Low Level Jet Making the Atmosphere Unstable Again

Christopher Rattray
University of Manitoba

David B. Parsons, Alan Shapiro
School of Meteorology, University of Oklahoma

This study investigates the spatial and temporal variation of the nocturnal low-level jet (NNLJ) over the Southern Great Plains and its relationship to vertical profile of convective instability through 3-hourly radiosonde measurements taken from five sites during the International H2O Project. The nocturnal maximum in convection over the Great Plains during the summer has long been known to be correlated with the occurrence of the NLLJ. This correlation is typically considered to be due to the creation of potential instability as warm moist air is advected poleward by the southerly component of the NLLJ. Recent investigations suggest that this interpretation may need to be re-examined. For example, the NLLJ has been shown to contain distinctly different maximum in the both southerly and westerly winds with the peak in the westerly winds located well above the southerly maximum. Further evidence that relationship between the southerly flow and convective instability may need to be examined is that composites of convective instability in the NLLJ regime reveal the presence of a deep layer of air favorable for deep convection above the height of the southerly peak winds. This study confirms that the NLLJ over this region contains a peak in both the southerly and westerly winds. The relationship between the NLLJ and the vertical profile of convective instability was also found to vary significantly in space. For example, during the night the more favorable region of convective instability sometimes shifted from the western Plains toward the east due to a decrease in the depth of the moist layer at the western site after 0300 LST and significant increases in convective instability at and above the height of the southerly jet at locations near and to the east of the southerly maximum. These changes in instability are consistent with the general trend of an eastward progression of convection systems during the night. However, significant variations in the relationship between the NLLJ and convective instability occur from night-to-night related to the presence of ascent and the impacts of differential advection. This ascent is likely not explained by quasi-geostrophic dynamics as the oscillations in both the westerly and southerly maxima are primarily ageostrophic.