Coastal processes and flooding
From offshore waves to coastal overtopping

FRMRC2 has produced:
- Coupled regional and local wave models
- Methodology for hindcasting nearshore waves and thus predicting for climate change scenarios

Intended readership:
- Consultants
- Environment agency
- Coastal groups
- Maritime operating authorities
- Key coastal infrastructure owners

Where to find more information:
- http://www.pol.ac.uk/ntslf/model.html
- http://wiki.manchester.ac.uk/sphysics
- www.telemacsystem.com

Summary

Coastal flooding is due to run-up / overtopping, and breaching in the case of soft defences, before inundation occurs.

Before reaching coastline defences, wave height, direction, period and skewness are modified due to interactions with varying bathymetry, wind, tidal currents. Operational numerical models, usually spectral models, are routinely used for forecasting offshore wave characteristics, where waters are deeper than 30m. From these offshore data, a procedure is proposed to transfer waves toward the shore, without excessive computational time. This provides wave integrated parameters for water depths no shallower than 5m.

In the vicinity of the shoreline, wave propagation, breaking, run-up, and reflection are represented by efficient shallow-water Boussinesq models and the general particle flow solver SPHysics – an open source code.

This framework of numerical models is applied to hindcast particular events with the aim of improving predictions of coastal flooding. Inundation induced by overflowing is investigated using available shock-capturing adaptive-mesh methods.

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The framework presented within the summary is applied to the coastline of East Anglia, and is discussed in detail here:

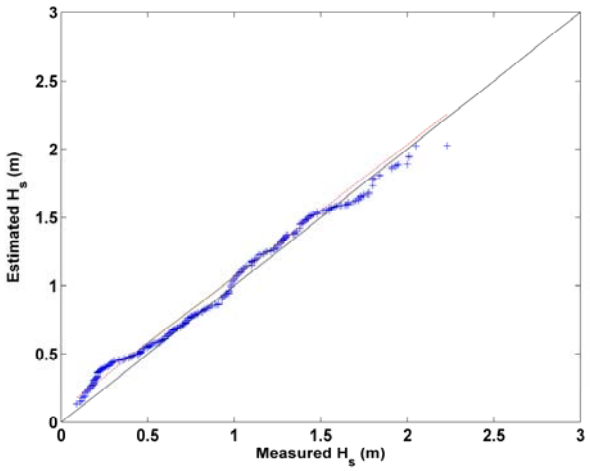
Offshore wave spectra are computed using the regional model WAM (Wave Modelling Group), suitable for deep waters.

Alongside the wave modelling, predictions of surges and tides are also provided by NOC depth-averaged shallow-water model, CS3.

Both wave and surge outputs are then used as offshore input for coastal domain models, with refined spatial resolution to capture bathymetric gradients. Up to date, only integrated wave parameters are prescribed at the offshore boundaries, assuming a JONSWAP spectrum. Waves are transferred towards the shoreline using TOMAWAC, with:

- varying water elevation due to tides and surges,
- wave energy dissipation due to breaking, and bottom friction and
- wind effects in case of extreme events.

UKCP09 climate change projections are applied over the continental shelf off East Anglia using this procedure. Estimations of wave heights, periods and directions are available along the coastline. These integrated parameters can be used as inputs for predicting beach volume evolutions, breaching, overtopping.



Comparison between measurement and the estimated nearshore wave prediction at Walcott for the years 2002-2003. Walcot was subjected to coastal flooding in November 2007 and is used as a case study.

Other sources of information

http://www.tyndall.ac.uk/

http://www.overtopping-manual.com/

http://cawcr.gov.au/bmrc/basic/wksp16/papers/Komen_waves.pdf

Research Team

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- Northern Ireland Rivers Agency

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