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GRACE gravity solutions validated by in-situ ocean bottom pressure in different regions of the global ocean

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The GRACE satellite mission provides gravity field estimates of the Earth with unprecedented accuracy. Nevertheless, the realistic detection of oceanic mass redistribution remains challenging due to comparatively small signal amplitude, aliasing by tides and other short-term variability, and smoothing of small spatial scales. To verify the capability of GRACE to measure oceanic mass variability, a validation with in-situ timeseries of Ocean Bottom Pressure (OBP) timeseries is essential.

Here, different GRACE gravity fields provided by the GRACE Science Data System (CSR, GFZ, JPL), GRGS, ITG and others are compared with more than 140 timeseries of OBP sensors deployed throughout all oceans. The performance of the different GRACE products to capture oceanic mass variability is assessed by a weighed correlation analysis, taking into account the length and data quality of the in-situ time series. Both Gaussian filtering and an ocean-model derived spatial pattern filtering method are used for the GRACE data, whereas for the in-situ timeseries, different de-tiding and de-trending methods are applied to reduce aliasing and sensor drift. The analysis aims (a) to quantify the skill of different GRACE products and to quantify the advances made by recent GRACE gravity field releases with improved data processing, and (b) to identify regions where GRACE performs exceptionally well (e.g. high latitudes), and in which parts of the oceans GRACE fails to detect real OBP variability. Spatial patterns related to the performance of GRACE may help to predict the quality of spaceborne gravity measurements also for those oceanic regions where no in-situ data are available. This is critical for the future use of GRACE to remotely determine water mass redistribution in all oceans.