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A climatology and preliminary investigation of predictability of pristine nocturnal convective initiation in the central United States

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The prediction of convective initiation remains a challenge to forecasters in the central United States, especially for elevated events at night. This study examines a subset of 287 nocturnal elevated convective initiation events that occurred without direct influence from surface boundaries or pre-existing convection over a four-month period during the summer of 2015 (May, June, July, and August). Events were first classified into one of four types based on apparent formation mechanisms and location relative to any low-level jet. A climatology of each of the four types was performed focusing on general spatial tendencies over the central United States and initiation timing trends. Additionally, analysis of initiation elevation was performed. Simulations from five convection-allowing models available during the Plains Elevated Convection At Night (PECAN) field campaign, along with four versions of a 4km horizontal grid spacing Weather Research and Forecasting (WRF) model using different planetary boundary layer (PBL) parameterizations, were used to examine predictability of these types of convective initiation.

The climatology revealed a dual-peak pattern for initiation timing with one peak near 0400 UTC and another 0700 UTC, and it was found that the dual peak structure was present for all four types of events, suggesting that the evolution of the low-level jet was not directly responsible for the twin peaks. Subtle differences in location and elevation of the initiation for the different types were identified. The convection-allowing models run during the PECAN project were found to be more deficient with location than timing. Threat scores typically averaged around 0.3 for the models, with false alarm ratios and hit rates both averaging around 0.5 to 0.6 for the various models. Initiation occurring within the low-level jet but far from a surface front was the one type that was occasionally missed by all five models examined. Once case for each of the four types was then simulated with four different configurations of a 4 km horizontal grid spacing WRF model. These WRF runs showed similar location errors and problems with initiating convection at a lower altitude than observed as was found from the simulations performed during PECAN. Three of the four PBL schemes behaved similarly, but one, the ACM2, was often an outlier, failing to indicate the convective initiation.