

# Role of Rear Inflow Jet in Moderate Shear Nocturnal Mesoscale Convective System

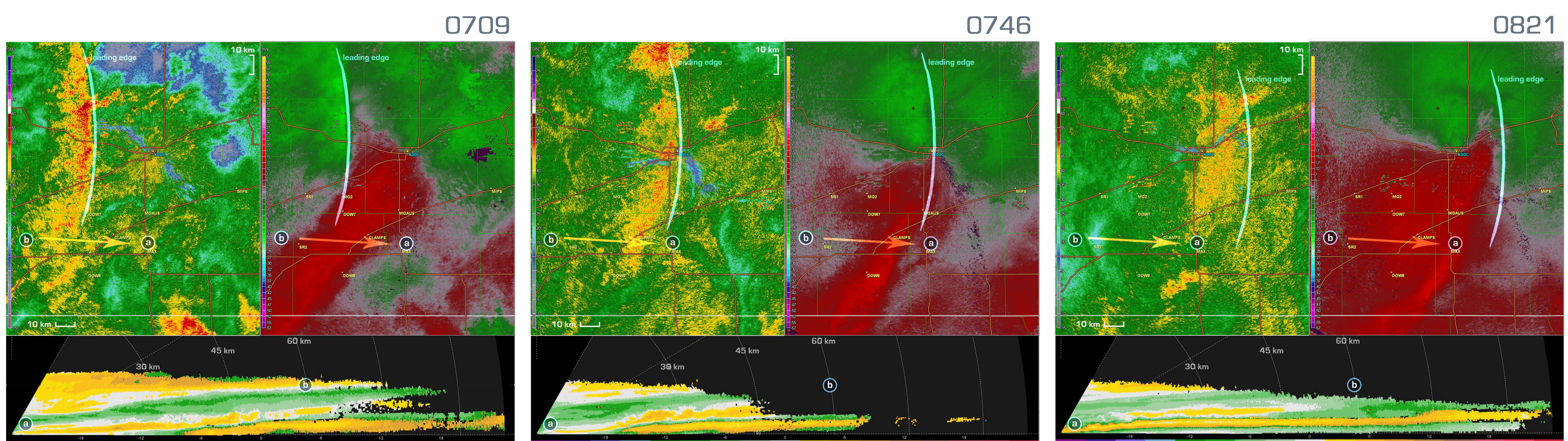
