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Reconciled ocean mass estimates in global and regional sea level budgets from combining GRACE, altimetry and Swarm

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Estimates of ocean mass change are necessary to separate steric sea level change from sea level changes measured with satellite altimeters. Published studies using the GRACE satellite mission indicated a large range in trends (1–2 mm/y) with reported standard errors of 0.1–0.3 mm/y. We found that a large part of this discrepancy (up to 0.6 mm/y) can be explained by which model is used to account for the effect of glacial isostatic adjustment (GIA). The second-largest contribution (0.3–0.4 mm/y) is related to the way how different studies have restored atmospheric and oceanic signals (AOD1B) which have been removed during the GRACE dealiasing procedure.

Two processing strategies, which originally resulted in significantly differing ocean mass trends are considered. The 'direct' method uses the standard GRACE Stokes coefficients, while the 'inverse' method applies a joint inversion of data from GRACE and altimetry. We show that, after accounting for the differences with respect to the processing corrections, global ocean mean estimates from the direct and inverse approach agree with each other on global scales within less than 0.01 mm/y.

We will present reconciled time series of GRACE only based ocean mass which agree well between the processing centers and with ocean mass estimates from combining GRACE and altimetry data in a joint inversion. Assuming the A et al. (2013) GIA model is correct, we estimate consistent ocean mass trends of 1.43 mm/y for the period 2002.6–2014.5. We compare these to independent JPL v02 mascon solutions and to ocean mass derived from subtracting steric sea level change from altimetry. Furthermore, we will show the impacts on global and regional sea level budgets.

In order to extend the ocean mass time series beyond the GRACE era and to bridge the gap between GRACE and GRACE-FO, we utilized consistently processed state of the art time-variable gravity field data from the Swarm mission. We show that it is possible to derive ocean mass from Swarm data which is consistent with GRACE based ocean mass estimates and can, consequently, be used to fill missing GRACE months as well as the gap to GRACE-FO.