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Towards a methodology for estimating extreme return levels and its climate variability of coastal sea level from satellite altimetry

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The estimation of extreme water level values on coastal areas is a requirement for a wide range of engineering and coastal management applications. There are many coastal locations where there are no in-situ records or the local records cover only a few years. In this study, a novel method is proposed for the analysis of coastal extreme sea level through the use of satellite altimetry data.
Nowadays the accumulating altimeter records of several satellite missions from the 1990's offer a more than twenty-five-year extension database. Aside the well-known issue of altimeter measurements very close to the coast (e.g. corruption by land, wet troposphere path delay errors and local tide effects on the coastal area), there are other aspects that have to be considered when sea surface height values estimated from satellite are going to be used in a statistical extreme model. They are the use of an along-track and inter-calibrated multi-mission product to get long observed time periods since altimeter observations do not provide values uniform in time and space.
In this study we propose a method to estimate extreme quantiles (e.g. 50 year return period) by using a non-stationary extreme model which allows also to characterize the seasonal, interannual and long term changes climate variability of extreme sea levels.
The method consists of: (i) a pre-processing of the non-tidal residual database from the altimetry information; (ii) the selection of the satellite values within a geographic area around the coastal location; (iii) the regression of time-dependent extreme model and, finally (iv) the application of a scale coastal factor.
The scale factor depends on geographical characteristics of the coastal location, such as coastal exposure or width of the continental shelf. The methodology has been calibrated on the east US coast and has been applied and validated in other continental locations that do not have in-situ records.

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