TITLE: Fire Season "Real Time" Estimation of Fuel Moisture Fluctuations in Regional Down Woody Material Inventories during a Fire Season

LOCATION: The project will employ fuels data collected by the North Central Forest Inventory and Analysis Program across the Great Lakes multi-state region. The Eastern Area Modeling Consortium will produce mesoscale atmospheric model data for the region.

DURATION: Starting Year 3 of 3-year project **FUNDING SOURCE:** Fire Plan

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PROJECT OBJECTIVES: 1) Employ mesoscale atmospheric numerical model output to modify FIA down woody material data to produce higher temporal resolution information on fuel moisture. 2) Produce an assessment of the variations in fuel moisture over the course of a fire season. 3) Assess the extent to which fire activity correlates with these simulated fuel moisture variations. 4) Determine if this system can be employed to produce real-time predictions of fuel moisture conditions based on the simulated variations in fuel moisture from the previous year.

JUSTIFICATION: Although regional-scale forest fuel maps are essential to wildfire management and fire risk mitigation efforts, forest fuel conditions are not static. Regionally assessing the fire season fluctuations of fuel moisture levels has never been undertaken using extensive fuels inventory and mesoscale models. Such effort is crucial to tracking weather dependent fire hazards across regional forest fuels during critical fire seasons. Subsequently, this project may address all four of the Evaluation Monitoring selection criteria employing both FIA P2 and P3 data, in conjunction with atmospheric modeling data already being produced under a National Fire Plan program. This study will generate periodic maps of fuel moisture levels during the course of a fire season. While there is a regional focus to the study, the techniques developed will be applicable to other areas of the country where FIA fuel inventories and atmospheric model data are currently available. This project may start producing potentially useful products within the first year, since fuels and atmospheric data are currently available. As the performance of these products are assessed and their efficacy during the later year(s) of the study are determined, the long-term development potential for existing fuels inventories data is substantial.

DESCRIPTION:

a. Background: The FIA inventories down woody material (DWM) across the Great Lakes region updating fuel loading estimates on a yearly basis. Fuel moisture strongly impact fire behavior and severity on a variety of temporal scales, ranging from seasonal down to daily and, in some cases, hourly time scales. Much of the impact on fire behavior is tied to the precipitation amounts and frequency across the region. However, it is very difficult to observe precipitation variations on the same scale as the FIA data due to the large separations between surface weather stations with rain gauges. Radar-derived precipitation estimates are also problematical, particularly in areas far removed from population centers, where radar coverage

is not optimal. However, the Eastern Area Modeling Consortium is producing real-time simulations of atmospheric conditions across the Great Lakes region on a daily basis on a 4km grid. The horizontal resolution of this data is similar in scale to that of the FIA DWM data. The precipitation, wind, and atmospheric moisture data from the atmospheric simulations may be used to update the seasonal fuel moisture conditions of FIA's DWM inventory producing maps of DWM moisture that vary on a weekly, daily, and hourly basis throughout the fire season. This information can then be evaluated to determine if there is a correlation with observed fire behavior during the fire season. Finally, the atmospheric simulations have the potential to assess how the DWM fuel moisture data from the previous year has changed over the winter and might impact the beginning of the next fire season.

b. Methods: This study will use FIA's inventoried and processed DWM data for years 2000 – 2004 (≅ 500 plots) for the North Central Region states. Interpolated/modeled fuel maps will be created by FIA based on emerging mapping methodologies. EAMC model output for the whole season will be produced and then interpolated to the FIA grid. North Central FIA's GIS team will aid with the mapping and output of fuel moisture variation maps for the season. Observations of fire occurrence and (if available) fire behavior will be compared to the fuel moisture variation maps. When correlations are established, work will begin on trying to account for the atmospheric impact on the PREVIOUS year's fuel moisture through the winter and into the spring, so that real-time predictions of fuel moisture can be made available to the fire managers.

c. Products: 1) regional-scale map of fuel moisture weekly/daily/hourly variations across multiple North Central states for a past fire season; 2) assessment of how past fire behavior correlates with the study's fuel moisture maps; 3) regional-scale real-time prediction and subsequent map production of fuel moisture conditions (available on a web page)

d. Schedule of Activities:

Year 1: collect DWM fuel moisture data, develop the software to modify the DWM data with atmospheric model data, and produce maps of DWM fuel moisture variation for the season.
Year 2: assess performance of the system compared with observed fire behavior and develop the real-time prediction system.
Year 3: test and implement the system for real-time use and dissemination.

e. Progress/Accomplishments: During the first two years of this study, timeline objectives were met and products were produced including: interpolating fuel field inventory data to a mesoscale modeling 4-km grid, predicting fuel moisture conditions for fuel-hour classes for a defined timeframe, refining a risk index (fuel loading + fuel moisture) for defined area and time period, and presenting results at regional and national meetings and in publications (see citations below). The risk index development entailed refining an existing severe weather (thunderstorm) index to account for the potential impact of fuel combustion on atmospheric stability and plume growth above a fire. This new index can allow firefighters to anticipate situations when DWM could impact fire behavior that are not well-predicted by existing fire weather indices. During the final year of funding, we look forward to refining the study's risk index such that the potential impact of the fuel loading and fuel moisture are more fully understood and implementing these maps into a real-time prediction system. We will also address larger spatial- and time-scale prediction of fuel loading and moisture conditions, and refined presentation and delivery of results (time-step movies of fire risk fluctuations and risk

summarizations among forest inventory strata).

Charney, J.J., and C.W. Woodall. 2004. Fuels and weather: Real-time fuel moisture predictions from FIA Down Woody Materials inventories and numerical weather simulation data. Region Nine Road-show. Milwaukee, WI. April 7, 2004.

Woodall, C.W., J. Charney, and G. Liknes. 2004. Linking the Down Woody Materials Indicator with Real-Time Atmospheric Data: Techniques and Outputs. The Joint Meeting of the Sixth Annual FIA Symposium and Monitoring Science and Technology Symposium. September 21-23, 2004. Denver, CO

Woodall, C.W., J. Charney, G. Liknes, and B. Potter. 2005. Determining and distributing real-time strategic-scale fire hazard assessments. Society of American Foresters National Convention, Oct. 22, 2005. Fort Worth, TX.

Woodall, C.W., J.J. Charney, G.C. Liknes, and B.E. Potter. 2005. What is the fire danger now? Linking fuel inventories with atmospheric data. Journal of Forestry. September Issue.

COSTS:

	Item	**Requested FHM EM Funding**	**Other-Source Funding**	**Source**
YEARS 1, 2, and 3				
Administration	Salary	27,000	20,000	NCRS internal RWU
	Overhead			
	Travel			
Procurements	Contracting			
	Equipment		10,000	National Fire Plan
	Supplies			