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National scale high-resolution mapping of coastal wave overtopping risk in England and Wales

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The coastal flooding associated with the 2013-2014 UK winter storms caused widespread property damage and one fatality along the coastlines of south-west England and Wales. High spring tides and large waves combined to unexpectedly overtop coastal flood defences. The increasing risk of waves overtopping sea defences coupled with the rise in property development along the coast highlights the need for new and innovative tools for understanding coastal flood risk. Until now, broad-scale coastal hazard maps have overlooked coastal wave overtopping inundation, thereby underestimating flood risk. Recognising this gap has led to the development of the first nation-wide wave overtopping flood map for England and Wales, which we present here.

Aimed primarily at the re/insurance sector, JBA has established a methodology for rapidly modelling large-scale wave overtopping flooding. An inception study investigated a range of modelling approaches for national scale modelling and the most suitable design computed general peak wave overtopping rates representative of four separate return period events. Hydrographs were calculated to reflect the changes in the overtopping rate as a result of changes to the water levels throughout the tidal cycle. Overtopping volumes were then computed from the overtopping rates and defence polylines digitised in ArcGIS. Finally, topographically controlled inundation was simulated across a high-resolution digital terrain model using a 2D hydrodynamic flood model.

Results from the selected methodology compared well against test areas modelled in detail using additional data on bathymetry, beach profiles, and defence geometry. Sensibility checks were performed using extreme sea level value data to ensure that the model outputs were consistent with the sea level heights expected during a storm event of a particular return period. Moreover, model results corroborated well with media reports on flood extents experienced by communities during the 2013-2014 winter storms.

In total, 180 coastal communities around England and Wales have been modelled, capturing approximately 161 square kilometres of additional flooding in comparison to an existing defended coastal map where wave-overtopping is excluded. We have also identified 28 communities that would benefit from further detailed modelling using information on local conditions, including wave height, water level and defence schematisation data. It is hoped that this hazard map and improved future releases will decrease insurance and land management uncertainty, refine risk management strategies, and enhance stakeholders' understanding of overall coastal flood risk.