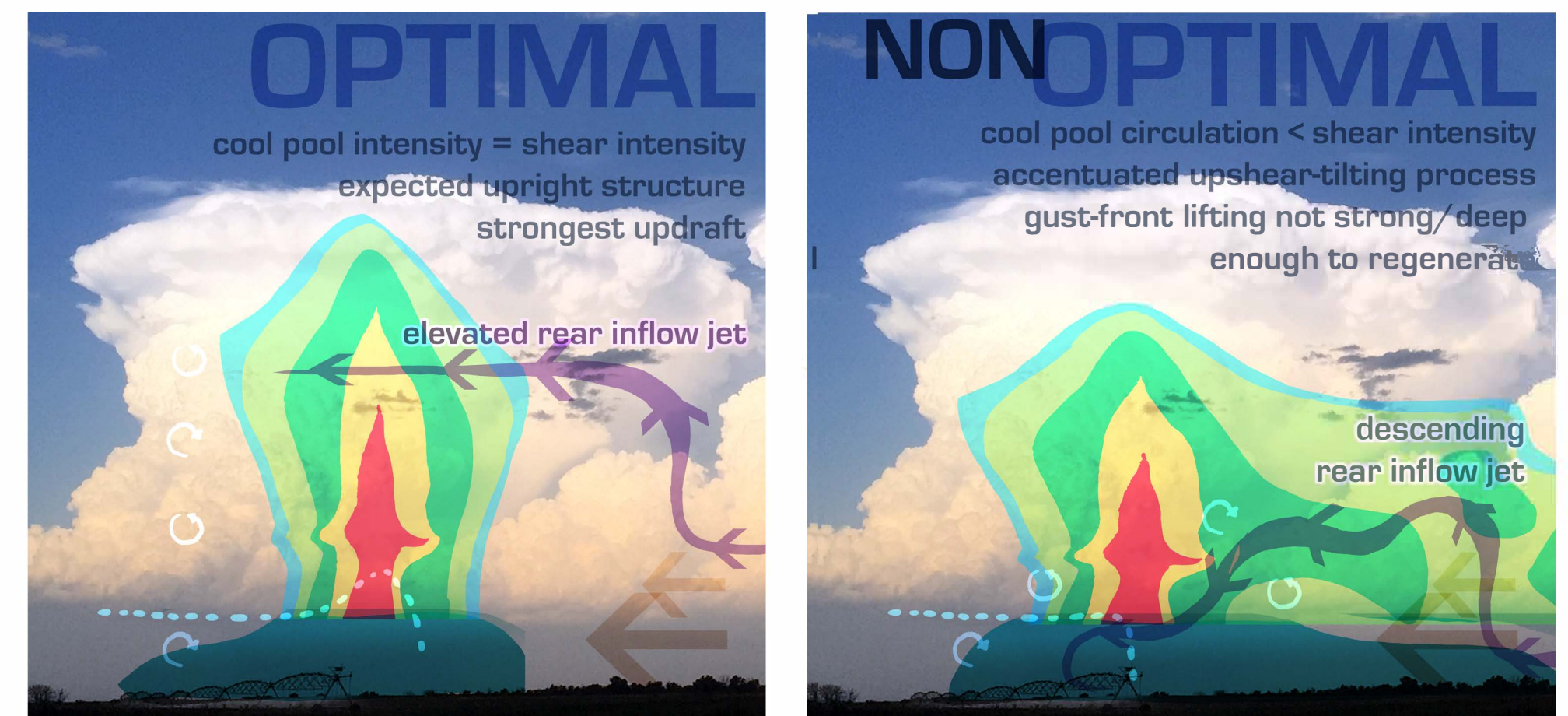
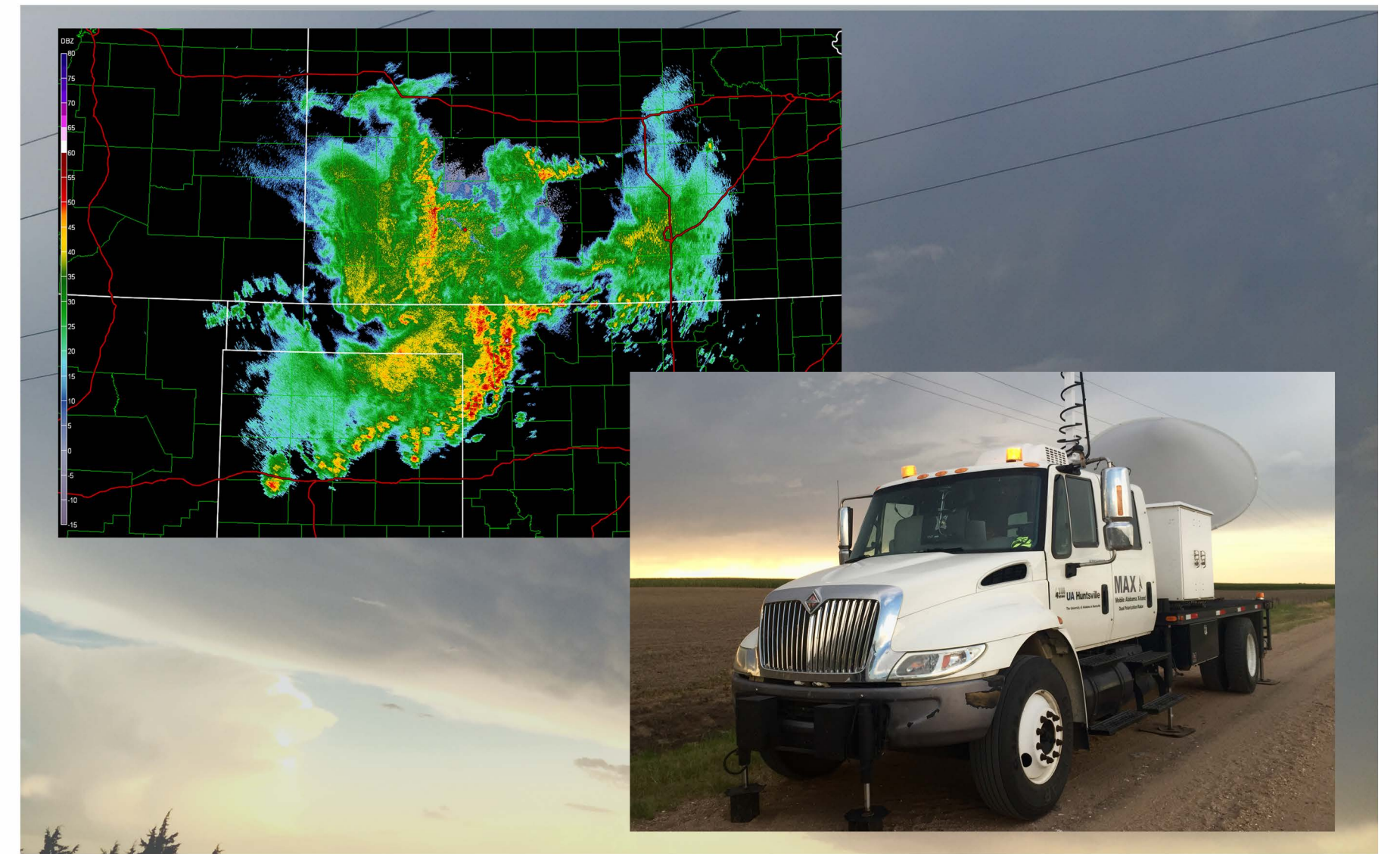
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## Overview

