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Uncertainty in coastal flooding: modelling and visualisation

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Two case studies are considered in the UK, where uncertainty and drivers of coastal flood risk are explored through modelling and visualisations. Visualising the impact of uncertainty is a useful way of explaining the potential range of predicted or simulated flood risk to both expert and non-expert stakeholders.

Significant flooding occurred in December 2013 and January 2017 at Hornsea on the UK East Coast, where storm surge levels and waves overtopped the town's coastal defences. Uncertainty in the potential coastal flooding is visualised at Hornsea due to the range of uncertainty in the 100-year return period water level and in the calculated overtopping due to 3 m waves at the defences. The range of uncertainty in the simulated flooding is visualised through flood maps, where various combinations of the uncertainties decrease or increase the simulated inundated area by 58% and 82% respectively.

Located at the mouth of the Mersey Estuary and facing the Irish Sea, New Brighton is affected by a large tidal range with potential storm surge and large waves. Uncertainty in the coastal flooding at the 100-year return period due to the combination of water levels and waves is explored through Monte-Carlo analysis and hydrodynamic modelling. Visualisation through flood maps shows that the inundation extent at New Brighton varies significantly for combined wave and surge events with a joint probability of 100 years, where the total flooded area ranges from 0 m² to 10,300 m². Waves are an important flood mechanism at New Brighton but are dependent on high water levels to impact the coastal defences and reduce the effective freeboard. The combination of waves and high-water levels at this return level not only determine the magnitude of the flood extent but also the spatial characteristics of the risk, whereby flooding of residential properties is dominated by overflow from high water levels, and commercial and leisure properties are affected by large waves that occur when the water level is relatively high at the defences.