Causal mechanism of extremes on a river network

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Abstract

Extreme hydrological events may severely impact human populations, aquatic organisms, and economic activity. One often characterizes the joint structure of the extreme events using the theory of multivariate and spatial extremes and its asymptotically justified models. There is interest however in cascading extreme events and whether one event causes another. In this work, we argue that an improved understanding of the mechanism underlying severe events is achieved by combining extreme value modelling and causal discovery. We construct a causal inference method relying on the notion of the Kolmogorov complexity of extreme conditional quantiles. Tail quantities are derived using multivariate extreme value models and causal-induced asymmetries in the data are explored through the minimum description length principle. Our approach uncovers causal relations between summer extreme river discharges in the upper Danube basin and finds significant causal links between the Danube and its Alpine tributary Lech. This is a joint work with Linda Mhalla and Debbie Dupuis.

Keywords: Extreme river discharges, Causality, Extremal dependance, Extreme value copula.

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