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The Relative Influence of Aerosols and Midlevel Dryness on Deep Convective Morphology

Leah Grant (1) and Susan van den Heever (2)

(1) Colorado State University, Atmospheric Science, United States (ldgrant@atmos.colostate.edu), (2) Colorado State University, Atmospheric Science, United States (sue@atmos.colostate.edu)

Several recent studies of aerosol impacts on deep convection suggest that environmental conditions, including humidity, vertical wind shear, and instability, may modulate the precipitation response to aerosol loading. The goal of this research is to investigate the relative sensitivity of deep convective morphology to increasing aerosol concentrations and midlevel dryness. These conditions are common in developing severe weather situations such as those that occur near the dryline or in high plains of the United States. This goal is addressed through the use of idealized cloud-resolving model simulations.

A common storm splitting pattern is simulated wherein the right moving storm becomes a dominant, cyclonically rotating supercell, and the left-moving storm evolves into a multicellular cluster. The relative impacts of aerosol loading and midlevel dryness on different types of organized deep convection within the same domain can therefore be addressed and will be presented. Sensitivity tests demonstrate that the right-moving storm transitions from a classic supercell to a low-precipitation supercell with increasing dryness aloft; the supercell storm structure is relatively insensitive to aerosol perturbations. The results also suggest that midlevel dryness exerts a stronger control than aerosol concentrations on the precipitation resulting from the left-moving multicellular cluster. However, the left-moving cluster is more sensitive than the supercell to aerosol perturbations through aerosol impacts on the cold pool strength and subsequent dynamical forcing.