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Perturbation method for modeling of lateral viscosity variations of 4 orders of magnitude.

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1 **To model the mantle velocities, dynamic geoid and topography we have used a combination of three techniques: a spherical harmonic method, a direct method for solution of differential equation systems with arbitrary functions for density and radial viscosity variations and a perturbation method for modeling of lateral viscosity variations. Compared to the most popular finite element method the latter combination offers an evident advantage: complete consideration of all the most important effects such as mantle compressibility, self-gravitation and lateral viscosity variations at the same time. This is far too complicated to incorporate simultaneously all these effects into finite element method.**

2 **We have developed a new perturbation method that takes into consideration lateral viscosity variations of 4 orders of magnitude and any radial variations as well as both effects of compressibility and self-gravitation. There exist two methods (U- and W-transform) suggested by Zhang and Christensen, 1993, both of which have rather limited range of application. Accordingly to Zhang and Christensen, 1993, maximum amplitude of lateral viscosity variations admissible for the initial U-transform method is only 1.5 orders of magnitude. W-transform method can withstand viscosity variations of 2.7 orders in magnitude but it is not applicable to any small-scaled viscosity variations.**

A set of models with different radial viscosity variations (up to 6 orders) and nulower mantle was elaborated to estimate limitations of the method. The novel method was applied to a 3D global viscosity model (approximately 3 orders of magnitude) constructed using the S20 seismic tomography model converted to temperature and assumptions about homologous temperature in the mantle (Paulson et al., 2005).