Nocturnal Moisture Patterns Observed in the S-Pol Radar Refractivity Field During the PECAN 2015 Experiment

*Rita Roberts[1], Tammy Weckwerth[1], Ya-Chien Feng[2]

1. NCAR, 2. CSU

The Plains Elevated Convection At Night (PECAN) experiment ran from 1 June –15 July 2015 over the United States Great Plains. The scientific objectives of this field campaign were to improve understanding of the processes leading to nocturnal, elevated convection initiation (ECI), its upscale growth into Mesoscale Convective Systems (MCSs), and the resulting rainfall that maximizes during the night in the Great Plains. The roles of nocturnal bores and the Low Level Jet (LLJ) in the initiation and enhancement of convection and rainfall were additional scientific foci of the experiment. The NCAR S-band polarization radar (S-Pol) was deployed south of Hays, Kansas filling an important gap in the operational NEXRAD radar coverage and providing high resolution, dual-polarization data on nocturnal convective storm initiation and evolution. Near surface water vapor information was obtained from the S-Pol radar by applying the radar refractivity retrieval technique developed by Fabry et al. (1997). In all prior field campaigns, the radar refractivity (N) fields were derived during the daytime hours. In this paper, refractivity retrievals are obtain during both the diurnal and nocturnal periods of PECAN. The nocturnal observations from PECAN show that the N values usually increase in association with a cold front or gust front passage through the S-Pol domain. This increasing moisture is often sufficient to produce new convection above these surface convergence regions. This is typical with what has been observed in past field campaigns during the daytime. Also observed were gust front passage without convection initiation. In these cases the refractivity field shows much lower moisture values behind the gust front indicating how important the role of available moisture is in dictating whether new convection will occur. In addition to these more typical observations, there have been some interesting discoveries associate with the nocturnal weather. Within the nocturnal stable boundary layer, characterized generally by a strong surface inversion, convectively-generated cold pools will eventually transition into bores that persist for long periods of time and travel large distances in the boundary layer. Bores act to destabilize their environment, lower the LFC and can lead to convection initiation. Bores are often evident in radar reflectivity as a series of parallel reflectivity thin lines moving in the same direction of propagation. The N field during these events may show some modest changes in the moisture field associated with the approach of the bore or following the bore, but more often these changes are quite subtle. However, examination of the refractivity gradient field, delta-N (ΔN) shows a very pronounced pattern parallel with the bore segments. Bands of increasing then decreasing ΔN are associated with each bore wave. With stronger bores, pairs of large positive and negative magnitudes of ΔN are observed. This pattern of bands passing through the S-Pol domain are evident even when the bores are no longer discernible as thin lines in the reflectivity field. Being able to track these features over time using the high-resolution refractivity data will help to inform the role bores play in nighttime convection and in maintaining MCSs. These patterns and examples of other N patterns associated with cold fronts, gust fronts, and LLJs observed during PECAN will be presented.

Keywords: Refractivity, Nocturnal Moisture patterns, Bores, Gust fronts, Convection initiation