Spatial Modeling of Weather Parameters for Fire Danger Rating Using Artificial Neural Networks

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Critical fire danger conditions 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 extent/severity of the fire conditions; 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 generally rather short.

Many places around the world have long time series of routine weather observations that can be useful in evaluating historic fire danger 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 fire danger 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 routine weather observations for use in fire planning. Network inputs include location (latitude and longitude), topography (slope, aspect and elevation) and land cover type. The ANN derived weather parameters are designed to integrate into the multi-agency Fire Program Analysis, or FPA, providing daily fire weather information for any location in the country.