Convective boundary layer sensible and latent heat flux lidar observations and towards new model parametrizations.

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The turbulent transport of heat, matter and momentum in the convective boundary layer (CBL) is a key process to understand the 3D distribution of scalars in the atmosphere. Particularly critical are the surface and the entrainment layers that buffer the CBL, at the bottom with the soil and at the top with the free troposphere, respectively. If the surface layer exchanges are usually well documented by in situ observations and well understood following Monin-Obukhov similarity theory (MOST), the entrainment processes are still an unknown field both for observations and models. However, a robust parametrization of entrainment fluxes is essential for transport models to link surface fluxes and tropospheric vertical profiles of scalars such as H2O, CO2 and CH4. This is of particular importance for current and future space borne GHGs missions like GOSAT, OCO, MERLIN, that try to estimate surface fluxes from column integrated mixing ratio measurements. To do so, new observations are needed that can provide, first, a 3-D view of the atmosphere and second, that have turbulence-scale temporal and spatial resolutions in order to investigate flux- gradient relationships and estimate higher-order moments. The observations will also have to be made in different climate zones in order to study the robustness of advanced parameterizations.

In this idea, a new wind, temperature, H2O and CO2 scanning lidars mobile observatory has been developed at Laboratoire de Météorologie Dynamique, Ecole Polytechnique, France, during the last years. Two different scanning lidars are involved: 1) a temperature and water vapor Raman lidar at 355 nm; 2) a prototype DIAL and Doppler lidar at 2051 nm with a coherent and direct detection for wind speed and CO2 absorption measurements. The mobile observatory was operated in a temperate region at SIRTA observatory, Palaiseau, France and then in the semi-arid area of Lleida, Spain during the LIAISE experiment (Land surface interactions with the atmosphere over the Iberian semi-arid environment) in July 2021.

In this paper we will present a preliminary analysis of the data with multiple goals: (i) to address the issue of dissimilarity of scalar transport such as heat and water vapor in different climate regions (ii) to test model parameterization of the interfacial layer especially for fluxes and scalar variances. (iii) to assess the relevance of MOST which links gradient and flux close to the surface in heterogeneous landscape.