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Surface deformations of a 3D elastic self-gravitating Earth

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Surface geology and seismic tomography show that the properties of Earth's internal structure vary laterally. Lateral heterogeneity has been demonstrated to have considerable effect on the observables of Glacial Isostatic Adjustment (GIA) such as surface deformation, geoid and sea-level change. A number of models have been developed to consider a complex viscous structure of the Earth by implementing 3D viscosity for linear or nonlinear creep laws. However, there are only few studies addressing lateral heterogeneity in the (an-)elastic structure.

Due to the increased accuracy of global observation systems like GNSS and an integrated interpretation of earth system processes, the demand for improved global deformation models for instantaneous to annual loading is rising. To analyse the effect of lateral heterogeneity on a global scale, we extend the spectral–finite element method suggested by Martinec for a viscoelastic body to compute the deformations and gravitational potential changes of an elastic spherical self-gravitating Earth. The effect of 3D elastic structure is studied by varying the elastic moduli in the crust and mantle. We present a sensitivity study in order to quantify its effect on solid-earth deformations on a regional to global scale.