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Assessing the variability in extreme high water levels and the implications for coastal flood risk

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In this research we assess the temporal variability in the time-series of extreme water levels at 44 A- Class tide gauges around the UK. Extreme (> 99th percentile) storm tide events, sampled from water level measurements taken every 15 minutes between 1993 and 2012, were analysed at each site, and the variability in elevation relative to a given event storm tide peak was quantified. The magnitude of the variability in the time-series was found to be both spatially variable across the UK, and temporally variable relative to the time of the high water.
Boundary water levels associated with a range of event magnitudes at case study locations around the UK were used to force two-dimensional hydrodynamic models to examine the importance of storm tide time-series uncertainty to flood risk predictions. The comparison of inundation extent, depth, and number of buildings affected demonstrated the importance of accurately defining the duration and magnitude of defence exceedance. For example, given a current 1 in 200 year event magnitude at Portsmouth (UK), the predicted number of buildings inundated differed by more than 30% when contrasting simulations forced with the 5th percentile time-series relative to those forced with the 95th percentile time-series.
The results clearly indicate that variability in the time-series of the storm tide can have considerable influence upon the duration and magnitude by which defences are exceeded, hence with implications for coastal flood risk assessments. Therefore, further evaluating and representing this uncertainty in future flood risk assessments is vital, while the 5th and 95th percentile time-series defined in this research provide a tool for coastal flood modellers.
Only defence overflow-induced inundation was examined in this research. However, it is expected that variability in storm tide time-series will also have important implications on other processes of interest to flood risk, including defence failure, wave-induced overtopping, and sediment transport in the nearshore region.