Spatial Modeling of Drought Using Artificial Neural Networks

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Periods of severe drought place tremendous stress on forests and other vegetative communities. Such events typically occur across a broad spatial scale with some degree of local variability. Assessing this local variability can play a key role in understanding the specific impacts of drought events on forest health; however, we seldom have spatially explicit measurements of environmental conditions in forests. While remote sensing is one means of assessing the spatial extent and variability of environmental conditions, it is often difficult to put such measurements in a historical context as the period of record is so short.

Many places around the world have long time series of routine weather observations (temperature and precipitation) that could be useful in evaluating historic drought conditions. This network of observing stations is very irregular with high concentrations of weather stations near heavily populated areas and relatively few in remote forested areas. The key to using this irregular network of observations to examine spatial patterns in drought is the method of spatial interpolation. Artificial Neural Networks (ANNs) provide a highly adaptive nonlinear method for performing this spatial interpolation.

In this study, an ANN is constructed to spatially interpolate temperature and precipitation. Network inputs include location (latitude and longitude), topography (slope, aspect and elevation) and land cover type. The ANN derived temperatures and precipitation are then be combined to form a simple drought index useful for wildland fire control planning, the Keetch Byram Drought Index. The result will be a 5 kilometers grid of estimated drought conditions across a large geographic area, France and Germany.