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Real-time modelling of defence failure and coastal inundation in the Solent

M. Wadey (1), R Nicholls (1), and C Hutton (2)

(1) (mw2p07@soton.ac.uk), School of Civil Engineering and the Environment, University of Southampton, Hampshire, UK, SO171BJ, (2) GeoData Institute, School of Geography, University of Southampton, Hampshire, UK

The aim of this work is to develop a modelling approach that can supplement existing coastal flood forecasts with specific real-time information of threatened sections of coastal defence and floodplain, and potential flood consequences.

This will be achieved by utilising assimilated water-level and wave data recorded by existing real-time offshore sensors. These measurements will underpin high resolution nearshore condition predictions generated by SWAN and MIKE-21. These models will output forecasts close to the shoreline, which will be applied to a probabilistic defence failure model. Breach scenarios and empirical wave overtopping formulae will provide flux onto the floodplain for inundation simulation using the floodplain component of the LISFLOOD-FP inundation model. Within a probabilistic framework, this output will take place as half-hourly forecasts up to 12 hours ahead of an event. The resulting data will be suitable for real-time estimation of damage, disruption and loss of life.

The Solent region (which contains the flood 'hotspot' of Portsmouth) will be used for validation and application of this model. Elementary scoping of flood risk indicates that up to 100 000 people live below a 1 in 200 year water level. The application of this model will demonstrate how exposure can be quantified in more detail by use of detailed defence data and hydraulic routing of water from specific breach and overtopping locations. Initial work has raised some interesting challenges that inevitably arise from development of a real-time model. Some of these are due to the nature of modelling defence failure in real-time – most prevalently identifying initiation and dynamics of defence failure. Others relate to the presence of other flood sources and floodplain features that occur in the study region; and may be applicable to other geographic locations. The probabilistic approach can partially justify uncertainty, but further work will include RTK GPS surveying (to improve defence crest height data); and testing by creating simulations of selected recent and historic events, and a 'worst-case' flood.

This project is one of two related PhDs which are part of the SG4E EU research project. Collaboration within and outside of the University of Southampton is directed at using this coastal-based study to demonstrate the use of real-world data, including that from sensor networks – to allow application developers to build systems for environmental management.