

A reconciled estimate of 20th century global mean sea-level rise

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The rate at which global mean sea level (GMSL) rose during the twentieth century is uncertain, with little consensus between various reconstructions that indicate rates of rise ranging from 1.3 to 2 mm yr⁻¹. Here we present a twentieth-century GMSL reconstruction computed using a novel area-weighting technique for averaging tide gauge records that (i) incorporates, for the first time, up to date estimates of vertical land motion (VLM) and corrections for local geoid changes due to ice melting and terrestrial freshwater storage (TWS), and (ii) allows for the identification of possible differences compared to earlier attempts. Our reconstructed GMSL trend of 1.1 ± 0.3 mm yr⁻¹ (1σ) before 1990 falls below previous estimates, while our estimate of 3.1 ± 1.4 mm yr⁻¹ from 1993 to 2012 is consistent with independent estimates from satellite-altimetry, leading to overall acceleration larger than previously suggested. This feature is geographically dominated by the Indian-Ocean-Southern-Pacific region marking a transition from lower than average rates before 1990 towards unprecedented high rates in recent decades. We demonstrate that VLM corrections, area-weighting, and our use of a common reference datum for tide gauges may explain the lower rates compared to earlier GMSL estimates, in approximately equal proportion. The trends and multi-decadal variability of our new GMSL curve compare well to the sum of individual contributions obtained from historical outputs of the Coupled Model Intercomparison Project Phase 5 (CMIP5). By reconciling modelled and observed GMSL change we increase confidence in process-based projections presented in the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC).