EVALUATION OF EAMC HIGH-RESOLUTION FIRE WEATHER PREDICTIONS (USING SURFACE METEOROLOGY, FOREST ENERGY BALANCE, AND SODAR MEASUREMENTS) IN THE NEW JERSEY PINELANDS

Joseph J. Charney[1], Kenneth L. Clark[2], Xindi Bian[1], Warren E. Heilman[1], and Brian E. Potter[1]

1- USDA Forest Service, North Central Research Station, East Lansing, MI
2- USDA Forest Service, Northeast Research Station, New Lisbon, NJ

I. Introduction

Fire behavior and fire danger prediction in the New Jersey Pinelands is complex, due to a wide range of meteorological and biophysical conditions that prevail across the region (Hom et al., 2005). Meteorological conditions are strongly influenced affected by the Appalachians to the west, the coastline to the east, and the Great Lakes to the northwest, the frequent passage of frontal systems during the spring and fall, and regular convective thunderstorm activity in the summer. Biophysical impacts on fire behavior are affected by the presence of sandy, well-drained soils and nutrient-poor litter that is resistant to decay, which can lead to the rapid buildup of fine fuels in the area. The combination of the meteorological and biophysical factors produce fire danger and fire behavior situations that are difficult to predict and that complicate firefighting activities in the region.

The USDA Forest Service North Central Research Station and Northeast Research Station are working together to better understand the interactions between meteorological conditions in the New Jersey Pinelands. The Northeast Research Station has installed and maintains a network of towers to observe meteorological and fuel conditions in the area, and the North Central Research Station produces atmospheric mesoscale model data to compare against the observations.

II. Model and Observational Data Sources

As part of a project funded by the USDA Forest Service's National Fire Plan, the Eastern Area Modeling Consortium (EAMC) in East Lansing, MI has run the MM5 atmospheric mesoscale model twice daily in real time since the summer of 2002 (Heilman et al, 2005). The EAMC simulations produce high-resolution predictions of meteorological variables for the Great Lakes and New England regions that are archived every hour for validation purposes. The MM5 is a valuable tool for predicting severe fire conditions, and can be linked to a variety of products such as fuel moisture models, fire behavior models such as FARSITE, and fuel prescription models such as CONSUME.

A network of fire weather towers and a SODAR (Sonic Detection and Ranging) system provide observations that are used to evaluate the MM5 predictions in the Pinelands of New Jersey (Fig. 1). Towers in the three major upland forest types, two of which are high fire risk areas, measure incoming solar radiation, net radiation, air temperature, relative humidity, wind speed and direction, precipitation and 10-hour fuel moisture. In addition to these variables, atmospheric turbulent momentum and sensible heat fluxes are measured above the forest canopy using sonic anemometers. Ambient winds above the forest canopy are provided by the SODAR mounted on a walk-up tower at one of sites, which gives 30-min averaged wind profiles to approximately 500 m above the surface.

III. Comparison between model and observations

Landscape level spatial variation in meteorological variables measured from the fire weather towers was low for air temperature and relative humidity. The MM5 adequately captured weather events and trends, but under-predicted daily minima and maxima values (Fig. 2). Model predictions are in better agreement with the tower measurements when integrated over three to five day time periods. Additional case

IV. References

Heilman, W. E., B. E. Potter, J. J. Charney, and X. Bian, 2005: Fire-Weather and Air-Quality Research and Product Development in the Eastern Area Modeling Consortium. EastFIRE Conference, 11-13 May 2005, Fairfax VA.

Hom, J., K. Clark, Y. Pan, S. V. Tuyl, N. Skowronski, and W. Heilman, 2005: Fire research in the New Jersey Pine Barrens.

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IV. Author Biography

Dr. Joseph J. Charney is a Research Meteorologist with the USDA Forest Service- North Central Research Station in East Lansing, MI. He has a B.S. degree in physics from the Pennsylvania State University, an M.S. degree in meteorology from the University of Maryland, and a Ph.D. in meteorology from the Pennsylvania State University. His graduate studies focused on frontal propagation responses to precipitation processes. His current research portfolio includes studies of small-scale fire-fuel-atmosphere interactions, the mesoscale prediction of smoke dispersion and regional air quality, and mesoscale modeling of fire environments.

