A Spatial Bayesian Hierarchical Modeling Approach for Precipitation Extremes

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Abstract. We present a spatial Bayesian hierarchical model for seasonal extreme precipitation. At the first level of hierarchy, the seasonal maximum precipitation (i.e. block maxima) at any location is assumed to be from generalized extreme value (GEV) distribution. At the second level the spatial dependence is captured via spatial processes on the GEV scale and location parameters. Gaussian predictive processes are used to efficiently incorporate a large number of observation locations, which is a novel addition. With suitable priors and using Markov Chain Monte Carolo (MCMC) the posterior distribution of the GEV parameters are obtained at any spatial location and consequently the return levels maps and the attendant uncertainty. This approach is applied to model the seasonal maximum precipitation return levels for the western United States, a region with widely varying terrain and climate influences. A separate model is developed for each season to capture the unique spatial features prevalent in the precipitation field. This modeling framework offers a flexible approach to incorporate covariates such as large scale climate features to model non-stationarity, which will be interesting extensions.