EMS Annual Meeting Abstracts
Vol. 10, EMS2013-39, 2013
13th EMS / 11th ECAM

Assessing Techniques to Detect Surface Layer Coherent Structures with Dual-Doppler Lidar using Large Eddy Simulations

C. Stawiarski (1), C. Knigge (2), K. Träumner (1), and C. Kottmeier (1)

(1) Institute for Meteorology and Climate Research, Karlsruhe Institute of Technology, Karlsruhe, Germany (christina.stawiarski@kit.edu), (2) Institute for Meteorology and Climatology, Leibniz University of Hannover, Hannover, Germany (knigge@muk.uni-hannover.de)

Measurements and simulations show that the atmospheric surface layer exhibits coherent, recurring turbulent structures on length scales of 100 m to 1 km: low-speed streaks connected with updrafts (ejections), their counterpart of high-speed downdrafts (sweeps), and even horizontal roll vortices.
Dual-Doppler lidar systems can provide high-resolution 2D wind measurements and are therefore particularly suited for coherent structure research.
Methods have been developed to derive statistics of structure length, spacing and intensity of streaks. The method of Lagrangian coherent structures even allows to derive the vertical wind field and determine ejections/sweeps and vortices.
However, the reliability of these methods remains unknown, since dual-lidar measurements include considerable time and spatial averaging processes, and comparisons with in-situ measurements are inherently impossible.
To assess and validate dual-lidar measurement and connected structure detection techniques, we developed a lidar-simulation tool based on Large Eddy Simulation (LES) data with 10 m resolution. The lidar simulator performs realistic virtual lidar measurements in the LES wind field, which are used for coherent structure detection using methods such as clustering, Lagrangian algorithms and wavelet analysis. The results are compared with the underlying LES wind field and virtual tower measurements, which provides an insight into the opportunities and limitation of the usage of dual-Doppler lidar in the pursuit of a better understanding of surface layer coherent structures.