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Land atmosphere coupling diagnosed from a regional climate model integration for West-Africa

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Land-atmosphere coupling exists at a wide range of spatial and temporal scales. Hydrological coupling involves (a) the direct feedback of the atmosphere to surface evaporation, (b) the sensitivity of soil moisture to precipitation, evaporation and runoff, (c) the development and fuelling of convective clouds and precipitation, (d) the memory exerted by the soil water reservoir, and (e) the spatial organization of atmospheric moisture in response to gradients in the surface conditions. Various diagnostics have been derived from models and observations, but usually these analyses focus on one or a few spatial or temporal dimensions.

The West-African monsoon area is a climate zone in which mutual land-atmosphere coupling is a strong component of the hydrological cycle. Model analyses demonstrate this area as a 'hotspot' for land-atmosphere coupling. Also observational analyses show a strong sensitivity of atmospheric hydrological properties to the land surface state.

In this study a regional climate model simulation over West-Africa, covering a 17-yr historical period, is analyzed with respect to a wide variety of coupling diagnostics. Areas are highlighted where a combination of significant sensitivities leads to a strong land-atmosphere feedback strength. All model diagnostics are in principle observable, which opens the pathway to a true evaluation of model feedback properties from observations.