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Evaporation from porous surfaces into turbulent air flows–On the coupling of momentum and thermal signatures

Erfan Haghighi and Dani Or

Institute of Terrestrial Ecosystems, Department of Environmental Systems Science, ETH Zurich, Zürich, Switzerland (erfan.haghighi@usys.ethz.ch)

The ubiquitous and energy intensive mass transfer between evaporating surfaces and convective air streams is of great interest for various natural and industrial applications. Turbulent air flows above surfaces are common and are associated with complex and highly dynamic boundary conditions that must be considered for prediction of surface evaporation rates. During a certain period in the drying process where phase change takes place primarily at the surface (the so called stage-1 evaporation), one may use thermal signatures associated with the complex evaporation filed using infrared thermography (IRT) to characterize instantaneous evaporation rates. The study explores quantifiable links between the spatio-temporal distribution of eddy-induced localized evaporation rates and associated thermal signatures to deduce overall evaporative losses and to quantify characteristics of turbulent airflow. Preliminary results suggest that the methodology offers unique opportunities for directly linking turbulent eddies interacting with the surface and the resulting evaporative fluxes thereby providing the essential building blocks for upscaling results to field and landscape scales for a range of turbulent flow regimes.

Keywords: Evaporative Drying, Turbulence, Surface Renewal, Infrared Thermography.