Geophysical Research Abstracts,
Vol. 11, EGU2009-11806, 2009
EGU General Assembly 2009
© Author(s) 2009

Exploring the Feasibility of Recovering Statistical Properties of Runoff from the Scaling Statistics of Peak Flows

P. Mandapaka, R. Mantilla, and W.F. Krajewski

The University of Iowa, IIHR-Hydroscience & Engineering, Iowa City, Iowa, United States (witold-krajewski@uiowa.edu)

Recent studies have revealed the existence of power laws, or scaling, in the magnitude of peak flows for individual rainfall-runoff events. These findings offer a new theoretical framework to understand the physical basis of power laws in annual flood quantiles with respect to basin areas (representing spatial scale) that arise in regional statistical analyses. Research in the last decade has shown that, under idealized conditions of the runoff production field, statistical simple scaling (power laws) of peak flows emerge as a consequence of the self-similar river network that controls aggregation and attenuation of water flow in the landscape. The idealized conditions of the space-time runoff field include uniform fields, statistically iid fields (e.g. white noise), and multi-fractal cascades (e.g. log-normal cascades). These idealized scenarios are motivated by our current understanding of the space-time distribution of rainfall fields, however, runoff production in the surface is controlled by complex processes that vary across the landscape. These include the spatial distribution of vegetation, impervious zones, soil and land-cover types, interactions of surface and ground water and antecedent soil moisture conditions. These highly variable spatial processes can break statistical symmetries observed in rainfall fields. In an attempt to better understand how the statistics of the space-time runoff production field are reflected in the spatial distribution of peak flows and times to peak, we perform numerical simulations in which the runoff field is represented by complex space-temporal fields that include spatial correlations, intermittency, and network dependent correlations. Our results provide a framework to understand how different statistical properties of the runoff field can be inferred from multi-scale streamflow observations. These numerical experiments are helping us to interpret multi-scale streamflow data measured in Whitewater, KS basin as part of the ongoing Hydro-Kansas project. Finally, our results lend further support to the hypothesis that multi-scale observations of streamflow coupled with novel statistical data analysis leads to better (in the sense of uniqueness) understanding of basin internal dynamics.