

Compound Coastal Flooding Risk in a Changing Climate in areas affected by Extra Tropical and Tropical Cyclones.

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A system for predicting stochastically flooding extents in coastal areas based on a cascade of metamodels has been built, integrating the multivariate effect of regular day conditions (Extra Tropical Cyclones) and extreme events (i.e., Tropical Cyclones, TCs). The key principles are: (a) a climate-based emulator of multivariate hourly time series of wind, rainfall, waves and water levels; (b) a system that relies on libraries of pre-run cases of a variety of numerical hydrodynamic models (e.g., SWAN, DELFT3D, XBeach, LisFlood-FP) for simulating waves, wind, overtopping, riverine flooding and coastal flooding. These libraries, coupled with state-of-the-art statistical techniques (clustering algorithms, non-linear interpolation techniques) allow to efficiently downscale hydrodynamic conditions to shore and ultimately produce inundation maps in a matter of seconds, to assess the risk faced by coastal communities and infrastructures at a range of time horizons. When applied to the past, the system allows to probabilistically study the areas more prone to flooding, while when applied to forecast conditions, both at a seasonal scale (~months) and short-term scale (~days), it improves the preparedness and minimizes the risk by the implementation of Early Warning Systems, in all cases at a very low computational effort.