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# Extrapolation of extreme sea levels: incorporation of Over-Threshold-Modeling to the Joint Probability Method

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In France, the storm Xynthia of February 27-28th, 2010 reminded engineers and stakeholders of the necessity for an accurate estimation of extreme sea levels for the risk assessment in coastal areas. Traditionally, two main approaches exist for the statistical extrapolation of extreme sea levels: the direct approach performs a direct extrapolation on the sea level data, while the indirect approach carries out a separate analysis of the deterministic component (astronomical tide) and stochastic component (meteorological residual, or surge). When the tidal component is large compared with the surge one, the latter approach is known to perform better. In this approach, the statistical extrapolation is performed on the surge component then the distribution of extreme seal levels is obtained by convolution of the tide and surge distributions. This model is often referred to as the Joint Probability Method.
Different models from the univariate extreme theory have been applied in the past for extrapolating extreme surges, in particular the Annual Maxima Method (AMM) and the r-largest method. In this presentation, we apply the Peaks-Over-Threshold (POT) approach for declustering extreme surge events, coupled with the Poisson-GPD model for fitting extreme surge peaks. This methodology allows a sound estimation of both lower and upper tails of the stochastic distribution, including the estimation of the uncertainties associated to the fit by computing the confidence intervals. After convolution with the tide signal, the model yields the distribution for the whole range of possible sea level values.
Particular attention is paid to the necessary distinction between sea level values observed at a regular time step, such as hourly, and sea level events, such as those occurring during a storm. Extremal indexes for both surges and levels are thus introduced.
This methodology will be illustrated with a case study at Brest, France.