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Stochastic downscaling of climate model outputs for continuous hydrological simulation

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There is increasing recognition that, in hydrological problems such as flood risk assessment and management, it is desirable to simulate catchment processes over extended time periods. Such 'continuous simulation' requires the ability to generate long sequences of rainfall data, at an appropriate spatial and temporal scale, for input to hydrological models of catchment response. Moreover, for medium and long term planning it is necessary to account for climate change. This talk will describe research at UCL and at Imperial College London, which aims to provide the UK with a national capability for the generation of future rainfall sequences at daily and subdaily time scales. The methodology exploits information from numerical climate models, while recognising that there are questions regarding the ability of these models to represent rainfall at scales of hydrological relevance. The work falls into two parts. First, generalized linear models (GLMs) are used to parameterise relationships between observed daily raingauge data and large-scale atmospheric variables that are represented reasonably well by the climate models. It is shown that GLM simulations are able to reproduce closely the properties of historical rainfall sequences, including measures of interannual variability and extremes. In the second stage, relationships are identified between rainfall properties at different temporal scales; these relationships appear invariant over a wide range of different climatic conditions (represented by different months of the year and different locations), and hence enable the properties of subdaily rainfall sequences to be deduced from those of daily sequences in an altered climate that is "not too dissimilar" to that of the present day. By conditioning GLM simulations on the results of future climate model runs, properties of future daily rainfall sequences can be deduced. The invariant scaling relationships then provide the

corresponding subdaily properties, which can be used to parameterise stochastic models for subdaily rainfall. The methodology is illustrated using raingauge data from the UK, along with the outputs from several climate models.