Evaluation of a fully coupled atmospheric-hydrological modeling system for the Sissili watershed in the West African Sudanian Savannah

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OBJECTIVE: Provide a coupled modeling system able to reproduce the hydro-meteorological fluxes observed in the Sissili watershed, in preparation to land use change and climate change impact studies that will be done in the context of WASCAL (West African Service Center on Climate Change and Adaptive Land Use)

Atmospheric-hydrological model (WRF-hydro) set-up

- Two nested domains at 10 and 2 km resolution (fig. 1) with the Weather Research and Forecasting (**WRF**) model
- Inner domain coupled with the NCAR Distributed Hydrological Modeling System (**NDHMS**) for computing overland and river water flow in the Sissili watershed on a 2 km resolution grid (fig. 2)
- This **WRF-hydro** set-up is run for **two time-periods**:
  - **2003-2004:** for comparison with available **discharge observations at Wiasi** (see location in fig. 2)
  - **2013:** for comparison with **Eddy Covariance (EC) flux observations at the tower site of Nazinga** (see location in fig. 2)

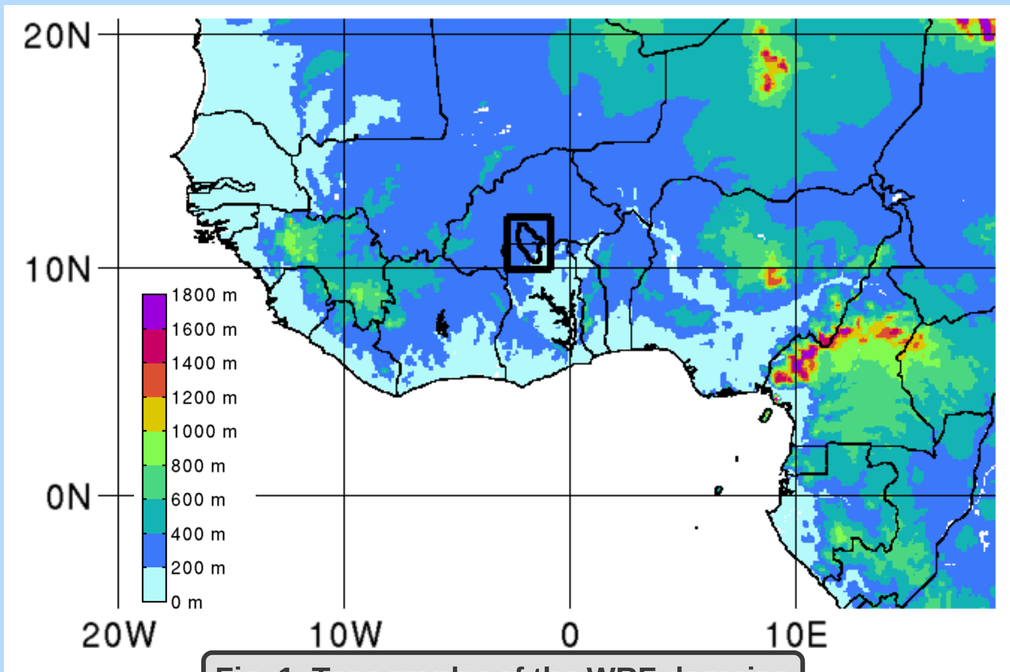

Fig. 1. Topography of the WRF domains

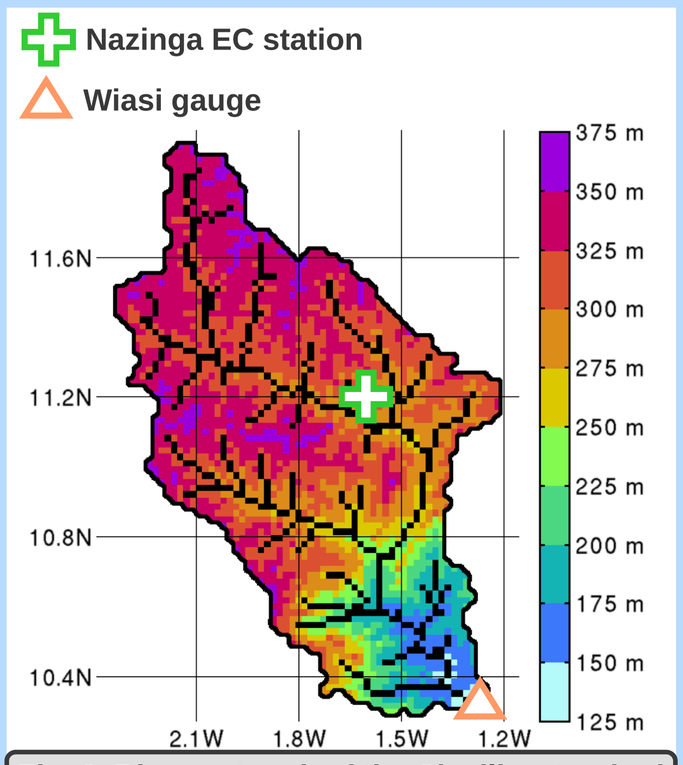

Fig. 2. River network of the Sissili watershed

WRF-hydro run for 2003-2004 : Rainfall, discharge validation

- Weekly areal-rainfall for the Sissili watershed from WRF-hydro, TRMM (Tropical Rainfall Measuring Mission)
- Daily discharge at Wiasi from WRF-hydro, gauge observation
- **Modeling weekly rainfall relatively close to TRMM, WRF-hydro also reproduces observed discharge with a Nash-Sutcliffe Coefficient of 0.4**

