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Temperature field beneath evaporating surface resolved by infrared thermography

Ebrahim Shahraeeni (1) and Dani Or (2)

(1) ETH Zurich, Mechanical and Process Engineering Department, Zurich, Switzerland (ebrahim.shahraeeni@env.ethz.ch),
(2) ETH Zurich, Environmental Science Department, Zurich, Switzerland (dani.or@env.ethz.ch)

Land-atmosphere mass exchange is intimately linked with radiation and energy balance of terrestrial surfaces. Surface evaporation is a key hydrologic flux affected by interplay between water supply from below, surface energy input, and exchange across air boundary layer. The thermal signature depression of an evaporating surface is proportional to the magnitude of the flux which makes remote monitoring of fluxes from heterogeneous surface feasible using advanced Infrared thermography (IRT). Inversion of IRT data to evaporation fluxes relies on knowledge of thickness of thermal depression beneath evaporation zone. We develop a mathematical model for 3D temperature field induced by evaporation from a patchy evaporative surface and compare the results with direct IRT measurements of cross section beneath an evaporating surface. Results yield a universal description of evaporative temperature depression that could serve for predicting spatial and temporal evaporation rates distributions based on IRT data. The thickness of thermo-evaporative zone is typically in the range of 10-40 mm for a wide range of soil properties and fluxes.