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Turbulent flux transfer over bare-soil surfaces: Characteristics and parameterization

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Parameterization of turbulent flux from bare soil and under-canopy surfaces is imperative for modeling land-atmosphere interactions in arid and semi-arid regions, where flux from the ground is dominant or comparable to canopy-sourced flux. This paper presents the major characteristics of turbulent flux transfers over seven bare soil surfaces. These sites are located in arid, semi-arid, and semi-humid regions in Asia, and represent a variety of conditions for aerodynamic roughness length (z0m; from $<$ 1 to 10 mm) and sensible heat flux (-50 ˜ 400 W mˆ-2). For each site, parameter kBˆ-1 (= ln(z0m/z0h), z0h is the thermal roughness length) exhibits clear diurnal variations with higher values during the day and lower values at night. Mean values of z0h for the individual sites do not change significantly with z0m, resulting in kBˆ-1 increasing with z0m, and thus the momentum transfer coefficient increases faster than the heat transfer coefficient with z0m. kBˆ-1 often becomes negative at night for relatively smooth surfaces (z0m ˜ 1 mm), indicating the widely accepted excess resistance for heat transfer can be negative, which cannot be explained by current theories for aerodynamically rough surfaces. Finally, we evaluate several kBˆ-1 schemes using the same data sets. The results indicate a scheme that can reproduce the diurnal variation of kBˆ-1 generally performs better than schemes that cannot.