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Inverse GIA estimates from satellite gravimetry and altimetry over Antarctica

Matthias Oskar Willen (1), Bernd Uebbing (2), Martin Horwath (1), Jürgen Kusche (2), Roelof Rietbroek (2), and Ludwig Schröder (3)

(1) TU Dresden, Institut für Planetare Geodäsie, Dresden, Germany (matthias.willen@tu-dresden.de), (2) University of Bonn, Institute of Geodesy and Geoinformation, Bonn, Germany, (3) Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany

A significant contribution to rising sea level originates from the continental ice sheets. It can be quantified using geodetic satellite methods. The separation of superimposed signals, such as present-day ice-mass change and glacial isostatic adjustment (GIA), as part of the data processing is challenging. Commonly, this is achieved by utilizing forward-modelled information on GIA in order to correct the influence for mass-balance studies.

Here, we investigate a regional inverse approach which combines satellite gravimetry and ice-altimetry to derive the GIA signal and separate it from ice-mass change over Antarctica. We investigate the sensitivity of the method by using different ice-altimetry products and various products to replace degree-1 and C_{20} coefficients in the GRACE monthly solutions. The uncertainty of modelled firn processes are characterized based on differences of two surface mass balance products. Our mass-change estimates of the Antarctic ice sheet have a range of 54 Gt a^{-1} for the time period 2003-03–2009-10. The GIA estimate is very sensitive to large-scale biases and their correction.

Furthermore, we show preliminary work of integrating the methodology for estimating the GIA signal from satellite observations into the global fingerprint inversion (Rietbroek et al., 2016). It combines GRACE and ocean-altimetry data to separate the total sea-level change into individual mass and steric contributions. In a first step, we make use of Antarctic ice-altimetry trends to include more realistic patterns of ice-sheet change. Second, we include ice-altimetry-derived ice-mass changes as pseudo-observations in order to constrain the Antarctic contribution to the total sea-level change. These results are compared with the GIA signal from forward models.