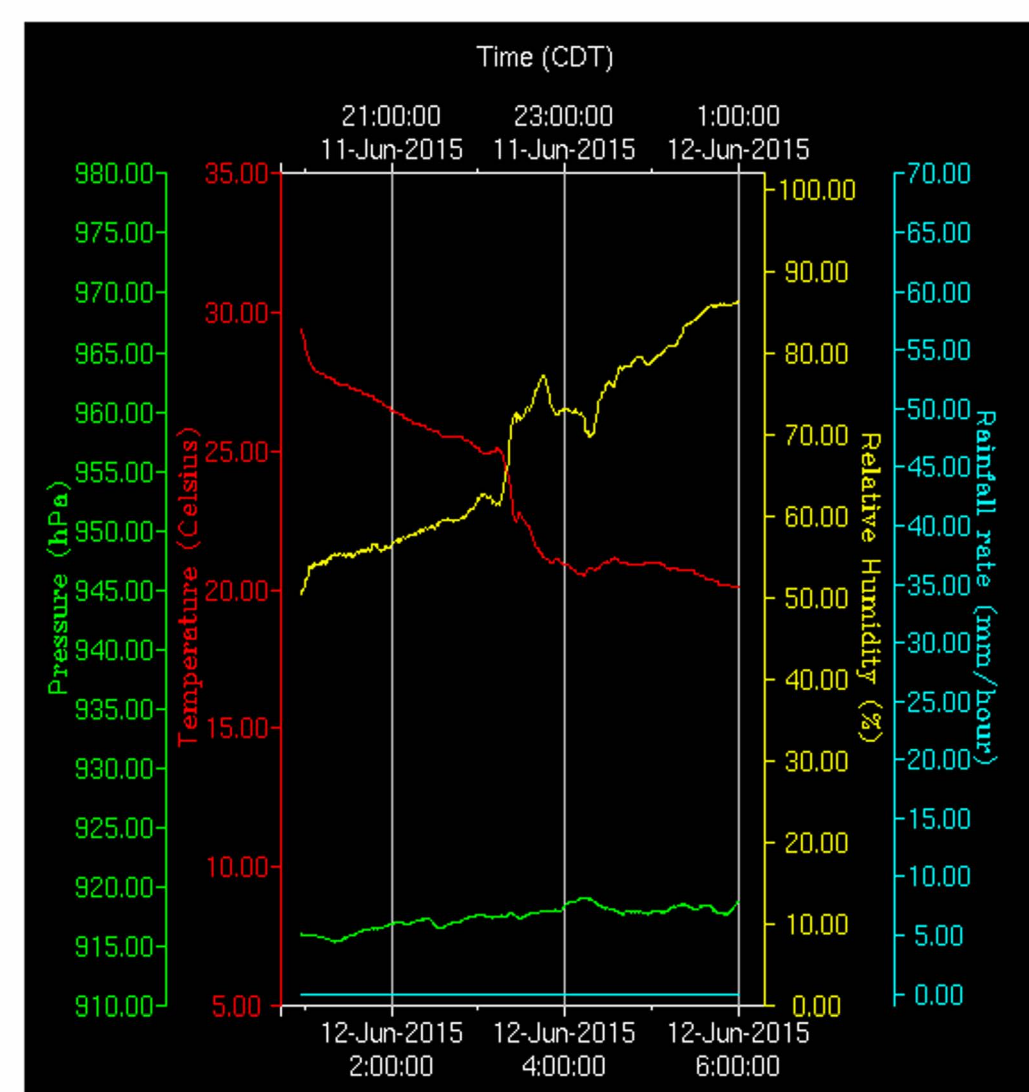
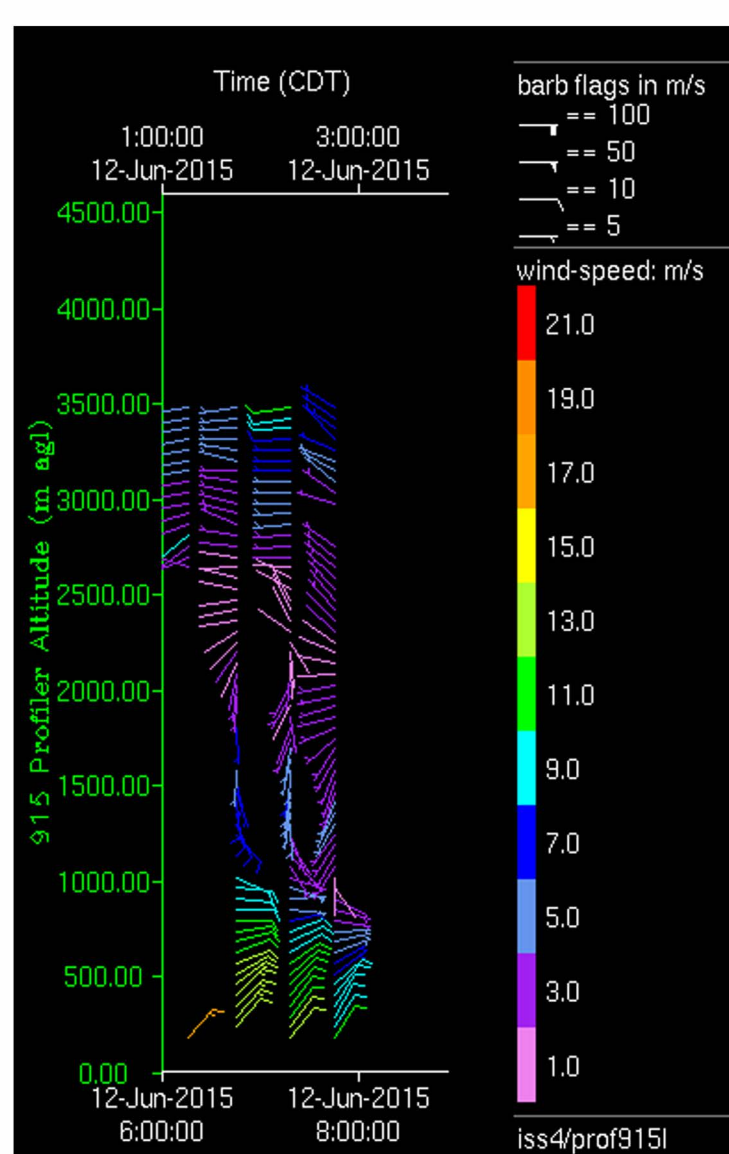
A number of significant hazardous weather events during the warm season occur during nighttime hours from nocturnal mesoscale convective systems (NMCS). Understanding the dynamical evolution and interaction between NMCS atmospheric waves and the evolving stable nocturnal boundary layer (NBL) is inherent to improving forecasts of overnight events. Using the observational data from the Plains Elevated Convection at Night (PECAN) field campaign as sampled by UAH's MAX radar, as well as 6 others, utilizing PPI and vertical slices with RHI, this study investigates the mechanisms and dynamics behind the June 12 NMCS with intent to validate the core principals of RKW Theory for convective systems.

