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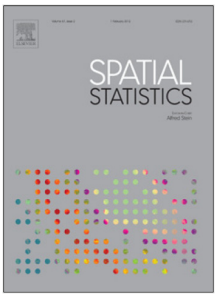

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Bridging Asymptotic Independence and Dependence in Spatial Extremes Using Gaussian Scale Mixtures

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Abstract

Gaussian scale mixtures are constructed as Gaussian processes with a random variance. They have non-Gaussian marginals and can exhibit asymptotic dependence unlike Gaussian processes, which are asymptotically independent except in the case of perfect dependence. In this paper, we study the extremal dependence properties of Gaussian scale mixtures and we unify and extend general results on their joint tail decay rates in both asymptotic dependence and independence cases. Motivated by the analysis of spatial extremes, we propose flexible yet parsimonious parametric copula models that smoothly interpolate from asymptotic dependence to independence and include the Gaussian dependence as a special case. We show how these new models can be fitted to high threshold exceedances using a censored likelihood approach, and we demonstrate that they provide valuable information about tail characteristics. In particular, by borrowing strength across locations, our parametric model-based approach can also be used to provide evidence for or against either asymptotic dependence class, hence complementing information given at an exploratory stage by the widely used nonparametric or parametric estimates of the χ and $\overline{\chi}$ coefficients. We demonstrate the capacity of our methodology by adequately capturing the extremal properties of wind speed data collected in the Pacific Northwest, US.

Keywords: asymptotic dependence and independence; censored likelihood inference; spatial copula; extreme event; random scale model; threshold exceedance.

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