Geophysical Research Abstracts
Vol. 13, EGU2011-8854, 2011
EGU General Assembly 2011

Understanding spatial and temporal dependencies in flood risk exposure in the UK

Linda Speight (1), Jim Hall (1), Chris Kilsby (1), and Paul Kershaw (2)

(1) Newcastle University, Civil Engineering and Geosciences, Newcastle Upon Tyne, United Kingdom (linda.speight@ncl.ac.uk), (2) Catlin, 3 Minster Court, Mincing Lane, London, United Kingdom

In the UK flooding represents a major natural catastrophe risk. The Environment Agency estimates that one in six houses in England and Wales are at risk of flooding, therefore when large events occur the consequences can be catastrophic. For example the widespread floods in the summer of 2007 cost the UK economy over £3 billion and caused the loss of 13 lives. This is a particular concern for insurance companies who need to be able to accurately model and understand flood risk to continue to provide insurance cover to property owners.

The standard means of assessing risk is through Catastrophe (Cat) models. These are complex process based models which use a mixture of numerical and statistical methods to provide estimates of expected losses. The disadvantage of Cat models is that due to their complexity, and commercial sensitivity surrounding their components, it is often difficult for the end user to fully understand the underlying processes and hence to make informed risk management decisions.

Illustrating a successful collaboration between academia and the insurance industry we use a case study of one company's exposure to demonstrate a methodology for flood risk assessment at multiple sites nested within a national framework. This nested approach allows for greater detail to be included at sites of interest and hence results in increased understanding of the risk driving processes. Following a source-pathway-receptor approach, a mixture of statistical and physically based methods is used in a systems based model incorporating the most important random processes associated with flood damage. Within the system, meteorological inputs are modelled statistically; floodplain inundation and damage calculations are deterministic; and the consideration of flood defence failure is probabilistic.

The statistical model of extreme events uses the conditional dependence model of Heffernan and Tawn (2004). Flows at all gauges in a network are simulated conditional on one gauge being above a specified threshold. The model is fitted over a range of time periods allowing for consideration of temporal dependencies, for example in the travel time of a storm event across the UK or due to lags as a flood peak passes through a river system. Due to the requirement for concurrent data across the network, the model is fitted to daily mean flow. This necessitates the use of a conversion method to transfer the simulated daily mean flows into peak flows for input to the floodplain inundation model.

The methodology explicitly couples spatial and temporal dependencies at multiple scales. Through the statistical model of event occurrences we are able to simulate local and widespread events allowing explicit consideration of the spatial distribution of flood events and the probability of events affecting large geographical areas. We also include consideration of the dependencies in flood risk at local scales through detailed consideration of flood defence systems and failure mechanisms, including a new methodology to incorporate spatial variation in defence properties. Results will be presented illustrating the importance of incorporating spatial and temporal dependencies into flood risk modelling.

The output from the modelling process is greater understanding of risk, and the associated uncertainties, which can be used to inform decision making. For insurance companies this may involve changing pricing policies, implementing requirements for mitigation measures or investing in further analysis. Outside of the insurance industry, the proposed methodology can be used to assess risk to any spatially distributed receptor and hence can be used in a wide range of risk management processes involving spatial and temporal considerations.

Heffernan, J. E. and J. A. Tawn (2004). A conditional approach for multivariate extreme values. *J.R.Statist.Soc.B* **66**: 497-530.