Geophysical Research Abstracts
Vol. 19, EGU2017-8914, 2017
EGU General Assembly 2017

Assessment of the spatial scaling behaviour of floods in the United Kingdom

Giuseppe Formetta, Elizabeth Stewart, and Victoria Bell
Centre for Ecology and Hydrology, Wallingford,UK, giufor@ceh.ac.uk

Floods are among the most dangerous natural hazards, causing loss of life and significant damage to private and public property. Regional flood-frequency analysis (FFA) methods are essential tools to assess the flood hazard and plan interventions for its mitigation. FFA methods are often based on the well-known index flood method that assumes the invariance of the coefficient of variation of floods with drainage area. This assumption is equivalent to the simple scaling or self-similarity assumption for peak floods, i.e. their spatial structure remains similar in a particular, relatively simple, way to itself over a range of scales. Spatial scaling of floods has been evaluated at national scale for different countries such as Canada, USA, and Australia. According our knowledge. Such a study has not been conducted for the United Kingdom even though the standard FFA method there is based on the index flood assumption.

In this work we present an integrated approach to assess of the spatial scaling behaviour of floods in the United Kingdom using three different methods: product moments (PM), probability weighted moments (PWM), and quantile analysis (QA). We analyse both instantaneous and daily annual observed maximum floods and performed our analysis both across the entire country and in its sub-climatic regions as defined in the Flood Studies Report (NERC, 1975). To evaluate the relationship between the k-th moments or quantiles and the drainage area we used both regression with area alone and multiple regression considering other explanatory variables to account for the geomorphology, amount of rainfall, and soil type of the catchments. The latter multiple regression approach was only recently demonstrated being more robust than the traditional regression with area alone that can lead to biased estimates of scaling exponents and misinterpretation of spatial scaling behaviour.

We tested our framework on almost 600 rural catchments in UK considered as entire region and split in 11 sub-regions with 50 catchments per region on average. Preliminary results from the three different spatial scaling methods are generally in agreement and indicate that: i) only some of the peak flow variability is explained by area alone (approximately 50% for the entire country and ranging between the 40% and 70% for the sub-regions); ii) this percentage increases to 90% for the entire country and ranges between 80% and 95% for the sub-regions when the multiple regression is used; iii) the simple scaling hypothesis holds in all sub-regions with the exception of weak multi-scaling found in the regions 2 (North), and 5 and 6 (South East). We hypothesize that these deviations can be explained by heterogeneity in large scale precipitation and by the influence of the soil type (predominantly chalk) on the flood formation process in regions 5 and 6.