Scenario-based projections of relative sea level rise through ensemble analysis of TWS change-driven VLM

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References to projected sea level rise often cite global mean sea level (GMSL) rise, which is only an average for the entire globe. In reality, sea level is changing at highly differing rates and is strongly dependent on location. Relative sea level (RSL) refers to the sea level with respect to the land in a given region. For governments and stakeholders to make actionable policies and mitigation plans, projections of RSL rise should be continuously improved, specific to location, in order to prepare for the future. Multiple processes affect RSL rise, with the most impactful being vertical land motion (VLM). Many factors contribute to VLM itself, such as glacial isostatic adjustment (GIA) and sediment compaction. One specific contributor to VLM is changes in terrestrial water storage (TWS). Changes in TWS are analogous to an elastic loading problem: when TWS (i.e., mass) changes, part of the crust undergoes elastic deformation, therefore inducing VLM, which affects RSL when near the coast. We can calculate the VLM resulting from changes in TWS through a geophysical disk load function (Bevis et al., 2016) in MATLAB. For the input, or load (TWS), we gather a multi-model ensemble of TWS projections from global circulation models (GCMs), similar to that in Pokhrel et al. (2021). To improve TWS change projections, we calibrate the models with observational data from the Gravity Recovery and Climate Experiment (GRACE) satellite (data spanning 2002-present). Once the models are calibrated via harmonic regression, we use them as input (TWS change) to calculate VLM. Through this method we will produce a global map of coastal VLM induced by changes in TWS, projected through the rest of the 21st century. These results will develop projections of RSL rise (Fig. 1)–a crucial factor in climate change related hazard mitigation.

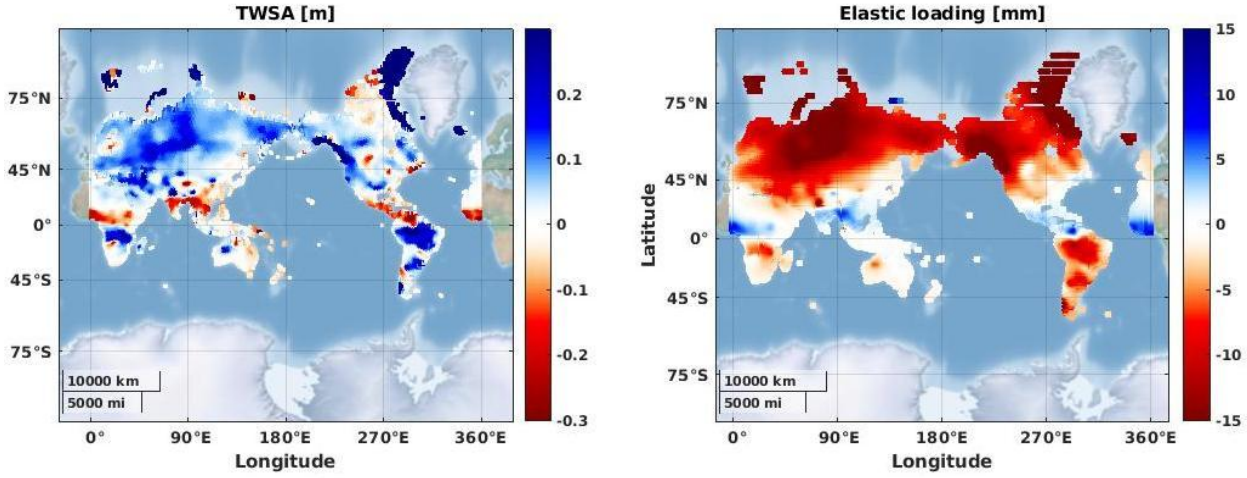

Fig. 1. Example map showing changes in TWS (TWSA) on the left in meters and elastic loading, or VLM on the right in millimeters. This is only a preliminary example based on an uncalibrated model.