Using GRACE and Surface Geodetic Data Combination to Improve GIA Knowledge

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Signatures of glacial isostatic adjustment (GIA) and present-day surface mass trend are coupled together in many modern geodetic data. To separate them, we take a global kinematic approach by solving simultaneously for 3 complete ($1 \leq n \leq 60$) sets of spherical harmonic coefficients of the present-day surface mass trend, vertical and horizontal GIA induced surface velocity fields, as well as rotation vectors of 15 major tectonic plates from a multi-satellite data combination of GRACE, GPS and altimetry-assimilated ocean bottom pressure model. The average predictions of ICE-5G and IJ2005 (VM2) are taken as a priori GIA mean model. A plausible and conservative priori covariance matrix is constructed in the spherical harmonic domain for the GIA model by propagating the covariance matrix of random and geographically correlated ice thickness and lower mantle viscosity errors so that the resulting magnitude and geographic pattern of the geoid uncertainties roughly reflect the difference between two recent GIA models. No effective a priori information is used for present-day surface mass trend, or for plate motions. Significant present-day surface mass trend and deviations from the a priori GIA model are found by the simultaneous inversion with substantially reduced uncertainties in both.