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How Informative is the Basin-Scale Sea-Level Budget?

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With ever improving accuracy in remote and in-situ observation systems, the sea level budget over the satellite era can be closed on the global scale to within observational uncertainties (WCRP, 2018). A regional study using the land-cryosphere mass change to inform the mass sea level change via the sea level equation has shown good agreement in most regional basins against vertical-land-motion-corrected tide-gauge records. However, the direct ocean mass measured by GRACE is considerably more sensitive than the land-cryosphere change (due to its smaller signal) and therefore has proportionally larger errors. Here, we investigate the robustness and sensitivity of the sea level budget at the regional scale, comparing direct satellite observations of mass and total sea level and in-situ steric sea level observations over the period 2005-2015. Discrepancies in the budget are known to arise from observation processing methods. There are additionally sensitivities to the way a regional mean is calculated and to data treatment in coastal and high-latitude areas (such as buffering from land masses in the GRACE data). For example, the choice of GIA model influences the global mean mass trend by around 5%. But the sensitivity of the mass trend in the sub-polar North Atlantic to the choice of GIA model is of the same magnitude as the observed steric-corrected sea level anomaly ($\sim$1.1 mm/yr). In the South Pacific and Indian Oceans, differences in the ocean mass estimate due to the GRACE processing choices and due to the calculation method for the trend, vary estimates by $\sim$50% of the steric-corrected sea level trend (which is around 2 mm/yr). Given these sensitivities in both the measurement and processing of observations in the sea level budget calculation, we discuss what information the regional sea level budget can provide at this time.