Geophysical Research Abstracts
Vol. 13, EGU2011-4561, 2011
EGU General Assembly 2011

The use of probabilistic techniques in the evaluation of storm surge hazard and risk.

Michael Whitworth (1,2)

(1) School of Geography Earth and Environmental Sciences, University of Plymouth, Plymouth UK (michael.whitworth@plymouth.ac.uk), (2) URS/Scottwilson, Plymouth, UK.

The results are presented of research into the applicability of different probabilistic techniques in the evaluation of storm surge return periods. The evaluation of storm surge extremes is of critical importance to engineers and planners when evaluating areas likely to be inundated from coastal flood events. This study utilises the longest observed tidal gauge record for the U.K (Newlyn-95 year record) and a shorter less homogeneous dataset at the nearby Devonport (40 year record) tide gauge station. The research analyses the suitability of different techniques and the effect the different predictions have on the overall level of hazard and risk to south-west England.

Typical probabilistic techniques employ methodology that utilise either the annual maximum (i.e. Generalized Extreme Value (GEV)) or a number of r values (i.e. r-largest or peak over threshold) from observed tidal records. More recently techniques have been applied to the full recorded dataset (i.e. Joint Probability). Within this study the GEV, r-largest and Joint Probability techniques were analysed for both the observed tidal record and the extracted storm surge component. Initially, the complete dataset was analysed, followed by a subset of each dataset (5, 10 and 20 years). For the joint probability technique, an analysis was completed for one year of the data. These were then compared back to the prediction made for the full data set. In addition to the above analysis, the r-largest technique was evaluated for the effect the chosen ‘r’ value has on the overall prediction.

The storm-surge predictions show that the choice of ‘r’ (either 10, 5 or 2) has little affect on the overall storm surge level (<0.05 m). However, the choice of the subset of data is of greater significance. Different 5 year subsets gave a difference of 0.45 m and different 10 year subsets gave a 0.2 m difference. Furthermore, it was found that as the number of years within the subset increased, the predictions became closer to the prediction made for the complete data set. A comparison between the predictions made for the r-largest and the GEV gave a good comparison for all subsets of data, with the predictions made for the complete data set being within 0.1 m. The findings for the Newlyn and Devonport datasets, and between the observed level and the extracted storm surge component predictions, showed the same trend in predictions and differences. It was found that both predictions for the r-largest and GEV were controlled by the highest astronomical tide, with higher return period predictions barely exceeding this level. The Joint probability methodology was not dependent on the subset of data, little difference (<0.1 m) was observed in the predictions made for different subsets of the data (1, 5, 10 and 20 years). However, when compared to the GEV and r-largest it was found to under-predict for all return periods, by as much as 0.8m.

This study indicates that the r-largest is not dependent on the number of ‘r’ values chosen, but that both the GEV and r-largest are dependent on the subset of data chosen rather than the number of years within the subset. Contrary to previous research the GEV was able to predict with as little as 5 years of data. Both the GEV and r-largest predictions that utilised the observed level were found to be dependent on the tidal component with predictions barely exceeding the highest astronomical tide. Although the Joint Probability was consistent for al subsets of data, it was found to significantly underestimate the storm surge level. A comparison with the results for Newlyn and Devonport shows that despite a less homogeneous data set the Devonport data provides consistent results and thus, the predictions are not dependent on having a homogeneous data set.

In conclusion, Extreme Value Theory is a useful tool in storm surge prediction but we caution that the choice of prediction methodology and the length of data set could significantly affect the overall prediction and thus the subsequent evaluation of hazard and risk.