EGU22-13323
https://doi.org/10.5194/egusphere-egu22-13323
EGU General Assembly 2022

Mantle viscosity derived from geoid and different land uplift data in Greenland

Mohammad Bagherbandi[1,2], Hadi Amin[1], Linsong Wang[3,4], and Masoud Shirazian[5]
[1]Department of Computer and Spatial Sciences, University of Gävle, SE-80176 Gävle, Sweden.
[2]Division of Geodesy and Satellite Positioning, Royal Institute of Technology (KTH), SE-10044 Stockholm, Sweden.
[3]Hubei Subsurface Multi-scale Imaging Key Laboratory, Institute of Geophysics and Geomatics, China University of Geosciences, Wuhan, China.
[4]Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, Telegrafenberg, Potsdam, Germany.
[5]Department of geomatics engineering, Civil Engineering Faculty, Shahid Rajaee Teacher Training University, Tehran, Iran.

The Earth's mass redistribution due to deglaciation and recent ice sheet melting causes changes in the Earth's gravity field and vertical land motion in Greenland. The changes are because of ongoing mass redistribution and related elastic (on a short time scale) and viscoelastic (on time scales of a few thousands of years) responses. These signatures can be used to determine the mantle viscosity. In this study, we infer the mantle viscosity associated with the glacial isostatic adjustment (GIA) and long-wavelength geoid beneath the Greenland lithosphere. The viscosity is determined based on a spatio-spectral analysis of the Earth's gravity field and the land uplift rate in order to find the GIA-related gravity field. We used and evaluated different land uplift data, i.e. the vertical land motions obtained by the Greenland Global Positioning System (GPS) Network (GNET), GRACE and Glacial Isostatic Adjustment (GIA) data. In addition, a combined land uplift rate using the Kalman filtering technique is presented in this study. We extract the GIA-related gravity signals by filtering the other effects due to the deeper masses i.e. core-mantle (related to long-wavelengths) and topography (related to short-wavelengths). To do this, we applied correlation analysis to detect the best harmonic window. Finally, the mantle viscosity using the obtained GIA-related gravity field is estimated. Using different land uplift rates, one can obtain different GIA-related gravity fields. For example, different harmonic windows were obtained by employing different land uplift datasets, e.g. the truncated geoid model with a harmonic window between degrees 10 to 39 and 10 to 25 showed a maximum correlation with the GIA model ICE-6G (VM5a) and the combined land uplift rates, respectively. As shown in this study, the mantle viscosities of 1.6×10^{22} Pa s and 0.9×10^{22} Pa s for a depth of 200 to 650 km are obtained using ICE-6G (VM5a) model and the combined land uplift model, respectively, and the GIA-related gravity potential signal.