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Sea level variability at the coast: is it dominated by waves even at interdecadal time scales?

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Tide gauge records and satellite altimetry indicate that global mean sea level has risen by 16±3 cm during the 20th century. This rise is essentially due to thermal expansion of the ocean and land ice loss from glaciers and ice sheets in response to anthropogenic emissions of greenhouse gases. It is projected to continue over the 21st century and raise concerns for coastal regions. But coastal sea level variations are influenced by other processes such as tides, atmospheric surges and wave induced run-up and set-up. Here we examine the relative importance of the processes causing sea level variations at the coast over the last 23 years from observational datasets and model reanalyses focusing on coastal sites distributed along the world's coastlines for which tide gauges records are available. We show that the long term wave signal can dampen or enhance the effect of the ocean thermal expansion and land ice loss at the coast, over all time scales from subannnual to multidecadal. We estimate that the effect of waves generally explains 60%±20% of the coastal sea level variations at interannual to multidecadal time scales. In the Eastern Pacific, the wave effect dominates the total budget and counterbalances the thermal expansion of the ocean and land ice loss signals. These results highlight that the wave effect has to be taken into account in sea level predictions and projections.