Geophysical Research Abstracts
Vol. 20, EGU2018-12542, 2018
EGU General Assembly 2018

Initial results of the Land-Atmosphere Feedback Experiment (LAFE)

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The Land-Atmosphere Feedback Experiment (LAFE) took place at the ARM Climate Research Facility Southern Great Plains (SGP) Megasite of the Atmospheric Radiation Measurement Program (ARM), OK, USA in August 2017. LAFE combined six thermodynamic scanning lidar systems with a suite of other state-of-the-art remote sensing and in-situ instruments. This novel synergy of remote sensing systems was applied for simultaneous measurements of land-surface fluxes and horizontal and vertical transport processes in the atmospheric boundary layer (ABL). The impact of spatial inhomogeneities of the soil-vegetation continuum on land-atmosphere (LA) feedback was studied using the scanning capability of the instrumentation as well as soil, vegetation, and surface flux measurements. For the first time, both the variability of surface fluxes and ABL thermodynamics over the SGP site was investigated simultaneously. This is essential for better understanding of LA feedback and for verifying simulations of LA feedback in large-eddy simulation (LES) and mesoscale models.

The synergy of remote sensing and in-situ instruments consisted of three components:

1) The SGP water-vapor and temperature Raman lidar, the SGP Doppler lidar, the University of Hohenheim (UHOH) Doppler lidar, and the National Center for Atmospheric Research (NCAR) water-vapor differential absorption (DIAL) to measure continuously mean profiles and vertical gradients of moisture, temperature, and horizontal wind. Due to their high vertical and temporal resolutions, also profiles of higher-order turbulent moments in the water vapor and wind fields as well as of profiles of the latent heat flux, the sensible heat flux, turbulent kinetic energy, and momentum flux were observed.

2) A novel scanning lidar system synergy consisting of the UHOH water-vapor differential absorption lidar, the UHOH temperature rotational Raman lidar, and the National Oceanic and Atmospheric Administration (NOAA) high-resolution Doppler lidar. These systems performed coordinated range-height indicator (RHI) scans from the top of the canopy level to the lower troposphere including the interfacial layer at the ABL top. This component was augmented by three energy balance closure (EBC) towers of NOAA and one EBC station of UHOH.

3) The University of Wisconsin-Madison Space Science and Engineering Center Portable Atmospheric Research Center (SPARC) and the University of Oklahoma/NOAA National Severe Storms Laboratory Collaborative Lower Atmospheric Mobile Profiling System (CLAMPS) operating two vertically pointing atmospheric emitted radiance interferometers and two Doppler lidar systems scanning cross track to the central RHI of component 2 for determining the surface friction velocity and the horizontal variability of temperature, moisture, and wind.

NOAA's Air Resources Laboratory (ARL) also provided unmanned aerial system (UAS) and aircraft measurements (Navajo Piper) in accordance with the surface scans.

Initial results of LAFE will be presented.