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Local Land-Atmosphere Interaction: Exploring the Terrestrial Leg with “Little Omega”

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Land-atmosphere coupling involves the interaction between the land-surface and the overlying atmospheric boundary layer, with effects on and by the free atmosphere above, and then with associated downstream impacts on clouds, convection and precipitation. We focus on the "terrestrial leg" of land-atmosphere coupling, that is, the near-surface land-atmosphere interaction where changing soil moisture affects the surface evapotranspiration. (The "atmospheric leg" of land-atmosphere coupling involves changes in surface fluxes and the effects on the atmospheric boundary layer, with those downstream impacts.) The change in surface evapotranspiration, or evaporative fraction, with changing soil moisture is an indicator of the strength of coupling between the soil/surface and the near-surface atmosphere, where for strong coupling, a given change in soil moisture yields a large change in the evaporative fraction, and for weak coupling, a given change in soil moisture yields a small change in the evaporative fraction. The strength of coupling depends on a number of different conditions and processes, i.e. the nature of the surface-layer turbulence, to what degree the surface is vegetated and by what type of vegetation, what the soil texture is, and how plant transpiration and soil hydraulic and soil thermal processes change with changing soil moisture. We examine this terrestrial leg of land-atmosphere coupling with an analytical development using the Penman-Monteith equation, then evaluate several years of fluxnet data sets from multiple sites to characterize these interactions on the local scale, contrasting different landscapes, e.g. grasslands versus forests, and other surface types. Initial findings show stronger coupling over forests.