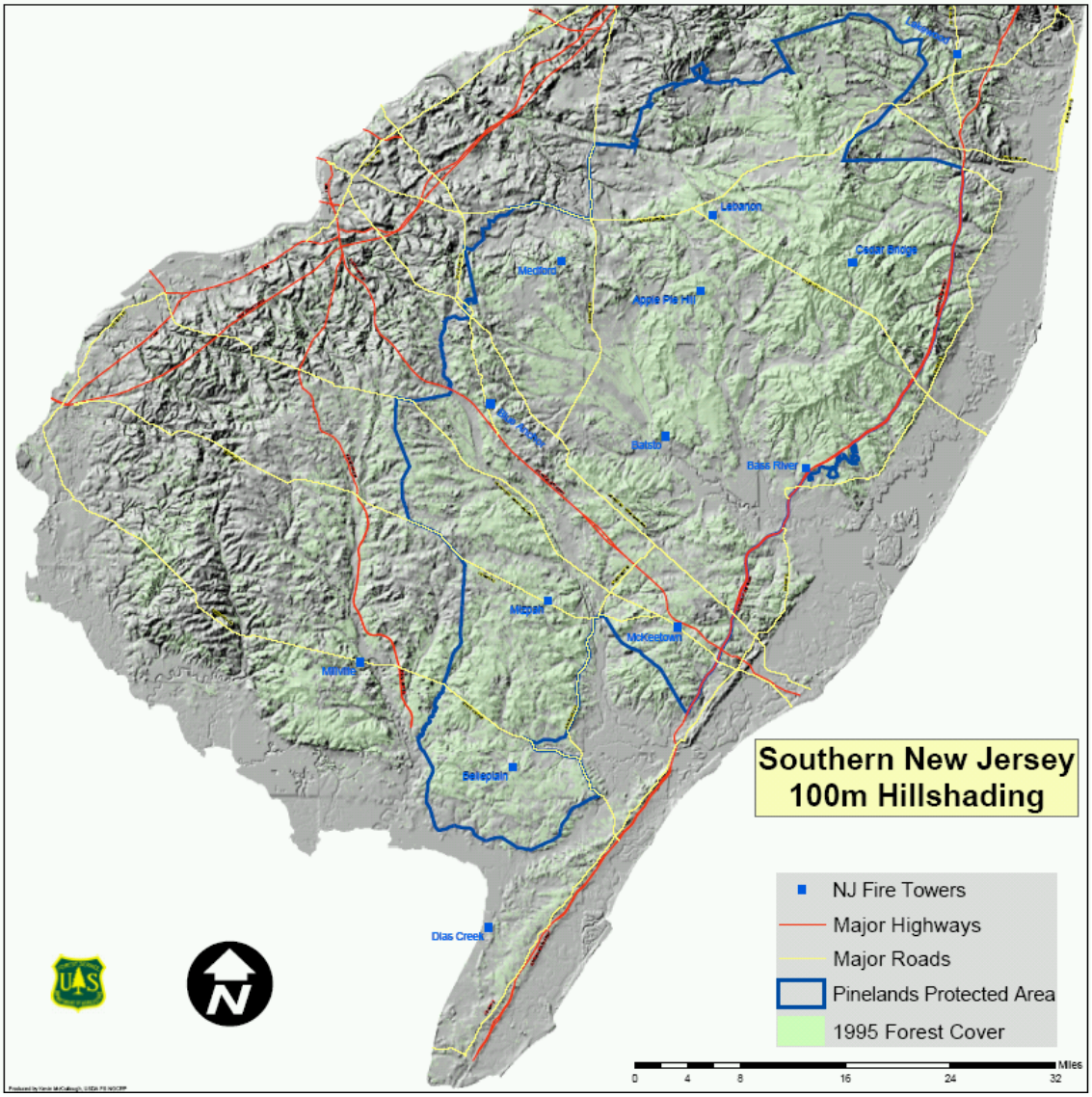

Figure 1: New Jersey Pinelands with the locations and names of fire towers indicated in blue.

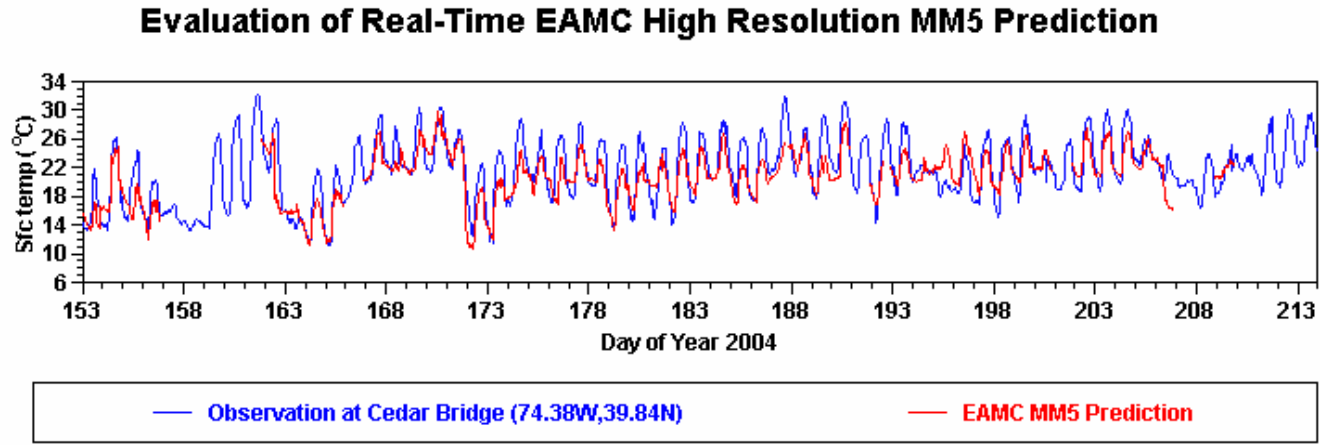

Figure 2: Time series of simulated (red line) and observed (blue line) surface temperature in °C at the Cedar Bridge fire tower.