ATS/CIRA Special Seminar

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Wide variability in simulated convective microphysical response to CDNC highlights the ongoing need for observational constraints on aerosol-convection interactions

Hosted by Sue van den Heever

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ATS room 101; Discussion will begin at 3 pm
Refreshments will be served at 2:45 pm in the weather lab

Aerosols affect deep convection through their influence on cloud and precipitation microphysics over a wide range of spatiotemporal scales. Despite these important microphysical impacts, studies of aerosol-convection interactions often focus on the sensitivity of a model with a single microphysics representation to perturbations of aerosol, cloud condensation nuclei (CCN) or cloud droplet number concentration (CDNC). However, this approach assumes a reliable representation of microphysical pathways.
In this study we investigate the robustness of simulated aerosol effects on convection across different microphysics representations. High-resolution convection-permitting simulations are performed using the WRF model in three configurations:a real-data simulation of deep convection in the Congo basin, an idealised supercell case, and a warm-rain large-eddy simulation (LES). For each case we compare two frequently used double-moment bulk microphysics schemes and investigate the cloud system response to CDNC perturbations.

In all cases, differences in the simulated cloud morphology and precipitation are found to be significantly greater between the microphysics schemes than due to CDNC perturbations within each scheme.Further, we show that the way that the schemes respond to CDNC perturbations strongly differs between every model configuration. Sensitivity tests show that the representation of autoconversion is the dominant factor that drives differences in rain production between the microphysics schemes in an idealised precipitating shallow cumulus case and in a sub-region of the Congo basin simulations dominated by liquid-phase processes. In this region, rain mass is also shown to be relatively insensitive to the radiative effects of an overlying layer of ice-phase cloud. In the idealised supercell case, thermodynamic impacts on the storm system using different microphysics parameterisations can equal those due to aerosol effects. These results highlight the large uncertainty in cloud and precipitation responses to aerosol in convection-permitting simulations and indicate the continuing need for tighter observational constraints of cloud processes and response to aerosol in a range of meteorological and convective regimes.

Link to colloquium videos and announcement page: http://www.atmos.colostate.edu/dept/colloquia.php