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# Urban and land surface effects on the 30 July 2003 mesoscale convective system event observed in the southern Great Plains

Dev Niyogi,[1] Teddy Holt,[2] Sharon Zhong,[3] Patrick C. Pyle,[4] and Jeffery Basara[5]

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[1] The urban canopy of excess heat, water vapor, and roughness can affect the evolution of weather systems, as can land vegetative processes. High-resolution simulations were conducted using the Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS®) to investigate the impact of urban and land vegetation processes on the prediction of the mesoscale convective system (MCS) observed on 30 July 2003 in the vicinity of Oklahoma City (OKC), Oklahoma. The control COAMPS model (hereinafter CONTROL) used the Noah land surface model (LSM) initialized with the Eta Data Assimilation System and incorporates an urban canopy parameterization (UCP). Experiments assessed the impact of land vegetative processes by (1) adding a canopy resistance scheme including photosynthesis (GEM) to the Noah LSM and (2) replacing the UCP with a simpler urban surface characterization of roughness, albedo, and moisture availability (NOUCP). The three sets of simulations showed different behaviors for the storm event. The CONTROL simulation propagated two storm cells through the OKC urban region. The NOUCP also resulted in two cells, although the convective intensity was weaker. The GEM simulation produced one storm cell west of the downtown region, whose intensity and timing were closer to the observed. To understand the relative roles of the urban and vegetation interaction processes, a factor separation experiment was performed. The urban model improved the ability to represent the MCS, and the enhanced representation of vegetation further improved the model performance. The enhanced performance may be attributed to better representation of the urban-rural heterogeneities and improved simulation of the moisture fluxes and upstream inflow boundaries.

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## 1. Introduction

[2] The effect of urban and land vegetative processes and their dynamical impact on land-atmosphere interactions was investigated using simulations of the 30 July 2003 mesoscale convective system (MCS) event that was observed in the vicinity of OKC at the conclusion of the Joint Urban 2003 Experiment (JU2003) [*Allwine et al.*, 2004]. Land vegetative processes, as driven by features such as surface heterogeneity [*Pielke*, 2001] or soil moisture gradients [*Zhang and Anthes*, 1982; *Segal et al.*, 1989; *Chang and Wetzel*, 1991; *Zhong and Doran*, 1995] have been shown to be important mechanisms for the development of convection. The land surface processes alter the mesoscale fluxes of temperature and moisture, which in turn alter the thermodynamic characteristics of the region. Heterogeneities in land surface characteristics tend to form mesoscale boundaries and an environment conducive to convective initiation or enhancement of preconvection [*Pielke*, 2001]. For example, *Holt et al.* [2006] investigated a convection case in the Great Plains region during a special field program (International $H_2O$ Project, 2002), and concluded that accurate representation of prestorm land-atmosphere interaction significantly improves the simulation of mesoscale boundaries and also affects convective initiation and model quantitative precipitation forecasts (QPF). The majority of these studies have been focused on nonurban landscapes, where soil moisture and vegetation heterogeneities are the main drivers. The urban-rural contrast, with significant surface heterogeneities in the land surface characteristics, may lead to a complex interaction of subsurface and boundary layer feedbacks with mesoscale boundaries in the vicinity of the urban areas. Such urban-rural interfaces could then become preferred zones for convection, typically occurring downwind of the urban region, that may act to

[1]Department of Agronomy and Department of Earth and Atmospheric Sciences, Purdue University, West Lafayette, Indiana, USA.
[2]Marine Meteorology Division, Naval Research Laboratory, Monterey, California, USA.
[3]Department of Geosciences, University of Houston, Houston, Texas, USA.
[4]Department of Marine, Earth and Atmospheric Sciences, North Carolina State University, Raleigh, North Carolina, USA.
[5]Oklahoma Climatological Survey, University of Oklahoma, Norman, Oklahoma, USA.


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