## RKW Theory

RKW Theory is a nickname for the concepts presented by Rotunno, Klemp, and Weisman in the 1980s that describes the structure of squall lines. It dictates that wind shear and the horizontal buoyancy gradient affect a system's cold pool circulation. When the effects of upshear acceleration by the cold pool are stronger than the downshear effects of the windshear, the system has a more expansive trailing stratiform precipitation region. The case of June 12 illustrates the case of leading stratiform where the cold pool circulations were weaker than effects of the wind shear.



Above: Reflectivity and velocity products from KDDC alongside correlating RHI cross-sections from MAX. The leading line of the mesoconvective system of interest is denoted by a light blue line; velocity RHI cross-sections as sampled by MAX are denoted on the PPI product with an arrow denoting direction at a distance of 60 km between points A and B. The system's rear inflow jet is denoted on these cross-sections by a purple arrow.  
Below: Surface station data denoting temperature, pressure, and relative humidity prior to the event, with vertical wind profile during the event as sampled by NCAR's Mobile ISS.



## Key Findings

- RKW Theory's of a strong rear inflow jet leading to dissipation is evident in this case of messy but otherwise strong upscale growth.
- evidence of the strong descending rear inflow jet can be observed in the time series above - most notably on the RHI cross-section at 0821 UTC.
- the lack of a tighter reflectivity gradient along the leading edge of the squall line can be attributed to the decreased cold pool circulation along the presence of a strengthening 15+ m/s descending rear inflow jet inherent of compressional warming of the system backend.
- the characterization of rear inflow jets that descend and spread along the surface typically develop in environments of moderate CAPE. The June 12 event's CAPE was approximately 1500 J/kg.
- suspect wave involvement and prior convection firing during the afternoon-evening transition led to disorganization of main event.

### References

1. Rotunno, R., Klemp, J. B., & Weisman, M. A theory for strong, long-lived squall lines. Journal of the Atmospheric Sciences. 1988;45(3), 463-485.
2. Weisman, M. The role of convectively generated rear-inflow jets in the evolution of long-lived mesoconvective systems. Journal of the Atmospheric Sciences. 1992;49(19), 1826-1847.

## Acknowledgements

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