Interaction of Nocturnal Low-Level Jets with Urban Geometries as seen in Joint URBAN 2003 Data

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ABSTRACT

The nocturnal low-level jet (LLJ) is a well-documented phenomenon world-wide, especially in the southern Great Plains of the United States (Bonner 1968, Whiteman et al. 1997, Banta et al., 2002) where it contributes to severe weather. In the canonical rural case, the nocturnal LLJ forms as the release of daytime convective turbulent stresses allow nighttime winds above a stable boundary layer to accelerate to supergeostrophic wind speeds. In situations with surface winds of less than 5 m/s, wind speeds at altitudes of 100m due to the nocturnal LLJ can be greater than 20 m/s. The turbulence generated by this wind shear can induce nocturnal mixing events and control surface-atmosphere exchange, thereby affecting atmospheric transport and dispersion.

The Joint URBAN 2003 urban dispersion dataset, collected in Oklahoma City in July, 2003, includes several occurrences of strong LLJs, thereby providing a unique opportunity to document how the LLJ interacts with the complexity of urban geometries and to explore the significance of LLJs for transport and dispersion in urban environments. Based on this dataset, we will answer the following questions:

- How often do LLJs occur during the experiment?
- How does the increase in surface roughness represented by the city center, as compared to the rural environment, affect the altitude and speed of the jet, based on data from upwind and downwind wind profiles?
- How often do LLJs contribute to nocturnal mixing events within the Oklahoma City urban area, as observed in profiles of turbulence quantities at an 80m pseudo-tower located 750m downwind of Oklahoma City center?
- Can the effect of these LLJ-induced mixing events be identified in the dispersion datasets?

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