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Evaporation Controlled by Boundary Layer Feedbacks in an Irrigated Semi-Arid Environment: a LIAISE Modeling and Data Study

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The LIAISE experiment (*L*and surface *I*nteractions with the *A*tmosphere over the *I*berian *S*emi-arid *E*nvironment) was conducted during the summer of 2021 in the Pla d'Urgell region of the Ebro River Valley in Catalonia, Spain (Boone et al., 2021). In the LIAISE experimental region, the surface was homogeneous at the field scale (e.g. fields of alfalfa); however, the surface was heterogeneous at the regional scale (~10-100km) because of the spatial distribution of irrigated crops and dry natural vegetation. During the LIAISE experiment, there were extensive observations of both the surface and the boundary layer in the dry and irrigated landscapes. The observed boundary layer is formed through a composite of surface fluxes from both the irrigated and rainfed surfaces. Likewise, the observed surface fluxes of individual fields in both regions are controlled by both the surface properties and the regional boundary layer characteristics.

In this study, we examine the impact of the boundary layer on surface fluxes at two of the LIAISE sites: one in the irrigated, crop-covered area and one in the dry, naturally-vegetated area. We use an atmospheric mixed-layer column model (CLASS, Vilà-Guerau de Arellano et al., 2015) that is heavily constrained by the surface and boundary layer observations from the LIAISE experiment. The modeling approach consists of two steps: first the boundary layer was modeled using a composite surface to mimic the landscape scale processes as a control, then a local perspective was adopted to investigate the drivers of evaporation in both the irrigated and rainfed areas. At the local scale, we use a parameterized evaporation tendency equation introduced by van Heerwaarden et al., 2010 for both model data and observations. This equation is used both to evaluate the time tendency of boundary layer feedbacks to evaporation and to diagnose the causes of local evaporation tendency. This approach allows us to quantify the relative importance of the boundary layer controls on evaporation compared to other controls on evaporation (e.g. radiation and advection) at the field scale.

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