Variability Assessment of Global Extreme Coastal Sea Levels Using Altimetry Data

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In-situ data for validation

The harmonic analysis is developed using the tidal analysis tool U-tide [1]. Although this model typically uses a total of 68 components to reconstruct the tide, here SA and SSA components are excluded. The harmonic analysis is conducted through a moving two-year time window (Figure SM1). Years with less than 60% of hourly data are not considered. Each step involves a two-year window with overlapping periods of six months at both the beginning and end, but only the central one-year period of the simulated block is stored. Finally, the astronomical tide time series is built by concatenating one-year length effective periods produced at each calculation step.

To evaluate the continuity of the resulting astronomical tide time series, the differences between the values twelve hours after and before the start of each effective period are analyzed. A warning flag is set for variations exceeding 1% of the tidal range. Warning cases have been carefully examined to confirm that the absence of discontinuities in the time series.

Following the tidal harmonic decomposition, the previously removed trend is re-added. The non-tidal residual record (NTR_{TG}) is then computed as the difference between the still water level and the astronomical tide time series.

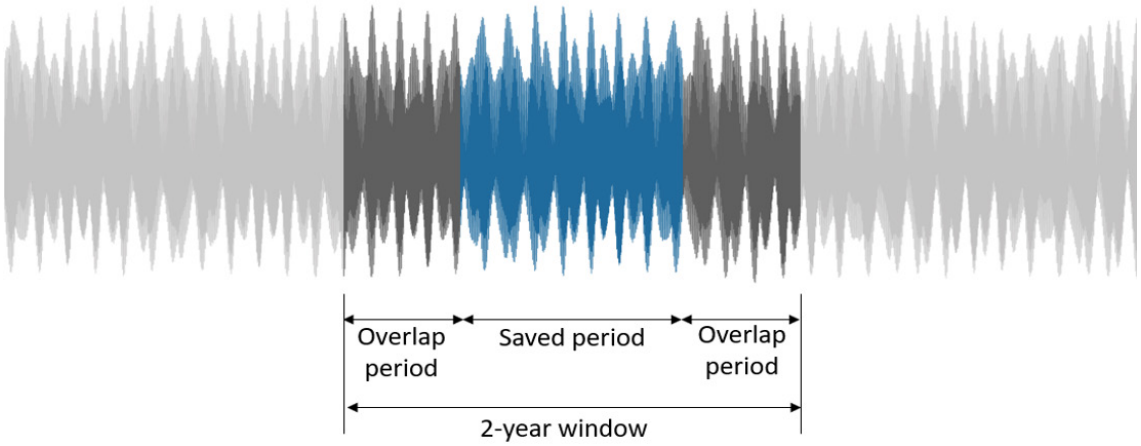

Figure S1: Harmonic analysis scheme. The effective 1-year period stored at each simulation step is represented in blue. The half-year overlapped periods are displayed in dark gray. Still water level time series is represented in light gray.

Statistical extreme model

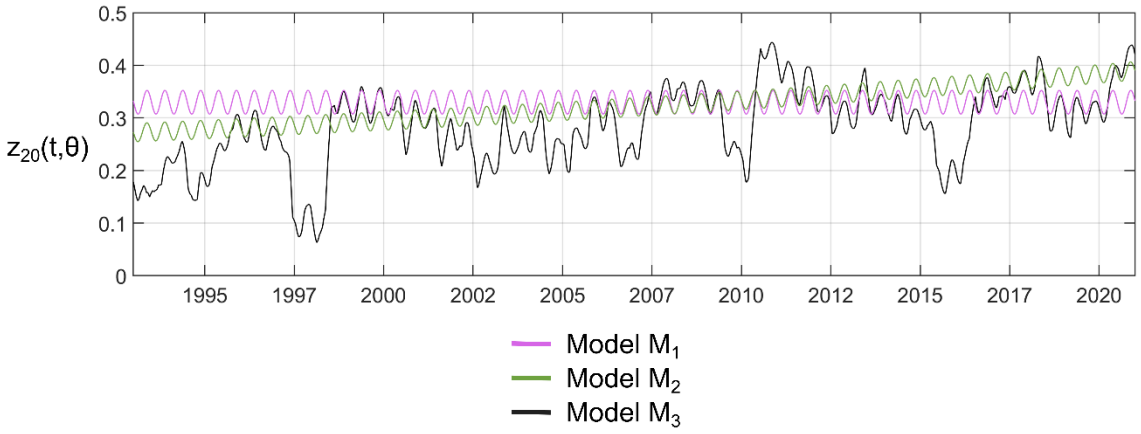

Figure S2: Evolution of 20-year return level NTR, z_{t20} , over the period of analysis at one example coastal unit. The pink, green and black lines represent z_{t20} estimated from statistical extreme model M_1, M_2 and M_3.

Selection of the validation extreme sample

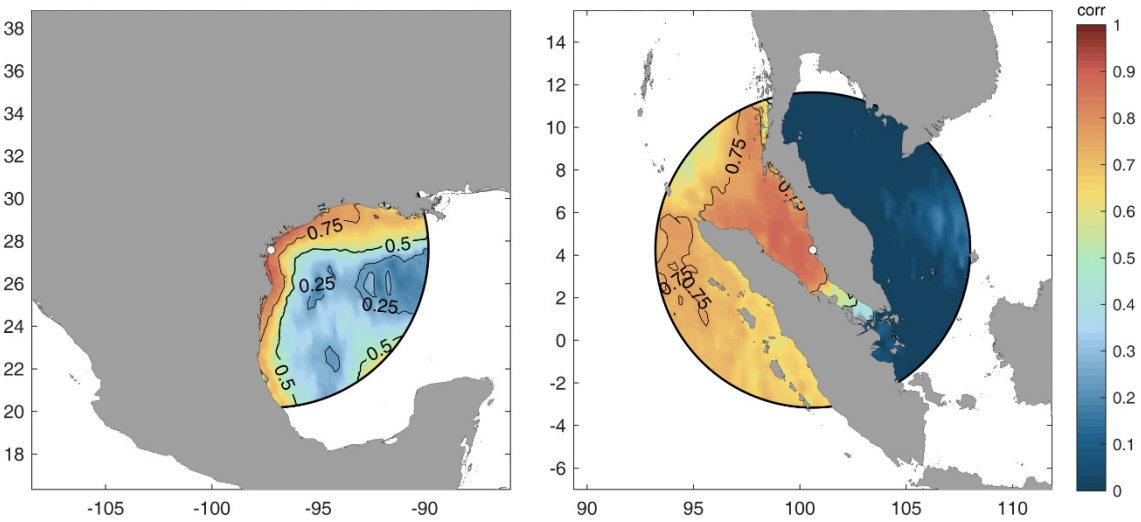

Figure S3: Pierson correlation between NTRTG and NTRSAT around the tide gauge station location for a) Corpues Cristi TG (Texas, USA) and b) Lumut TG (Malasya). The 0.25, 0.50 and 0.75 correlation contours are displayed. The location of the station is represented with a with circle.

References

1. Codiga, D.L. *Unified Tidal Analysis and Prediction Using the UTide Matlab Functions. Technical Report 2011.01*; Graduate School of Oceanography, University of Rhose Island, Narragansett, RI. 59pp, 2011;