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On the use of climate teleconnections for investigating the non-stationary dynamics of extreme significant wave height and storm surges

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Abstract

It is useful to evaluate the risk associated with coastal hazards such as coastal flooding, marine submersion and erosion. In the context of increased coastal hazards due to climate change and to the variability in storminess patterns, this risk is related to the sum of sea-level conditions, storm surges and maximum wave heights. In this study, a new statistical inference based on the use of an envelope approach is proposed. The methodology of extreme identification is based on the envelopes of real-valued signals from the signal processing perspective by the use of an Empirical Mode Decomposition (EMD) algorithm.

The interpolative envelope used for demodulating non-stationary surges, waves and their non-stationary dependence. contains the lower chirp signal component with the fault characteristic frequency and its harmonic interferences. The demodulated surges and waves, obtained from the envelope approach, cover a series of frequencies with different time-periods able to reconstruct the most variability of the original signal. This part of the work is performed in view of a subsequent non-stationary analysis to characterize extreme sea levels with a stationary and a non-stationary time-varying Generalized Extreme Value (GEV) Distribution. Climate indices have also been incorporated within the GEV parameters with the aim to link the local variability of extreme waves and surges to the global atmospheric circulation.