Geophysical Research Abstracts
Vol. 14, EGU2012-2439, 2012
EGU General Assembly 2012
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From pores to eddies - linking diffusion-based evaporative fluxes from porous surfaces with a turbulent air boundary layer

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Evaporation affects hydration and energy balance of terrestrial surfaces. Evaporation rates exhibit complex dynamics reflecting interactions between external conditions and internal transport properties of a the drying porous surface Motivated by recent progress in estimating evaporative fluxes from isolated pores across laminar air sublayer, we seek to expand the description and quantify evaporation across a turbulent boundary layer. We adopt concepts from surface renewal (SR) theory focusing on turbulent exchange with individual eddies and linking eddies surface footprint and their local boundary layer over patches of a drying surface. The model resolves diffusive exchange during limited residence time and integrates fluxes over the entire surface to quantify mean evaporative fluxes from drying surfaces into turbulent airflows accounting for subsurface internal transport processes and diffusive exchanges. Input parameters and model evaluation would be based on data from spatially and temporally resolved Infrared (IR) thermography of drying surfaces under prescribe turbulent regimes conducted in a wind-tunnel experiment. The study provides basic ingredients and building blocks essential for upscaling the results to estimation of evaporative fluxes at the field and landscape scales.

Keywords: Evaporation; Turbulent Coupling; Surface Renewal; Infrared Imaging.