Analysis of a Severe MCS and Nocturnal Tornadogenesis sampled by PECAN on 5-6 July 2015

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Synoptic and Project Overview
Southeast SD, July 5-6, 2015

PECAN Deployment Strategy
IOP 20 – “The Megagon”

Comparison to Theoretical Models
Mesovortex-genesis

Nocturnal mesoscale convective complexes (MCSs) commonly traverse the Great Plains in the boreal summer. In addition to heavy rainfall, MCSs may produce severe weather, including up to 20% of reported tornadoes (Trapp et al. 2005). While these tornadoes are typically weaker than their supercellular counterparts, they often present a greater forecasting challenge due to their typically transient lifetimes. Nocturnal tornadoes in particular pose an enhanced societal threat with respect to daytime tornadoes and thus require larger forecast lead times (Ashley et al. 2008).

At 0100 UTC on 6 July 2015, PECAN assets mobilized to get into position for an MCS deployment. Eight mobile radars moved into a hexagon with two center points to optimize multi-Doppler scanning strategies. While this “megagon” assembled in southeastern SD, mobile mesonets began transmitting a strong bow echo that had formed a few counties west. Simultaneously, collocated mobile sounding units located near the center of the mobile radar array began launching radiosondes at 20-minute intervals. These sampling techniques continued for the next several hours as the bow echo developed into a more extensive MCS, merged with another storm complex in eastern SD, and moved directly over the radar array.

To this end, an armada of mobile radars, mesonets, lidars, and aircraft assembled in the Great Plains from June-July 2015 in association with the Plains Elevated Convection At Night (PECAN) field project. Along with fixed radar and lidar sites, these platforms were deployed to collect data on multiple nocturnal atmospheric phenomena, including low-level jets, convective initiation, mesoscale, and MCSs. On the night of July 5-6, 2015, the group captured a severe MCS in southeastern SD that produced several severe wind reports and an EF-0 tornado.

This study will examine high-resolution simulations of this event using the NSSL Experimental Warn-on-Forecast (EWoF) system for ensembles (NEWS-e). Ensemble Kalman Filter (EnKF) techniques are used to assimilate data from both conventional and mobile platforms on the convective-scale (e.g., Snyder and Zhang 2003). Recent studies have led to mixed conclusions regarding the development of low-level mesovortices in quasi-linear convective systems (QLCs; e.g., Trapp and Weisman 2003). Wakimoto et al. (2006, Weather et al. 2008, Atkins et al. 2009), which are often associated with the most damaging surface winds. This study will determine meteorological processes influencing the development and maintenance of a mesovortex and associated tornado and discuss these influences in the context of previous conceptual models.

Ongoing Research Questions:
- What evolution is necessary to resolve the mesovortex and the tornado-like vortex?
- What processes led to mesovortex-genesis in this case?
- How similar are processes leading to supercell vs. QLCS mesovortex-genesis?
- How important is friction in the development of significant low-level rotation?