity variations and a perturbation method by Christensen and Zhang, 1993, which has been modified to implement mantle compressibility. To investigate the influence of lateral viscosity variations on geoid and dynamic topography we use seismic tomography data (e.g., Ektroem and Dziewondski, 1996), converted to a 3D density distribution and to lateral viscosity variations, obtained with the aid of the formulas by Karato and Wu, (1993). We checked several radial viscosity profiles, taken based on the latest studies. A relationship between the magnitude of LVV and changes of mantle velocities has been investigated for a set of models. The test results have been compared with the results provided by an independent method based on the FD technique (Trubitsyn and Rykov, 1995) with simplified conditions (no compressibility and self-gravitation). Both methods gave reasonably comparable results, which confirmed a reliability of the new method.

Preliminary computations with real data have demonstrated significant changes of the calculated geoid (more than 10% compared to a geoid calculated with only radial viscosity variations) in the areas with maximal lateral viscosity variations. The program

code was tested for various initial conditions. The redistribution of mantle flows is also visible in all cases, particularly, the difference for the surface velocities reaches up to about 8 – 10 %, which is important to provide a better fit with the observed GPS plate velocities.