Spatial and temporal models for synthetic oceanographic extremes

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Climatologists, meteorologists and oceanographers routinely study the outputs from complex deterministic models for geophysical systems. Model runs are used both for operational forecasting, and in order to assess long-term trends in system behaviour. In particular, model runs are frequently used to study the characteristics of extreme events, for which observational data are sparse or non-existent. Simple summary statistics do not adequately characterise the properties of extreme events, however, and cannot account for the effects of natural variability. A more rigorous statistical approach to the analysis of model output is therefore required.

In this talk we treat the output from a (deterministic) hydrodynamical model as data, and use statistical methods from extreme value theory to investigate changes in extreme sea surge levels in the North Sea over the period 1955-2000. We use parametric and nonparametric methods to search for temporal trends in storm surge behaviour, and then use bootstrap techniques to quantify the uncertainties involved in trend estimation. We find strong evidence for increasing trends in both the frequency and magnitude of storm surge events in an area around the Scottish coast, but find little evidence for long-term trends in storm surge behaviour throughout the southern and eastern parts of the North Sea (the areas most susceptible to coastal flooding). Finally, we show how our estimates of temporal trend can be made more precise by the incorporation of spatial information.