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Partitioning global and regional sea level variability with altimetry and GRACE, and an outlook to SWARM

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Using altimetric and gravimetric data in an inverse 'fingerprint' approach, we quantify the effect of mass flux (ice sheets, glaciers, land water storage) and steric changes on long-term and seasonal regional and global sea level variability. We perform a joint inversion with GRACE time-variable gravity and Jason-1/2 altimetric data over 2003-2011 and compare our results with our earlier findings (Jensen et al., 2013) and those obtained with other methods. Our method takes into account the effects of self-gravitation, elastic loading of the ocean bottom, and the response of Earth rotation to mass redistribution. In this way, we are able to assign 0.66/0.40/0.43/-0.20 mm/a of total sea level rise observed in the mentioned time frame to mass flux from Greenland/Antarctica/land glaciers/land water storage change. Furthermore, our results indicate a steric contribution of 1.2 mm/a (of which we suspect the largest part occurs in the deep ocean) in the considered time frame.

Gravimetric data represents the key element for separating mass flux from volumetric sea level variability; however the GRACE satellites are way past their design lifetime and it is not guaranteed that they will provide a complete time series until the GRACE-FO satellites are launched. It has been suggested that GNSS-tracking and accelerometry on board the recently launched SWARM satellites may be used to recover the time-variable gravity field, albeit at much lower resolutions as compared to GRACE. Here, we will assess the potential benefit of SWARM to sea level partitioning through simulations and a sensitivity study.