

# Producing a Precipitation Return Levels Map

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Quantification of extreme values is important for planning purposes. To aid with the understanding of potential flooding along Colorado's Front Range, we are developing a map of precipitation return levels for the region.

We model daily precipitation above a high threshold at 56 weather stations throughout the region with the generalized Pareto distribution (GPD). Each station's GPD parameters are modeled within a Bayesian hierarchical structure which allows us to pool the data from all the stations. GPD parameter estimates also take into account geographical covariates such as elevation or mean annual precipitation. This strategy yields parameter and return-level estimates which have more spatial consistency. The Bayesian model allows us to estimate the spatial structure between the parameters at each station, and once the spatial structure is estimated, it is used to interpolate over the entire region. These region-wide parameter estimates can then be converted into the desired return levels.

Model inference is obtained using a straightforward MCMC algorithm, through which draws for the posterior distribution are obtained. These draws yield a natural method for obtaining uncertainty estimates for the precipitation return levels.

The flexibility of the Bayesian hierarchical structure allows us to test different models which can be compared. The model testing and comparison process provides meteorologists insight into how extreme precipitation behaves in Colorado.