Using joint geodetic data to estimate viscous surface velocities in Antarctica due to past and recent ice sheet changes

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Résumé

In Antarctica, estimates of the glacial isostatic adjustment (GIA) effects are quite imprecise with GIA-induced mass changes ranging from 40 to 150 Gt/yr, although models seem to converge since 2012 around 40 – 80 Gt/yr. The variability obtained from one model to another is significant with important geophysical and geodetic implications. We have developed an inversion strategy that allows estimating viscous surface displacement in Antarctica without restrictive assumptions on the viscosity structure and the rheology of the Earth's mantle and without using a priori models to account for the densification of the ice sheet. The methodology we developed assumes that current ice sheet changes occur within a thin layer on the Earth's surface and that in response the Earth deforms viscoelastically. The elastic part of this response is modeled using the PREM model. We assume that surface displacements and satellite gravity variations, induced by viscous deformations, are related using a gravimetric gradient value. The strategy aims to jointly invert monthly satellite altimetry and gravimetry data as well as GNSS positioning series to determine the coefficients of the spherical harmonic decomposition of ice sheet thickness variations, surface mass densities, and displacements associated with viscous surface deformations. Preliminary tests performed on realistic synthetic data show that this new approach can recover coefficients up to harmonic degree 40. The parameters, maps and data predicted by the inversion are close to within few percent of those expected.

Mots-Clés: glacial isostatic adjustment, Antarctica, space, based geodesy, viscous deformations

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