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Development and validation of modeling tools for predicting smoke dispersion during low-intensity fires

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Abstract
Prescribed burning can be a viable tool for managing forest ecosystems. However, smoke from prescribed fires that often occur in the vicinity of the wildland-urban interface (WUI) can linger in an area for relatively long periods of time and have an adverse effect on human health. Smoke from low-intensity prescribed fires can also reduce visibility over roads and highways in the vicinity of these fires, reducing the safety of our transportation system. Improved tools that quantitatively predict the potential impacts of smoke are necessary in order to maximize the benefits of prescribed fires and balance the conflicting needs of ecological fire use and effective smoke management.

This study, funded by the U.S. Joint Fire Science Program, is focused on the evaluation of fine-scale atmospheric dispersion modeling systems for predicting short-range, near-source smoke transport and diffusion within and above forest vegetation layers. These modeling systems include the Weather Research and Forecasting (WRF) – FLEXPART system, the Regional Atmospheric Modeling System – Forest Large Eddy Simulation (RAFLES) system, the Advanced Regional Prediction System (ARPS) - FLEXPART system, and the Atmosphere to Computational Fluid Dynamics (A2C) system. Smoke concentration and meteorological measurements via surface and tower-based instrumentation within and in the vicinity of prescribed burn units in the New Jersey Pine Barrens are being used to validate the modeling systems. Through this study, we seek to (1) improve our understanding of the effects of different forest canopies on particulate matter and water vapor transport and diffusion within and above those canopies, (2) examine how those effects could be included in operational smoke prediction systems, (3) determine the uncertainties and limitations of current models in predicting smoke dispersion from low intensity fires, and (4) develop new observational data sets for effective validation of smoke dispersion models.

Additional keywords: Modeling, model validation, monitoring, forest canopies, smoke management, prescribed fire