



LAWRENCE  
LIVERMORE  
NATIONAL  
LABORATORY

# Turbulence Kinetic Energy in the Oklahoma City Urban Environment

J. K. Lundquist, M. Leach, F. Gouveia

March 31, 2004

Fifth Symposium on the Urban Environment  
Vancouver, Canada  
August 23, 2004 through August 27, 2004

## **Disclaimer**

---

This document was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor the University of California nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or the University of California, and shall not be used for advertising or product endorsement purposes.

## Turbulence kinetic energy in the Oklahoma City urban environment

Julie K. Lundquist, Marty Leach, and Frank Gouveia  
Atmospheric Science Division  
Lawrence Livermore National Laboratory

The Joint URBAN 2003 field experiment took place in Oklahoma City, Oklahoma, during July 2003 to explore the effect of an urban canopy on the transport and diffusion of a passive tracer released in an urban area. Over one hundred three-dimensional sonic anemometers were deployed in and around the urban area to monitor wind speed, direction, and turbulence during releases of SF<sub>6</sub>. Deployment locations include a profile of eight sonic anemometers mounted on a crane located 1 km north (typically downwind) of the central business district, and several surface meteorological towers within an urban canyon.

We quantify the effect of the urban area on atmospheric turbulence using mean quantities and turbulent fluctuations from these sonic anemometers. We calculate several parameters that are typically used in parameterizations of urban turbulence, and compare the observed values to the empirical results currently used in many atmospheric urban models and results derived from wind tunnel studies. These parameters include the drag coefficient (local friction velocity/local mean wind speed) and normalized turbulent standard deviations.

We also quantify the turbulence kinetic energy (TKE) budget in the Oklahoma City urban area. Our analysis considers spectral data from the sonic anemometers: using streamwise spectra, TKE dissipation rates are calculated. The other terms in the TKE budget are also calculated. TKE budgets in various stability regimes will be presented and compared to those predicted by surface similarity theory and observed in other field experiments. The dominant length scales of velocity spectra will also be presented.

This work was performed under the auspices of the U.S. Department of Energy by University of California, Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.