

Bayesian Hierarchical Spatial-temporal Models

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Spatial-temporal processes are prevalent especially in environmental sciences where, under most circumstances, the processes are non-stationary in time so that their temporal-variability must be captured in traditional spatial models for better estimation and prediction. We propose a Bayesian hierarchical spatial-temporal model to describe the dependence of extreme data on spatial locations as well as temporal effects. The first layer of the hierarchical model specifies a measurement process for the observed extreme data. The second layer characterizes the latent spatial process and temporal process. The hierarchical formulation concludes with a third layer of priors on parameters. A key idea is to model spatial and temporal dependence simultaneously. Statistical inference is performed by Markov chain Monte Carlo methods which involve filtering and smoothing of parameters. The methodology is applied to simulated data and real environmental data.

Keywords: Bayesian analysis; environmental data; hierarchical models; spatial-temporal processes.