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Dynamics of nocturnal convective systems

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Many parts of Europe and the United States have either a primary or secondary nocturnal maximum in convective frequency associated with mesoscale convective systems (MCSs). Both understanding and prediction of such nighttime storms continue to be poorer than for daytime storms. A common assertion is that nocturnal MCSs are typically elevated and lack surface cold pools. A related assertion is that nocturnal MCSs therefore owe their maintenance and evolution primarily to external processes such as lifting along pre-existing fronts and interactions with nocturnal low-level jets. This study provides a longitudinal look at a group of intense, long-lived, overnight MCSs from the 2015 PECAN field campaign. Development of these MCSs is compared between simulations with realistic, fully-heterogeneous, temporally-evolving environments vs. simulations with homogeneous, temporally steady environments. The simulated structures are found to be surprisingly insensitive to the degree of idealization in the numerical model. This implies that nocturnal MCSs may often "self-organize" via their own internally generated outflows and mesoscale wind fields. Indeed, each of the MCSs produces a substantial surface cold pool and ingests considerable near-surface air into its updrafts, much like a classical daytime convective system. The presentation will describe the dynamics of nocturnal self-organization, both in isolation and within the context of a fully varying synoptic and mesoscale environment.