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Study of the Relationship Between Surface Fluxes and Convective Boundary Layer Dynamics with Lidars.

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The atmospheric boundary layer (ABL) is the lowest part of atmosphere. It is directly influenced by the Earth's surface. To understand the influence of surface fluxes on ABL turbulence processes during daytime in convective conditions, the use of lidars and Eddy covariance stations are essential. Such better understanding will then help to improve weather and climate models. The Land-Atmosphere Feedback Observatory (LAFO) at the University of Hohenheim, Stuttgart, Germany is a designated study site for agricultural experiments equipped with various sensors to analyze state variables from the soil to the lower free troposphere (Späth et al., 2023). To investigate boundary layer turbulence, two Doppler lidars, a Doppler Cloud Radar, the lidar Atmospheric Raman Temperature and Humidity Sounder (ARTHUS) (Lange et al., 2019), and two Eddy covariance stations are deployed at LAFO to capture high-resolution data. Two Doppler lidars are continuously operated, one in vertical pointing mode and the second in six-beam scanning mode (Bonin et al., 2017) to measure high spatial and temporal resolution vertical and horizontal wind data. The turbulent surface fluxes significantly impact the ABL exchange processes. Therefore, it is very interesting to integrate the continuous high temporal resolution measurements of Eddy covariance sensors with lidars measurement. The key turbulent variables are retrieved from high frequency vertical wind data. These turbulence statistics are transversal temporal autocovariance functions, its coefficients in the inertial subrange using appropriate fit lags, atmospheric vertical wind variance, integral time scale, turbulence kinetic energy dissipation (Wulfmeyer et al., 2023), cloud base height and ABL depth. We have used two methods to determine the ABL depth. The first retrieval method is based on fuzzy logic (Bonin et al., 2018) which uses atmospheric vertical velocity variance profiles. The second method employs Haar wavelet transform (Pal et al., 2010) on water vapor mixing ratio and potential temperature profiles.

In this contribution, we are presenting our analyses on correlation statistics between surface fluxes and ABL depth and influence of these surface fluxes on turbulence variables covering different daytime weather conditions from June to August in 2021.

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