Geophysical Research Abstracts
Vol. 20, EGU2018-117, 2018
EGU General Assembly 2018

A new global GPS dataset for testing and improving modelled GIA uplift rates

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Permanent GPS stations provide a globally distributed record of long-term signatures of glacial isostatic adjustment (GIA). In this study, we use about 4000 GPS vertical velocities as an observational estimate of global GIA uplift rates, after correcting for major elastic deformation effects. A novel fully-automatic strategy is developed to post-process the GPS time series and to correct for non-GIA artefacts. Before estimating vertical velocities and uncertainties, we detect outliers and jumps, and correct for atmospheric mass loading displacements. We correct the resulting velocities for the elastic response of the solid Earth to global changes in ice sheets and glaciers, as well as for changes in the Earth's rotational pole relative to the 20th century average. We apply a spatial median filter to remove sites reflecting local effects and to arrive at the around 4000 GPS site velocities.

The novel global GPS dataset shows a clean GIA signal at all post-processed stations and is therefore suitable to investigate the behaviour of global GIA forward models. The dataset is compared with 13 global GIA solutions considering differences in reference frame origins. Furthermore, we use the novel dataset to update global forward model solutions within a Bayesian Hierarchical Modelling framework to identify statistically significant deviations between the observations and the models, which may be due to either uncertain mantle rheology and/or ice loading history and/or GPS errors.