Water vapor transport in the turbulent planetary boundary layer (PBL) measured over heterogeneous terrain using multiple LiDAR systems.

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Water vapor plays a crucial role for several processes on almost every scale of Earth’s atmosphere. However, its turbulent transport throughout the PBL is at the same time particularly important and not very well understood. With the increasing resolution of numerical models arises the need for improved representations of the small-scale and nonlinear turbulent processes inside the PBL. Recent papers have shown that these refinements, predominantly on water vapor transport, are urgently needed as they are a limiting factor in the process of lifting numerical weather prediction to the next level.

The CHEESEHEAD campaign, carried out in summer 2019, especially addresses the complex, turbulent land-atmosphere interactions over heterogeneous terrain and aims to close the energy balance. Therefore, a dense network of sensors has been installed measuring throughout the scales of the PBL with a multiple set of different measurement techniques. Within this proposed contribution, first results from the CHEESEHEAD measurements with a water vapor DIAL in combination with several Doppler wind LiDARs will be presented. The synergy of a virtual tower scanning geometry of the Doppler LiDARs right next to the water vapor DIAL delivers highly resolved data throughout the entire PBL. Therefore, special focus of this work lies on turbulent fluctuations inside vertical water vapor columns during the measuring time, spanning the entire PBL. This gives the additional opportunity to observe important entrainment processes at the very top of the PBL. Furthermore, this work deals with the calculation of vertical fluxes of latent heat. Therefore, the essential question whether this data is suitable for these calculations, which are highly sensitive towards temporal resolution, will be addressed. As a further step, aerosol and temperature data that have been measured with the same LiDAR system shall be integrated as well - aiming towards a comprehensive insight on relevant processes throughout the entire PBL.

How to cite: Speidel, J., Vogelmann, H., Mauder, M., Perfahl, M., Wagner, T. J., and Wanner, L.: Water vapor transport in the turbulent planetary boundary layer (PBL) measured over heterogeneous terrain using multiple LiDAR systems., EGU General Assembly 2020, Online, 4–8