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A global inverse solution for GIA

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Glacial isostatic adjustment (GIA) is a crucial component in evaluating sea level change. The GIA process has been simulated using various global physical forward models and it can also be measured at permanent GPS stations. In this presentation, we combine the physical forward model simulations and GPS measurements in a Bayesian hierarchical modeling framework to update global GIA. For this, a new GPS dataset is developed to globally represent the long-term signitures of GIA (Schumacher et al., 2018). The time series of the up component for more than 15,000 GPS sites are carefully analyzed. A novel fully-automatic post-processing strategy is implemented to detect outliers and jumps, correct for atmospheric mass loading displacement, the Earth‘s elastic response, and changes in the rotational pole. A spatial median filter is applied to remove sites reflecting local effects. The result is a global dataset of around 4,000 GPS site velocities showing a clean GIA signal. The dataset is compared with 13 global GIA forward models considering differences in the reference frame origins. For combining GIA models and GPS data, two major challenges need to be addressed: (1) the scale of the update, which is too large for naïve Gaussian conditioning and (2) the non-stationarity of the prior. We address challenge (1) with the now well established stachastic partial differential equations and integrated Laplace approximation approach and challenge (2) with two general models that accommodate commonly seen geospatial patterns (Sha et al., 2018). The Bayesian framework is currently being extended to combine global geodetic data not only on GIA, but also on ice mass and hydrological mass changes, changes in sea level and prior information from geophysical models to allow new insights about the different contributors to sea level rise on a regional and global scale.