FAST MOVING FRONTS - 2009

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Hayley J. Fowler & Marie Ekström talk with *ScienceWatch.com* and answer a few questions about this month's Fast Moving Front in the field of Geosciences.

Article: New estimates of future changes in extreme rainfall across the UK using regional climate model integrations. 1. Assessment of control climate
Authors: Fowler, HJ;Ekstrom, M;Kilsby, CG;Jones, PD
Journal: J HYDROL, 300 (1-4): 212-233, JAN 10 2005
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(addresses have been truncated)

SW: Why do you think your paper is highly cited?

We believe that this paper and its companion paper, "New estimates of future changes in extreme rainfall across the UK using regional climate model integrations. 2. Future estimates and use in impact studies," (Ekström M, *et al.*, *Journal of Hydrology*, 300[1-4], 234-51, 2005), have been highly cited due to a combination of the popularity of the topic (i.e., climate extremes) and the fact that the extreme value and regional frequency analysis methodology used within the paper is well-described and can easily be repeated by other researchers for other regions, using different regional climate models.

It is, to our knowledge, one of the first examples of the use of regional frequency analysis in extreme value analysis to provide more reliable estimates of high return period rainfall events, particularly using pooling of regional climate model information. This method allows more accurate assessment of changes to rare events.

SW: Does it describe a new discovery, methodology, or synthesis of knowledge?

The paper draws together methodologies from the fields of hydrology and climatology. It is a pragmatic paper where methodologies commonly applied within hydrological research (i.e., regional frequency analysis and extreme value theory) are applied within a climatological framework where, more frequently, methods such as percentiles have been used to describe changes to extremes.

SW: Would you summarize the significance of your paper in layman's terms?

One of the few options available to climate scientists, in terms of studying

the impact of future climate change on rainfall, is to use climate models. However, climate models are not perfect representations of the real climate and therefore, despite their complexity, the climate models need to be evaluated so that we can identify how well they are performing.

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To assess the performance of the models, we can compare patterns in space and time of observed rainfall, with the patterns estimated by the climate model for current climate conditions. In this paper we have studied how a particular climate model, HadRM3H, represents extreme rainfall in different regions of the UK. In our paper we show that the climate model does indeed capture the expected observed magnitudes of rainfall extremes for large parts of the UK. This is an important validation of the climate model's ability to simulate extreme rainfall and a necessary requirement if we want to use the climate model to investigate how rainfall may change under future climate conditions which we published in the companion paper (Ekström M, *et al.*, 2005).

This has been used in interim policy guidance on Flood and Coastal Defence Appraisal by the UK Government Department for Environment, Food and Rural Affairs (DEFRA) to produce new indicative sensitivity ranges for peak rainfall intensity. The study was also cited by the Intergovernmental Panel on Climate Change's 4th Assessment Report in 2007.

SW: How did you become involved in this research and were any particular problems encountered along the way?

This research was conducted under a European project called SWURVE (Sustainable Water Uncertainty, Risk and Vulnerability in Europe) funded by the 5th Framework Programme. It is a natural extension of previous research by Fowler HJ and Kilsby CG, "A regional frequency analysis of United Kingdom extreme rainfall from 1961 to 2000," (*International Journal of Climatology*, 23[11], 1313-34, 200) and Fowler HJ and Kilsby CG, "Implications of changes in seasonal and annual extreme rainfall," (*Geophysical Research Letters*, 30[13], 1720, 2003).

"Although climate models do not provide predictions for the future, they provide scenarios under which users can test their infrastructure system (e.g., water supply, storm drainage network, etc.) and optimize their robustness and preparedness for different possible futures under climate

These papers were the first applications of regional frequency analysis to examine changes in observed extreme rainfall, providing the first evidence of statistically significant changes to UK extreme rainfall during the 1990s which may be a result of global warming. The natural extension of this work was to apply the same methodologies to examine whether climate models were able to simulate realistic extreme rainfall and to estimate the potential changes in extreme rainfall over the long term for management under climate change.

It should be noted that climate models are simplifications of the real climate and therefore models provide a "model climate projection" and not a real future climate or "prediction." As different climate modelling groups use different ways of creating their models (in terms of representing the physics and chemistry—we call these "parameterizations"), the models will give different results. Because there is no definitive "climate model," it is difficult to say that one model is better than another. Therefore we need to consider results from many different models to ensure that we aren't providing a biased result in terms of representing the future climate.

The difficulty lies in representing the uncertainty or the range of results from different models in a sensible way. Are all models equally likely or are some better than others and how can we tell? These are large questions which we have continued to work on in our more recent research.

SW: Where do you see your research leading in the future?

Climate model intercomparison studies that don't attempt to elucidate the reasons/ causes for inter-model differences are outdated. Future work on deriving rainfall estimates—extremes or otherwise—need to encompass a greater understanding of the physical causes. We know that different models give different results, but now we need to investigate why this is the case so that we can start to reduce/understand the uncertainty in the differences between models and thus, our estimates of future changes.

SW: Do you foresee any social or political implications for your research?

This research has already been used in interim policy guidance on "Flood and

change."

Coastal Defence Appraisal by the UK Government Department for Environment, Food and Rural Affairs within the UK." The issue of changing extremes of weather is highly politicized and has huge implications for social systems through changing community resilience.

Climate extremes happen now and will continue to occur in the future, perhaps with even greater frequency. Flooding and the sustainable use of water is not just a problem for future climates; it exists now in many parts of the world. Any tools that can help organizations or governments to plan for and adapt to possible future changes to already overstretched resources are urgently required.

Although climate models do not provide predictions for the future, they provide scenarios under which users can test their infrastructure system (e.g., water supply, storm drainage network, etc.) and optimize their robustness and preparedness for different possible futures under climate change.

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