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Improving the representation of ice-sheet mass changes in the global inversion for sea-level contributions

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Global-mean sea level rises (GMSLR) by 3.1-3.5 mm a^{-1} (1993-2017) and of which about 50 % can be attributed to changes in global-mean ocean mass due to hydrological variations, mass changes of land glaciers, and mass changes of the major ice sheets in Greenland and Antarctica. The ice-sheet contributions account for more than the half of the contemporary ocean mass change and can be observed with time-variable gravimetry by the Gravity Recovery and Climate Experiment (GRACE) and its follow-on mission (GRACE-FO). In addition, geometric surface changes due to the volume change of ice sheets is also observed by polar altimetry missions. Of particular importance here is the signal of glacial isostatic adjustment (GIA) which is superimposed with ice mass change.

Conventionally, the gravimetry and ice-altimetry observations are processed independently. For ocean applications, a global fingerprint inversion (Rietbroek et al., 2016) allows to estimate individual mass and steric contributors to the sea-level budget by combining GRACE and ocean-altimetry data in a joint approach. To improve the estimates of the ice-sheet contributions to GMSLR, we present first results from additionally incorporating independent ice-altimetry data over Greenland and Antarctica into the fingerprint inversion. We examine the sensitivity of the sea-level contributions to the additional ice-altimetry data (from ERS-2, Envisat, ICESat, CryoSat-2 missions) and provide validation against independent estimates. In our standard runs, GIA is accounted for as an a-priori correction during the inversion. However, we demonstrate the potential and limitations of a regional inverse approach in which GIA is separated from ice mass change over Antarctica using GRACE and ice altimetry. In our future work, we aim to parametrise and co-estimate GIA within the global inversion framework.