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A new global dataset with extreme sea levels and its application for assessing flood risk

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Extreme sea levels, caused by storm surges and high tides, can have devastating societal impacts. The global coastal population is faced with an increasing trend in flood risk, induced by socio-economic development and climate change. Without action, the increasing trends in flood hazard and exposure will be associated with catastrophic flood losses in the future. The adequate allocation of global investments in adaptation requires an accurate understanding of the current and future coastal flood risk on a global-scale.

Here we present the first global reanalysis of storm surges and extreme sea levels (GTSR dataset) based on dynamical modelling. GTSR covers the entire world's coastline and consists of time series of tides and surges and estimates of extreme values for various return periods. The dataset is based on two different hydrodynamic models: FES2012 for modelling tides, and GSTM for modelling storm surges. GSTM is forced by meteorological fields from ERA-Interim to simulate storm surges for the period 1979-2014. Validation showed that there is very good agreement between modelled and observed sea levels. Only in regions prone to tropical cyclones, extreme sea levels are severely underestimated due to the limited resolution of the meteorological forcing. This will be resolved for future updates of GTSR.

As a first application of GSTR, we estimate that 99 million people are exposed to a 1 in 100 year flood. This is almost 40% lower than estimates based the DIVA dataset, another global dataset of extreme sea level. We foresee other applications in assessing impacts of climate change and risk management, such as assessing changes in storminess, estimating the impacts of sea level, and providing warning levels to operational models.