

Assessing Real-Time Fire Hazard: Linking Phase 3 Inventories with Weather Data

Christopher W. Woodall, Joseph Charney, Greg Liknes, and Brian Potter
North Central Research Station, USDA Forest Service

Abstract

The combination of forest fuel maps with real-time atmospheric data may enable creation of more dynamic and comprehensive assessments of fire hazards. The goal of this study was to develop techniques for combining fuel maps, based on data from the Forest Inventory and Analysis program of the USDA Forest Service, with real-time atmospheric data for creation of a real-time index of fire hazard. Results indicated fuel loadings could be estimated for specific points on a meteorological modeling grid network (4-km). Based on atmospheric observations over a defined period of time (2-weeks), moisture conditions of spatially interpolated fuel loadings were predicted. A burnable fuels index, combining both fuel loadings and moisture predictions, was created and observed for changes over the modeled period of time. Overall, combining fuel-loading estimates with atmospheric data enables both real-time prediction of fuel hazards and refined understanding of fuel dynamics across forest ecosystems with varying fuel loadings and weather patterns.

Objectives

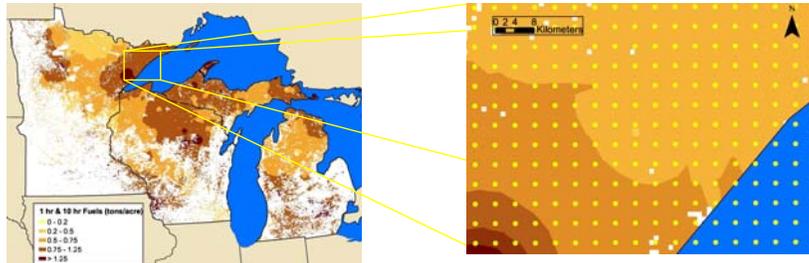
1. To use the FIA phase 3 down woody materials inventory to predict fine woody fuel loadings for a meteorological grid (4x4 km)
2. To predict fine woody (1-hr & 10-hr) fuel moistures on a daily time step (Aug. 27th-Sept. 9th, 2004) and link to fine woody fuel loadings in burnable fuels index (BFI)
3. To observe changes in BFI during weather events and across forest types

Fire Hazard

	Down Woody Fuels		Fuel Moisture	
Low Fire Hazard =		+		<p>In this study, fire hazard will be assumed to be indexed by a combination of fine woody fuels (1-hr & 10-hr) and their associated daily moisture, less than 30% moisture will be deemed as a hazard (combustible)</p>
High Fire Hazard =		+		

Fuel Loading Predictions on a Meteorological Grid

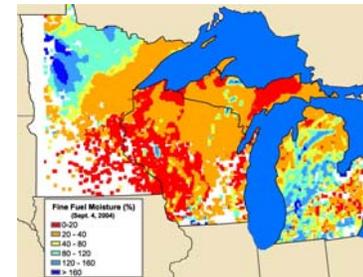
In order to predict strategic scale fuel moistures for fine woody fuels, fuel loadings must be interpolated and predicted for 4x4 km meteorological grid.



Inverse distance weighted interpolation predictions for 1-hr and 10-hr fuels for MN, WI, and MI based on 2001-2003 FIA down woody inventory data

Meteorological grid (4 x 4 km) overlaid on interpolated fine woody fuels map. Fine woody fuel estimates were extracted for each grid point.

Mesoscale Models and Burnable Fuels Index



A mesoscale meteorological model simulates precipitation, humidity, and temperature as inputs to the fine fuel moisture code (Can. Fire. Weather Index) to calculate day to day values for fine fuel moisture

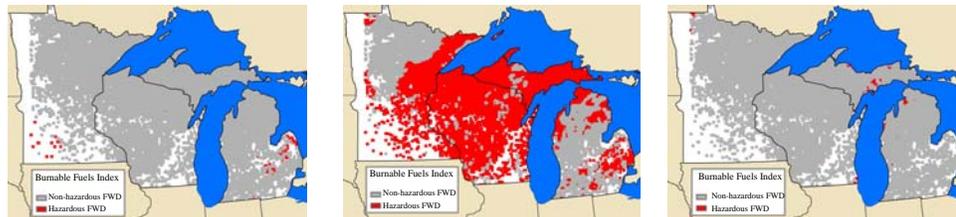
BFI Formulation

$$BFI = L \frac{(30 - fm)}{100}$$

Where...

L = 1- and 10-hr fuel loadings/acre
 fm = fine fuel moisture (%)

Dynamic Fire Hazard Assessment



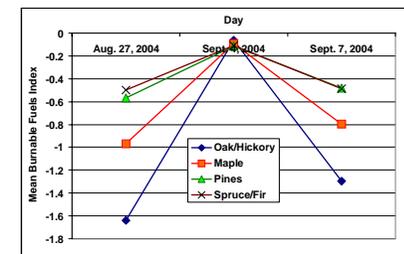
August 27, 2004

September 4, 2004

September 7, 2004

The regional burnable fuels index is highly sensitive to the daily fluctuations in fuel moistures; while at finer-scales, variations in the BFI will be attributable to fine woody fuel loading differences. Although some areas may be highlighted in red as having a high fire hazard, this only indicates that there is a parcel of forest land within the pixel that has fine fuels with a fuel moisture low enough to allow ignition.

Fire Hazard Variation among Forest Types



Fine woody fuel hazards may vary temporally by forest type due to: 1) spatial variability in rainfall over spatially auto correlated forest types, 2) differences in fuel loadings among forest types...hardwoods usually have higher fine woody loadings than conifer forest types

Conclusions

1. Fuel maps from the FIA program (or other data sources, e.g., LANDFIRE) may be incorporated with real-time weather data by interpolating to meteorological grids
2. Although still requiring refinement, the burnable fuels index is sensitive to both dynamic fuel moisture and more static fine woody fuel loadings
3. Fire hazard varies both by forest type and day which may be captured at strategic-scales by combining fuel loadings and weather data