Assessment of Global and Regional Sea-Level Estimates Based on Reprocessed TOPEX/Jason Altimetry

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Abstract

Accurate sea-level projections based on global and regional rates derived from satellite altimetry warrants continuous improvements in the referenced sea surface height measurement. In the coastal zone, nearshore-related problems and the degradation of geographical and environmental range corrections pose challenges in determining local rates of sea-level rise. In this presentation, we assess the efficacy of an adaptive iterative retracking procedure (ALES) to improve the quality and retrieval rates of Jason-1 and Jason-2 range measurements. A status report is provided on the development of new POD standards which offers significant improvements to force and measurement modeling to further mitigate geographically correlated errors that translate directly into regional sea-level changes.

Current Global and Regional Mean Sea Level Estimates Referenced to ITRF2014

Revised estimates of GMSL based on ITRF2014 on the 10-year regional sea-level rates are shown below. These estimates are compared to the different POD solutions and their associated errors. The POD solutions are based on the analysis of the Jason-1 and Jason-2 satellite missions. The errors are derived from the combined analysis of the satellite altimeter data and the associated terrestrial tide gauges.

Towards Improved Local Sea-Level Rate Estimations Provided by ALES + (Adaptive Leading Edge Subwaveform) Retracking

For satellite altimetric POD outside the “station solution interval” (1979 to 2008 for ITRF2010), the tracking station coordinates must be extrapolated. It is in this “extrapolation period” that we can see significant degradation in tracking data fits and the resultant orbits based on ITRF2010, which can include potential drift time. We have evaluated ITRF2014 (Alamemi et al., 2018) and compared it to the performance of ITRF2008 (Legret et al., 2017). We see an improvement in the Satellite Laser Ranging Data RMS of fits per 10-year arc of 1-2 mm for ITRF2014 after this. This certification will be presented for the anticipated ITRF2020. ITRF2020 is anticipated to improve the GMSL-based solution by around 200 nms to 4 mm. This is an improvement for both nearshore sea level and regional sea level.

Ocean Mass Budget Accounting

Ocean mass balance is a key factor in understanding the changes in the Earth’s water cycle. It is the study of how much water is added to and removed from the Earth’s oceans. The main components of the ocean mass balance are:

- Freshwater contributions from land, including rivers, precipitation, and precipitation minus evaporation.
- Oceanic heat content changes due to warming and cooling of the ocean.
- Oceanic salt content changes due to changes in salinity. This is the result of changes in evaporation and precipitation.
- Changes in oceanic volume due to changes in the Earth’s gravitational field (glacial isostatic adjustment).
- Changes in oceanic volume due to changes in oceanic circulation.

References


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