Climate and Land Surface Changes in Hydrology
Proceedings of H01, IAHS-IAPSO-IASPEI Assembly, Gothenburg, Sweden, July 2013 (IAHS Publ. 359, 2013) 140-145 .

Impact of groundwater dynamics and soil-type on modelling coupled water exchange processes between land and atmosphere

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Abstract Regional atmospheric models such as the Weather Research and Forecasting model (WRF) employ land-surface models (LSMs) that usually neglect the influence of the saturated zone. An inadequate representation of the interaction between the saturated and unsaturated zones, however, could lead to unrealistic soil-moisture and -temperature conditions and thus introduce limitations to accurately describing the evapotranspiration and planetary boundary layer processes, and consequently precipitation generation. We present a process study comparing two parameterization schemes for groundwater–soil-moisture interaction in the Noah-LSM against the standard free-drainage lower boundary. It serves as the foundation for a fully two-way coupled extension of the hydrological-atmospheric model system, WRF-Hydro.With the groundwater controlled lower boundary condition, depending on the soil-type, the resulting annual water budgets change by up to 20% for the volumetric water content of the top soil layer, by 6 to 67 mm for surface runoff, and by –10 to 75 mm for evapotranspiration.

Key words groundwater; soil moisture; surface atmosphere feedback; coupled model; water budgets