



Beach Profile Prediction

Use of advanced statistical techniques

FRMRC2 has produced:

- A statistical method to predict beach profiles using wave parameters, such as wave height and wave energy flux

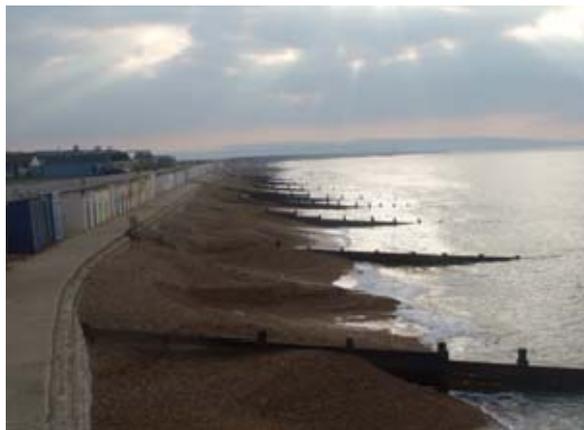
Intended readership:

- Other researchers, local authorities and consultants
- Coastal groups

Where to find more information:

- http://www.research.plymouth.ac.uk/cerg/field_of_work/flooding%20consortium.htm

Summary



Shoreline at Milford-on-Sea

This study is focussed on improving our understanding of how beaches respond to waves during storms, and how this affects the risk of flooding. Coastal flooding occurs in storm conditions typically associated with high tides and storm surge. It results from waves overtopping sea defences or the natural shoreline barrier. Severe or extended overtopping can lead to localised damage to the defence and thence to breaching, which markedly increases inundation.

The size of the waves reaching the shoreline, (and thus the amount of overtopping), is controlled by the depth of water, which is a combination of the water level and the beach level. Retaining a healthy (high) beach is one means of reducing the wave heights. If done carefully, it may also mean less intrusive structures at the shoreline. Indeed, some of the newer flood defence schemes being constructed around the UK use this principle to good effect. Examples of this are the detached breakwater scheme at Sea Palling in Norfolk (bottom left) and the oblique detached breakwater scheme at Sidmouth (bottom right).





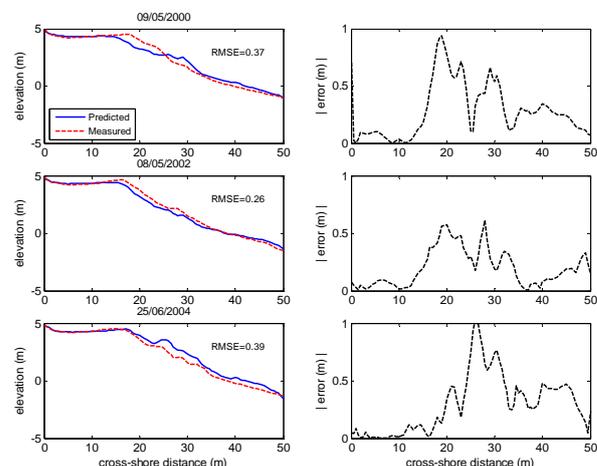
By understanding the relationships between the beach shape and the prevailing wave conditions, beach material and structures; it will be possible to quantify the uncertainty in the beach level. This will feed into the uncertainty in water depths during storms and thus into the estimates of the amount of overtopping that will occur. Using advanced statistical techniques on datasets from around the world the team at Plymouth are working on unravelling these complex relationships.

One of these advanced statistical techniques is Canonical Correlation Analysis which can be used to investigate the intercorrelation between two sets of variables. Based on the correlation between the dominant patterns in the profile and wave data established by the CCA, a regression matrix may be derived that relates the profiles to the wave properties. This means, if the wave properties are known, the profile response may be predicted by using the regression matrix. Further, if wave properties can be forecast then these forecast waves can be used to predict future beach profiles on the basis of the CCA regression.

This method has been used in the Field Research Facility in Duck, NC (USA), New Forest District Council, Herne Bay and Walcott (UK) to forecast beach changes over eight years into the future.

The use of alternative wave distribution functions, such as an empirical distribution or the Beta - Rayleigh distribution can improve the prediction of profile response.

The figure below shows comparisons between the prediction and measured beach profile at Milford-on-Sea, and the corresponding absolute error across the profile.



Other sources of information

FRMRC web site: <http://www.floodrisk.org.uk/>

Publications:

J-M Horrillo-Caraballo & D E Reeve, in press, *Marine Geology*,

J-M Horrillo-Caraballo & D E Reeve, *J Flood Risk Management*, Vol 1(2), p110-122, 2008.

J-M Horrillo-Caraballo & D E Reeve, *Marine Geology*, Vol 254, p91-106, 2008.

Research Team

This work is being undertaken by The University of Plymouth with Prof. Dominic Reeve as team leader and Dr. Jose M. Horrillo-Caraballo as a Post-Doctoral Research Fellow

FRMRC is an interdisciplinary research consortium made up of partners from universities, government bodies and practitioners supported by:

- Engineering and Physical Sciences Research Council
- Department of Environment, Food and Rural Affairs/Environment Agency Joint Research Programme
- United Kingdom Water Industry Research
- Office of Public Works Dublin
- Northern Ireland Rivers Agency

Data were provided by the Environment Agency and the Ordnance Survey.