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Further scrutiny of the contemporary sea-level budget using models and observations

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Recent studies and community efforts have documented closure of the global mean sea-level (GMSL) rise budget over the satellite altimetry and gravimetry era. Exact decomposition of observed GMSL rates into mass and steric contributions to within ~ 0.5 mm yr^{-1} is still challenging, though, and characterized by sensitivities to the chosen input data, individual processing strategies, and budget constraints. Given that a combination of measurements and ocean models can shed light on the discrepancies between component estimates and inherent uncertainties in the underlying data sets, we explore contemporary sea-level trends using an ocean state estimation tool (ECCOv4, Estimating the Circulation and Climate of the Ocean, version 4), which provides a dynamically consistent fit of a general circulation model to the chosen instrumental record without violation of the fundamental conservation laws for heat or ocean mass. Here, we present results of a first benchmark test with the nominal ECCOv4 solution and a free-running unconstrained model integration over the period 1992 to 2015, using identical initial conditions. These solutions are not or only partially capable of representing mass variations and the associated gravito-elastic effects on relative sea level. Hence, steric sea-level changes from each model run are introduced in a global fingerprint inversion that allows for partitioning of the total sea-level change into mass and steric terms by combining GRACE (Gravity Recovery and Climate Experiment) and altimetry information. Specifically, spatial patterns from the individual model runs are utilized and rescaled by fitting to the observations. We investigate discrepancies in steric GMSL rates before and after the least-squares inversion, possibly arising from model sensitivities to the incorporation of hydrographic data (e.g., from Argo floats). Such scrutiny can provide guidance in performing additional experiments with the ocean state estimate, for which different input data are excluded or equipped with more realistic errorbars.