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Reliability of Extreme Significant Wave Height Estimation from Satellite Altimetry and In Situ Measurements in the Coastal Zone

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Measurements of significant wave height from satellite altimeter missions are finding increasing application in investigations of wave climate, sea state variability and trends, in particular as the means to mitigate the general sparsity of in situ measurements. However, many questions remain over the suitability of altimeter data for the representation of extreme sea states and in particular applications that examine extremes in the coastal zone. In this paper, the limitations of altimeter data to estimate coastal Hs extremes (<10 km from shore) are investigated using the European Space Agency Sea State Climate Change Initiative (CCI) L2P altimeter data v1.1 product recently released. This Sea State CCI product provides near complete global coverage and a continuous record of 28 years. It is used here together with in situ data from moored wave buoys at a number of sites around the coast of the United States. The limitations of estimating extreme values based on satellite data are quantified and linked to several factors including the impact of data corruption nearshore, the influence of coastline morphology and local wave climate dynamics and the spatio-temporal sampling achieved by altimeters. The factors combine to lead to considerable underestimation of estimated Hs 10-yr return levels. Sensitivity to these factors is evaluated at specific sites, leading to recommendations about the use of satellite data to estimate extremes and their temporal evolution in coastal environments.