SENSITIVITY AND EVALUATION OF SMOKE PLUME RISE SCHEMES FOR REGIONAL AIR QUALITY SIMULATION

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ABSTRACT

Smoke plume rise is an important emission property required by simulation of the air quality effects of wildfires with models such as CMAQ. A number of smoke plume rise schemes have been developed based on the fundamental fluid dynamical equations, dimensional analysis and similarity principles, or statistical relationships of observed parameters. The schemes, however, have yet to be systematically evaluated. This study seeks to analyze and evaluate smoke plume rise schemes with a focus on Daysmoke, a smoke plume rise model recently developed for prescribed burning in the South. Sensitivity of these schemes is first examined for two 2007 Georgia burn cases. One is a prescribed burn in central Georgia on 28 February. The smoke plume from the burn passed over metro Atlanta, generating extremely high $PM_{2.5}$ concentrations. The other is the southern Georgia wildfire during spring. The smoke plume from the fire was controlled by a dominant circulation system. The sensitivity analysis shows large uncertainty in plume rise calculation, which in turn affects CMAQ simulation of smoke transport and PM concentrations. An evaluation project recently funded by the Joint Fire Science Program is then described. This project is to evaluate and improve the performance of Daysmoke. The objectives to be achieved include evaluating plume rise estimates from Daysmoke and comparing them with other schemes using field measurements, improving accuracy and feasibility of Daysmoke, evaluating and analyzing uncertainty in regional smoke and air quality modeling due to plume rise calculation, and transferring research products into field application tools. A combined approach of field measurement, numerical modeling, and dynamical and statistical analysis will be used to obtain data, conduct simulation and evaluation, and improve the model.

Keywords: air quality simulation, measurement, plume rise, sensitivity, wildland fire.

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THE GREAT ATLANTA SMOKE OUT——PRESCRIBED FIRE IN THE WILDLAND–URBAN INTERFACE

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ABSTRACT

On 28 February 2007 emissions from wildland fires caused significant particulate matter exceedences at three monitors in Atlanta, a non-attainment area for $PM_{2.5}$ and ozone. The smoke was from 63 prescribed fires for 5,414 acres, 15 wildfires for 112 acres, and 511 small piles. Piedmont National Wildlife Refuge and Oconee National Forest burned 57% (3,104 acres) of the prescribed fire acreage on two fires in close proximity to each other. Analysis suggests these two burns were significant contributors to the smoke intrusion. An after-action review indicated the need for an improved state permitting system that manages smoke at a regional level, not just a local level; however, the tools to accomplish this do not currently exist. In response to this information deficit the two federal agencies developed an interim smoke management strategy. This strategy is designed to coordinate their prescribed fire activities until a science-based regional permitting system is implemented.

Keywords: non-attainment, prescribed fire, smoke management, wildland–urban interface.

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