Geophysical Research Abstracts
Vol. 19, EGU2017-18813, 2017
EGU General Assembly 2017

Joint atmospheric-terrestrial water balances for East Africa: A WRF-Hydro case study for the upper Tana River basin

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The fully coupled WRF-Hydro modeling system is applied to the Mathioya-Sagana subcatchment in the upper Tana River basin in order to study its water balances (terrestrial and atmospheric). The simulation period runs for 4-year period. The simulated terrestrial and atmospheric components from the coupled WRF-Hydro are compared to the WRF-only model. The coupled WRF-Hydro slightly reduces precipitation, evapotranspiration, and the soil water storage, but increases runoff. Precipitation results are closer to that derived from the Climate Hazards Group Infrared Precipitation with Stations (CHIRPS) data (989 mm/yr) than from the TRMM (795 mm/yr) precipitation product. The coupled WRF-Hydro accumulated discharge (323 mm/yr) is close to that observed (333 mm/yr) at the outlet of the subcatchment. The land-precipitation feedback mechanisms (precipitation recycling and efficiency) in both coupled WRF-Hydro and WRF-only are small and close. This suggests a weak land-precipitation feedback mechanism and that precipitation in the region comes from moisture advection from outside that analysis domain. In general, the coupled WRF-Hydro is a promising tool in quantifying the atmospheric- terrestrial water balance in this region.