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Dra. Daniela Castro

KING ABDULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

LOCAL LIKELIHOOD ESTIMATION OF COMPLEX TAIL DEPENDENCE STRUCTURES, APPLIED TO U.S. PRECIPITATION EXTREMES

To model the complex non-stationary dependence structure of precipitation extremes over the entire contiguous U.S., we propose a flexible local approach based on factor copula models. Our sub-asymptotic spatial modeling framework yields non-trivial tail dependence structures, with a weakening dependence strength as events become more extreme, a feature commonly observed with precipitation data but not accounted for in classical asymptotic extreme-value models. To estimate the local extremal behavior, we fit the proposed model in small regional neighborhoods to high threshold exceedances, under the assumption of local stationarity. This allows us to gain in flexibility while making inference for such a large and complex dataset feasible. Adopting a local censored likelihood approach, inference is made on a fine spatial grid, and local estimation is performed by taking advantage of distributed computing resources and the embarrassingly parallel nature of this estimation procedure. The local model is efficiently fitted at all grid points, and uncertainty is measured using a block bootstrap procedure. An extensive simulation study shows that our approach can adequately capture complex, non-stationary dependencies, while our study of U.S. winter precipitation data reveals interesting differences in local tail structures over space, which has important implications on regional risk assessment of extreme precipitation events.

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