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Regional glacial-isostatic adjustment in Antarctica inferred from combining spaceborne geodetic observations (ESA-STSE CryoSat+ Project REGINA)

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A major uncertainty in determining the mass balance of the Antarctic ice sheet from satellite gravimetry, and to a lesser extent altimetry, measurements is the poorly known correction for the glacial isostatic adjustment (GIA) of the solid Earth. Although much progress has been made in consistently modelling ice-sheet evolution and related bedrock deformation, predictions of GIA remain ambiguous due to the sparsity of geodetic and geological constraints. Here, we present an improved geodetic GIA estimate based on GRACE, Envisat/ICESat/CryoSat-2 and GPS measurements. Using viscoelastic response functions of the radial displacement and gravity field change to a disc load forcing, we estimate GIA based on multiple space-geodetic observations, making use of their different sensitivities to surface and solid Earth processes. The approach allows us to consider a laterally varying lithosphere thickness and mantle viscosity in Antarctica, and particularly investigate the effect of a low-viscosity asthenosphere and a ductile layer in the elastic lithosphere in West Antarctica. We compare our GIA estimate with published estimates and results from numerical modelling, and evaluate its impact on the determination of ice-mass balance in Antarctica from GRACE and CryoSat-2. The results presented are the final results of the Support To Science Element Project REGINA and its Supplementary Study of the European Space Agency, www.regina-science.eu.