EGU21-11924
https://doi.org/10.5194/egusphere-egu21-11924
EGU General Assembly 2021

How much of the decadal, coastal sea level variability can we describe by climate modes?

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It is well known that key climatic variability like the El Niño Southern Oscillation and Pacific Decadal Oscillation dominate steric sea-level variability in the Pacific Ocean and that this variability influences global- and regional-mean sea-level time series. Reducing the known internal variability from these time series reduces trend errors and can elucidate other factors including anthropogenic influence and sea-level acceleration, as has been demonstrated for the open ocean. Here we discuss the influence of key climate modes on coastal, decadal sea-level variability. For coastal stakeholders and managers it is important to understand the decadal-scale and local changes in the rate of sea-level rise in the context of internal variability in order to inform management decisions in the short- to medium-term. We use a 53-year run of a high-resolution NEMO ocean model run, forced by the DRAKKAR reanalysis atmospheric data set and with the global-mean sea level at each timestep removed, to investigate modes of decadal sea-level variability at the coast, in different basins and from different sea-level components. At more than 45% of Pacific Ocean coastal locations, greater than 50% of the decadal sea-level change can be explained by a regression of the leading principal component mode with key climate indices; ENSO in the Pacific Ocean. In different ocean basins, 18.5% to 61.0% of coastal locations have more than 33% of decadal sea-level variance explained by our climate index reconstructions. These areas include coastal regions lacking long-duration or good quality tide gauges for long-term observations such as the North-West Africa coastline. Because of the shallow depth of continental shelves, steric sea-level change propagates onto the shelf as a manometric (mass) sea-level signal. We use a set of tide gauge locations to demonstrate the internal, decadal sea-level change observed at many coasts has a substantial contribution from local, manometric signal that is driven by climate variability.