Coupled atmosphere - wildland fire modeling, applications, and data assimilation

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Abstract

Computer simulations use numerical weather prediction models tied to fire behavior models to simulate the impact of a fire on the atmosphere and the subsequent feedback of these fire-induced winds on fire behavior - i.e. how all fires, to some degree, 'create their own weather'. Although this influence is most dramatic near the fire, model simulations show this influence can change windspeeds by several miles per hour even miles from the fire. This has important implications for understanding and predicting fire behavior which this work addresses.

The methodology involves the use of a numerical weather prediction model capable of modeling fine scale atmospheric flows (under 1 km grid spacing) in steep (slope where the rise over run of terrain may exceed 0.6) terrain. The wildland fire component is based upon the Rothermel surface fire algorithms, a canopy fire model, coupled to the atmospheric model such that low level winds (which may be affected by the fire) drive the spread of the surface fire, which in turn release sensible heat, latent heat, and smoke fluxes into the lower atmosphere.

This work describes the latest developments in and applications of this type of modeling :(1) the interaction of fires, which is the basis for assumptions on where and when backfires may be safely and effectively set assuming they will be drawn into the uncontained wildfire for fire suppression, (2) severe weather aspects of intense wildland fires, (3) and steps toward the application and validation of such models as real-time forecasts of fire growth. This includes interdisciplinary work to develop methods to assimilate data on meteorology and fire data into the coupled atmosphere-fire models.

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