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Analysis of nocturnal convection initiation using convective-scale data assimilation of mobile radar and thermodynamic observations collected during PECAN

James Marquis (1,2), Joshua Wurman (2), Glen Romine (3), Tammy Weckwerth (3), and Jim Wilson (3)

(1) University of Colorado, Boulder, CO, (2) Center For Severe Weather Research, Boulder, CO, (3) National Center for Atmospheric Research, Boulder, CO

Nocturnal convection initiation (CI) processes differ from daytime CI owing to stabilization of the boundary layer; thus, nocturnal convection is generally assumed to be elevated in nature. Direct, fine-scale observations of nocturnal CI and its surroundings are rare because it is a difficult phenomenon to target with instruments. Data assimilation has been recognized as a powerful tool for producing dynamically consistent analyses of mesoscale environments and convective-scale processes by expanding the influence of limited observations to areas of the analysis domain not directly observed. Therefore, this technique has the potential to increase our scientific understanding of storm-scale nocturnal CI processes observed by instruments that are spatially dispersed.

Ongoing research by the coauthors and collaborators is exploring improvements in mesoscale details of the environments and triggering mechanisms associated with nocturnal CI that occurred during the Plains Elevated Convection at Night (PECAN) experiment, which took place during Jun-Jul of 2015 on the U.S. central plains. Events were observed with several mobile and fixed research radars, sondes, profilers, aircraft, and mesonets. These observations are assimilated into a multi-scale (3-km and $\sim$1-km grid spacing) WRF ensemble using the Kalman filter. Initial analysis is conducted on nocturnal CI that took place on 24 June 2015 in eastern Nebraska. The goal of this project is to provide the most detailed set of four-dimensional gridded kinematic and thermodynamic analyses possible for examination of processes triggering nocturnal CI, including localized details of the stability and shear in the surrounding environment. We will focus on understanding the roles that gravity waves (e.g., bores), surface boundaries (e.g., a low-level gust front from prior convection), and a low-level jet play to dictate the precise location of nocturnal CI within a broad area of elevated mesoscale convergence. Current mesoscale analyses will be shown and the relative impacts of assimilating PECAN versus routine observations on the numerical analyses will be illustrated.