Estimation of flood peak frequencies at river confluences

Alberto Viglione (1), Günter Blöschl (1), Murugesu Sivapalan (2), and Bruce Rhoads (3)

(1) Technische Universität Wien, Institut für Wasserbau und Ingenieurhydrologie, Wien, Austria
(viglione@hydro.tuwien.ac.at), (2) University of Illinois, Civil and Environmental Engineering, Urbana-Champaign, USA, (3)
University of Illinois, Department of Geography, Urbana-Champaign, USA

The estimation of flood peak frequencies at river confluences is a hitherto unsolved problem that impacts the design of bridges and flood control structures located near the junction of two (or more) streams. Since floods at the confluences are determined by high flows from either streams or both, it is important to know the relationship between the coincident exceedence probabilities on the confluent streams. The problem is therefore twofold: (1) how are the flood peak occurrences in the upstream streams related? (2) how does the upstream peaks combine to produce the flood peak after the confluence? We use here a downward approach where flow data at (up- and downstream) confluences of several river in Illinois (USA) and Austria are collected and coincident events are identified and analysed. The first issue is investigated statistically through Copulas in order to formulate joint probability distributions for the coincident flows at the upstream rivers. For the second issue, simple relationships involving controlling factors (e.g., catchments size, climate, . . .) are sought to express the peak flow at the confluence point as a function of the peak flows of the upstream tributaries. The theoretical value of the analysis is to understand how flood peaks and their probabilities combine at confluences and what are the major controls on it. The practical value is to provide means to assist/enhance regional flood frequency analyses, i.e. to use the information on data dependency to improve flood peak estimation in ungauged catchments rather than considering it as a problem when pooling regional data.