ATS/CIRA Colloquium

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Elevated convective systems and extreme rainfall

Friday, March 13, 2015

ATS room 101; Discussion will begin at 11:15am
Refreshments will be served at 10:45am in the weather lab

In the central and eastern U.S., as well as other continental locations at midlatitudes around the world, warm-season heavy precipitation is most frequent at night. This suggests that the convection responsible for the heavy rainfall is not primarily originating at the surface, which stabilizes after dark, but from unstable air located somewhere above the surface: "elevated convection." Elevated mesoscale convective systems (MCSs) tend to be poorly predicted by numerical weather prediction models, and the processes responsible for their development and maintenance have not received as much attention as their surface-based counterparts. An overview of the climatology of extreme precipitation in the U.S. will be provided, and the typical thermodynamic environments and synoptic and mesoscale processes responsible for the maintenance of elevated, heavy-rain-producing MCSs will be reviewed. Quasi-idealized simulations, which incorporate either the mesoscale ascent, or the full three-dimensional variability, in elevated MCS environments, are used to address the respective roles of large-scale forcing for ascent, convectively generated cold pools, and convectively generated gravity waves. In particular, these simulations show that the amount of rain produced by MCSs is strongly sensitive to very small changes in the thermodynamic profile within the near-surface stable layer. Even though the near-surface layer has strong convective inhibition in all simulations and the convective available potential energy of the most-unstable parcels is unchanged, convection is less intense in the experiments with drier sub-cloud layers, as less air originating in that layer rises in convective updrafts. These findings raise questions about how often nocturnal convection is truly "elevated" or if it instead continues to draw air from near the surface despite the stabilization of near-surface air overnight. Furthermore, considering that the thermodynamic differences imposed in the simulations are comparable to observational uncertainties in low-level temperature and moisture, the strong sensitivity of accumulated precipitation to these quantities has implications for the predictability of extreme rainfall. The presentation will conclude with plans for addressing some of these questions with observations in the upcoming Plains Elevated Convection At Night (PECAN) field experiment.

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