Mapping of Coastal Flood Hazard at the Continental to Global-Scale

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Storm surges and high tides can cause catastrophic floods. Due to their intense wind speeds and low pressure, tropical cyclones (TCs) typically cause higher storm surges than extra-tropical storms. Climate change and socio-economic development are increasing the potential impacts of coastal floods. In this contribution, we show how a novel approach to model storm surges at the global-scale can provide important information for flood risk management

By applying a hydrodynamic approach at the global-scale, we have developed the Global Tide and Surge Reanalysis (GTSR) dataset (Muis et a., 2016). Surge levels are simulated by forcing the Global Tide and Surge Model (GTSM) with meteorological fields from ERA-Interim (Dee at al., 2011). Based on timeseries for the period 1979-2014, GTSR provides probabilities of extreme sea levels for the entire world's coastline. We evaluate the performance of GTSR dataset and demonstrate how GTSR can be applied to provide improved estimates of the number of people living in areas prone to flooding.

A severe limitation of the GTSR dataset is the fact that the probabilities of extreme sea levels in areas prone to TCs are severely underestimated. As such, the application of GTSR is limited to assessing the risk of extra-tropical storms. Due to the relatively coarse grid resolution of ERA-Interim, the strong intensities of TCs are not fully captured. Furthermore, the length of such global reanalysis datasets is too short to estimate the probabilities of extreme TC events in a reliable way. We will discuss potential ways to address this limitation, and demonstrate how to improve the global GTSR framework for the east coast of the United States. First, we obtain high-resolution meteorological forcing by applying a parametric hurricane model to the TC extended track data set (Holland 1980, Demuth et al., 2006). Second, we imrpove our sampling by statistically extend the observed record to many thousands of years (Emanuel et al. 2006). The results from the improved framework allow the development of reliable probabilities of surge levels, including extremes TC events, for the east coast of the United States.

References

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