SYNOPTIC REGULATION OF THE 3 MAY 1999 OKLAHOMA TORNADO OUTBREAK

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Despite the relatively successful long-lead-time forecasts of the storms during the 3 May 1999 tornadic outbreak in Oklahoma and Kansas, forecasters were unable to predict with confidence details concerning convective initiation and convective mode. The forecasters identified three synoptic processes they were monitoring for clues as to how the event would unfold. These elements were (a) the absence of strong surface convergence along a dryline in western Oklahoma and the Texas panhandle, (b) the presence of a cirrus shield that was hypothesized to limit surface heating, and (c) the arrival into Oklahoma of an upper-level wind-speed maximum (associated with the so-called southern PV anomaly) that was responsible for favorable synoptic-scale ascent and the cirrus shield.

The Pennsylvania State University/National Center for Atmospheric Research Mesoscale Model Version 5 (MM5) is used in forecast mode (using the operational AVN run data to provide initial and lateral boundary conditions) to explore the sensitivity of the outbreak to these features using simulations down to 2-km horizontal grid spacing. A 30-h control simulation is compared to the available observations and captures important qualitative characteristics of the event, including convective initiation east of the dryline and organization of mesoscale convective systems into long lived, long-track supercells. Additional simulations in which the initial strength of the southern PV anomaly is altered suggest that synoptic regulation of the 3 May 1999 event was imposed by the effects of the southern PV anomaly. The model results indicate that: (1) convective initiation in the weakly forced environment was achieved through modification of the existing cap through both surface heating and synoptic-scale ascent associated with the southern PV anomaly; (2) supercellular organization was supported regardless of the strength of the southern PV anomaly, although weak-to-moderate forcing from this feature was most conducive to the production of long lived supercells and strong forcing resulted in a trend toward linear mesoscale convective systems; (3) the cirrus shield was important in limiting development of convection and reducing competition between storms.