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The Land-Atmosphere Feedback Observatory (LAFO)

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A new Land-Atmosphere Feedback Observatory (LAFO) was established at the University of Hohenheim, Stuttgart, Germany. It is considered as a role model for a network of GEWEX LAFOs (GLAFOs) that is a central project and proposed by the GEWEX Global Land/Atmosphere System Study (GLASS) panel (Wulfmeyer et al. 2020). Its main objective is to observe directly land-atmosphere (L-A) feedback for process understanding and improving its representation in weather and climate models. The set up phase of this research facility was funded as infrastructure project of the Carl Zeiss Foundation. The main goals are to

1) investigate the diurnal cycle of the planetary boundary layer (PBL) including its turbulent properties,
2) improve parameterizations based of vegetation dynamics, surface and PBL fluxes, and
3) verify mesoscale and turbulence permitting models,
4) characterize L-A feedback by suitable metrics.

LAFO brings together a sensor synergy with unequaled spatial and temporal resolution. An extended set of soil physical, plant dynamic as well as meteorological variables throughout the PBL are measured focusing on evapotranspiration and turbulent exchange processes over an agricultural landscape. Observations are recorded with state-of-the-art instruments on a long-term basis as well as with a more sophisticated sensor setup campaign based.

The first key component of the LAFO sensor synergy consists of 3D scanning lidar systems: A scanning water vapor differential absorption lidar and a scanning temperature and humidity rotational Raman lidar, both developed at the Institute of Physics and Meteorology. Both systems are worldwide unique and provide water vapor and temperature remote sensing data in the surface layer up to the lower free troposphere with very high resolution up to the turbulent scale (Behrendt et al. 2015, Wulfmeyer et al. 2015, Muppa et al. 2016, Späth et al. 2016, Lange et al. 2019). Additionally, two scanning Doppler lidars measure the horizontal and vertical wind profiles and turbulent wind fluctuations. The lidar measurements are complemented by a 3D scanning Doppler cloud radar.

The second key component is a soil water and soil temperature sensor network distributed over the agricultural study area combined with two eddy-covariance stations (Imukova et al. 2016) to observe fluxes at the land surface.

The third key component consists of devices for vegetation characterization. As an example, the "BreedVision" phenotyping platform (Busemeyer et al. 2013) based on an innovative sensor-setup provides an extensive set of sensor-data for field phenotyping and feature prediction without vegetation destruction. Unman aerial vehicles (UAVs) with spectroscopic cameras are also available.

For specific campaigns studying L-A feedback with particularly high detail, research partners are highly welcome to join our research team. Following the FAIR (Findable, Accessible, Interoperable, Reusable) data principle, our data will be made available on a website. We present first measurement examples and show how these can be used to reach our research goals.

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