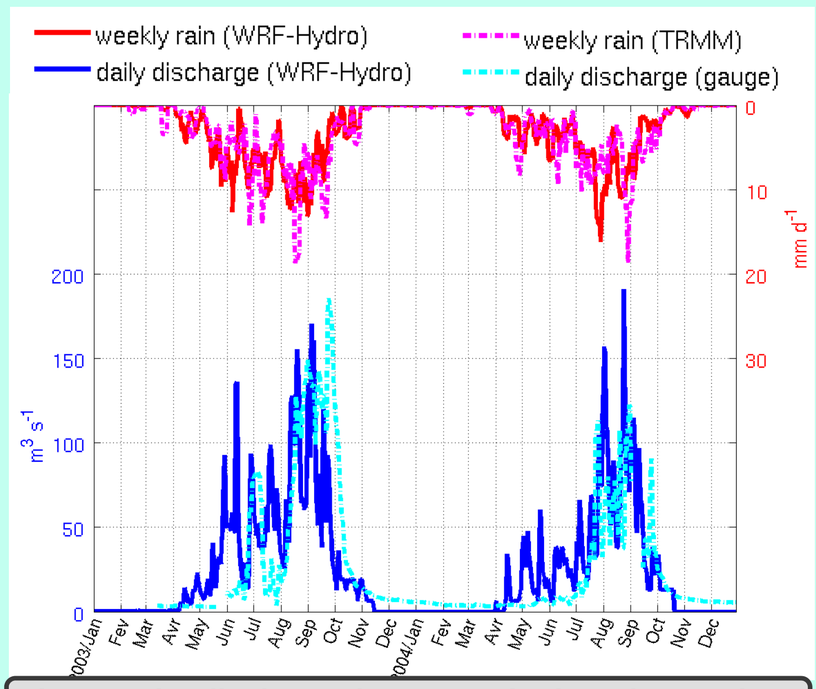

Fig. 3. Rain, discharge from WRF-hydro, observations

WRF-hydro run for 2013 : Surface fluxes validation

- Net Radiation flux (R_{NET}), sensible (H) and latent (LH) heat fluxes are generally overestimated
- The ground heat flux (G) is generally underestimated

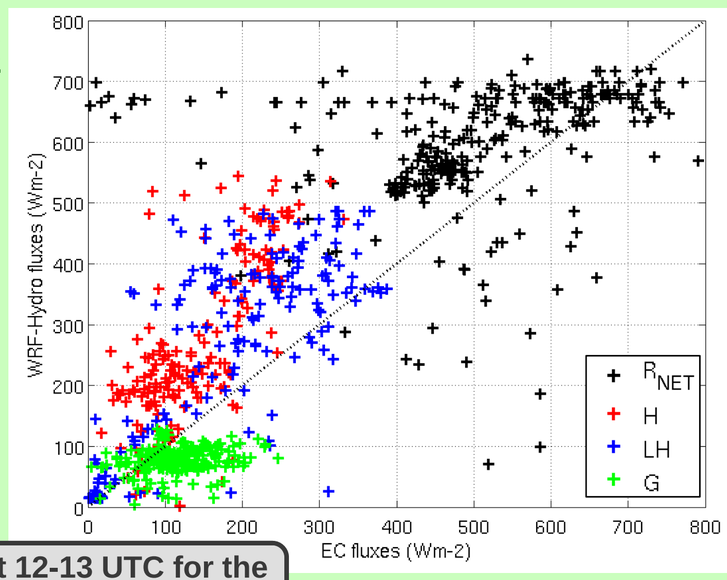

Fig. 4. Scatter plot of surface fluxes at 12-13 UTC for the year 2013, between WRF-hydro and EC observations

Soil water balance (WRF-hydro - WRF) in 2013

According to WRF-hydro, most of the surface runoff predicted by WRF goes into the soil storage

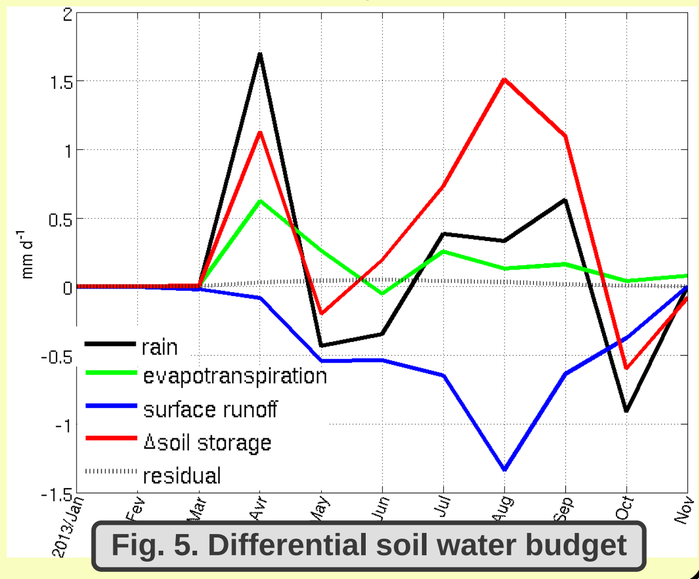

Fig. 5. Differential soil water budget

ON-GOING WORK: Further tune NDHMS (routing grid resolution vs river network density vs surface roughness vs infiltration excess), add a ground water model, compare WRF and WRF-hydro for multi-year runs

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