The use of probabilistic downscaling in relating local-scale extreme events to large-scale meteorological conditions

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Statistical downscaling in meteorological applications is often used to develop a direct relationship between large- and local-scale meteorological conditions. However, these direct approaches often suffer from various caveats, such as over-emphasis on the relationship between the large- and local-scales, requirements of variance inflation, or misrepresentation of extreme events. Instead of downscaling directly from large-scale conditions to a single local-scale value, we have developed a downscaling methodology that uses large-scale predictors to predict the parameters of the distribution of local-scale values. That is, we produce a probability density function (PDF) for every day in the input large-scale timeseries that represents the range of possible local-scale values of the given variable that could have occurred, given each day's large-scale conditions.

A benefit of downscaling to a PDF, in addition to maintaining information on the variance as well as the mean, is the flexibility in the uses of the downscaled dataset. One advantage of this technique is that it allows a quantification of the probability of an "extreme" event for every day. As a result, relationships between large-scale flow and local-scale extreme events can be investigated without being overly constrained by limited sample size. Examples of how the probability distribution can be used to relate extreme temperature and precipitation events to large-scale conditions will be presented.