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Influence of variable uncertainties in seismic tomography models on constraining mantle viscosity from geoid observations

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The radial viscosity structure of the Earth is explored on the basis of the geoid observations. The variations of uncertainty in seismic tomography models are accounted for when finding the radial viscosity structure. The new methodology we propose attempts to fit more closely those features of the geoid that are better constrained by tomography models and avoids to fit those features that are poorly constrained. This approach is particularly important because the error of geoid predictions caused by uncertainties in seismic tomography models is overwhelmingly larger than the noise in the geoid measurements. The synthetic tests indicate that the viscosity structures obtained by disregarding the uncertainty variations in seismic tomography models can be biased depending on the geoid spectral band and on the 'input' seismic tomography model. When the uncertainty variations in seismic models are considered in the inversion process, results do not indicate a viscosity in the transition zone lower than in the upper mantle. A robust feature found with the new method is a viscosity in the upper mantle two orders of magnitude smaller than in the lower mantle. The error covariance of seismic tomography models is critical for the method we suggest. A covariance matrix rigorously derived by seismologists should help to even more reliably infer the viscosity structure and relation between anomalies in density and seismic velocities from surface observations such as the geoid, and thus lead to a better knowledge of the Earth interior.