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Coastal Community Adaptation to Future Potential Climate Change

Thomas Prime
University of Liverpool, Environmental Sciences, Liverpoool, United Kingdom (tprime@liv.ac.uk)

This research project aims to determine the physical and economic resilience of coastal communities. This translates into identifying how such communities can adapt to potential future climate change in the most efficient cost effective way. Fleetwood in Lancashire has been chosen as a case study site, with recently refurbished sea defences. This research is interested in the best way to maintain resilience of the defences over long time horizons and against low probability high impact events as the coastal defences deteriorate.

We assess coastal flood risk using a flood inundation model called LISFLOOD-FP, this is a 2D hydrodynamic model designed to simulate flood inundation over complex topography. LISFLOOD-FP predicts water depths in each grid cell at each time step, simulating the dynamic propagation of flood waves over fluvial, coastal and estuarine floodplains. The model is forced at the boundary with an extreme water level that has a defined probability of occurring, e.g. 1 in 100 years. This is combined with a scaled surge curve for the area, a high spring tidal curve and the addition of a sea level rise parameter, which is dependent on the defined time horizon and future carbon emissions scenarios.

LISFLOOD-FP has been extended to simulate wave over-topping of sea defences, this is achieved by using a Shallow Water And Boussinesq (SWAB) 1D model which models wave over-topping of sea defences. The outputs from this model can be added into LISFLOOD as a flow of water that originates from the top of the sea defences and simulates the over topping.

The simulation has also been extended further by adding a river component. The flow within the river channel has been added into the model as a 1D vector with bed elevation and width, the river flow vector consists of a hydro-graph of a high flow event. Return period analysis will be applied to the river peaks over threshold data and the example hydro-graph can then be tailored to the peak return period flow rate.

Combining all these inputs; storm surges, rivers and waves will give the best simulation of what inundation could occur at varying levels of sea level rise, extreme water return period, wave return period and river flow rate. Preliminary results show that river flow rates do not have a big impact on coastal flood inundation area. Waves increase the impact of sea level rise due to over-topping occurring sooner, for longer, and more frequently. They will also increase the rate of deterioration of sea defences due to increased erosion rates; this will have an effect on maintaining resilience.

The flood risk maps that are produced will later be used in to perform a real options multi-objective optimisation study. This approach will find the optimal adaptive strategy for maintaining the resilience of the coastal community.