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Development and Validation of Modeling Tools for Predicting Smoke Dispersion During Low-Intensity Fires

Project Goal and Hypotheses

Study Hypotheses
• Land-surface characteristics, such as terrain and forest vegetation, and near-surface atmospheric processes induced by variations in terrain and vegetation can have significant impacts on smoke transport and diffusion from low-intensity fires.

• Improved understanding of these impacts will lead to better predictions of smoke transport and dispersion over areas of complex terrain and forest vegetation.

Study Goal
Adapt three existing numerical models for predicting short-range smoke transport and diffusion from low-intensity fires and evaluate their performance using observational data from prescribed burn experiments.

WRF-FLEXPART

We are implementing a canopy sub-model in the Weather Research and Forecasting (WRF) system (Skamarock et al. 2008) coupled with the FLEXPART particle dispersion model (Fast and Easter 2006) to predict local and regional atmospheric transport and diffusion of smoke from fires within forest vegetation layers. Test simulations have been carried out without the canopy sub-model to determine how the meteorological conditions during the March 19, 2010 experimental burn in the NJ Pine Barrens could have distributed smoke particles over the NE U.S.

ARPS-FLEXPART

The Advanced Regional Prediction System (ARPS) (Xue et al. 2000) coupled with the FLEXPART particle dispersion model (Fast and Easter 2006) has been modified/adapted to predict the local atmospheric transport and diffusion of smoke from fires within forest vegetation layers and to simulate the effects of forest vegetation on that transport. Test simulations have been carried out (nested grids from 9 km to 100 m grid spacing) of a 3-km diameter low-intensity surface fire located at 38°20’N, 79°30’W at the New Jersey Pine Barrens at the same location where the 2 June 2002 Double Trouble State Park wildfire occurred, using the same “meteorology” that occurred that day. The movement of air parcels released at different heights within and above the vegetation layer immediately upwind of the “fire” was analyzed.

Meteorological and Smoke Monitoring

A prescribed burn experiment (backing fire) was initiated by the New Jersey Forest Fire Service (NJFFS) on 03/19/2010 around 1830 EDT under light northwesterly winds (25% relative humidity). Burning was initiated in the vicinity of the 30 m instrumented tower located at the southeastern boundary of the burn unit. Burning continued in the vicinity of the tower until ~2330 EDT, when the NUFFS shut down the fire due to adverse fire-weather conditions. The graphs and photos below show some of the meteorological and air-quality conditions observed near the 30 m tower.