Estimating trajectories for groundwater and surface water resources in West Africa requires a correct representation of the geometry and hydraulic properties of the weathering profile of Hard-Rock aquifers in integrated models. Particular attention should be paid to subsurface clay accumulations and vegetation.

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METHODS

Exp1: Mean Ks	Exp2: Ks heterogeneity	Exp3: Role of fissured layer	Exp 4: Mean Ks subsurface	Exp5: clay extent in lowlands
24 % of clay cells	24 % of clay cells	24 % of clay cells	a) 24 % of clay b) $2 \cdot 10^{-4}$ c) $3 \cdot 10^{-4}$ d) $4 \cdot 10^{-4}$	a) 0%, of clay b) 10%,of clay c) 24% of clay d) 48% of clay
a) $2{,}9 \cdot 10^{-3}$ b) $1.5 \cdot 10^{-2}$ c) $6 \cdot 10^{-2}$ d) $6 \cdot 10^{-1}$	a) $1.5 \cdot 10^{-2}$ b) σ–0.66 cl–1 km c) σ=0.66 cl=10 km d) σ=0.66 cl=50 km	a) $1.5 \cdot 10^{-2}$ b) $1.5 \cdot 10^{-2}$ c) $1.5 \cdot 10^{-2}$ d) $1.5 \cdot 10^{-2}$	a) $1.5 \cdot 10^{-2}$ b) $1.5 \cdot 10^{-2}$ c) $1.5 \cdot 10^{-2}$ d) $1.5 \cdot 10^{-2}$	a) $1.5 \cdot 10^{-2}$ b) $1.5 \cdot 10^{-2}$ c) $1.5 \cdot 10^{-2}$ d) $1.5 \cdot 10^{-2}$
		b) $Ks_{H4}=Ks_{H3}$ c) $Ks_{H4}=10 \cdot Ks_{H3}$ d) $Ks_{H4}=100 \cdot Ks_{H3}$		

Hydraulic conductivity Ks in [m h^{-1}]

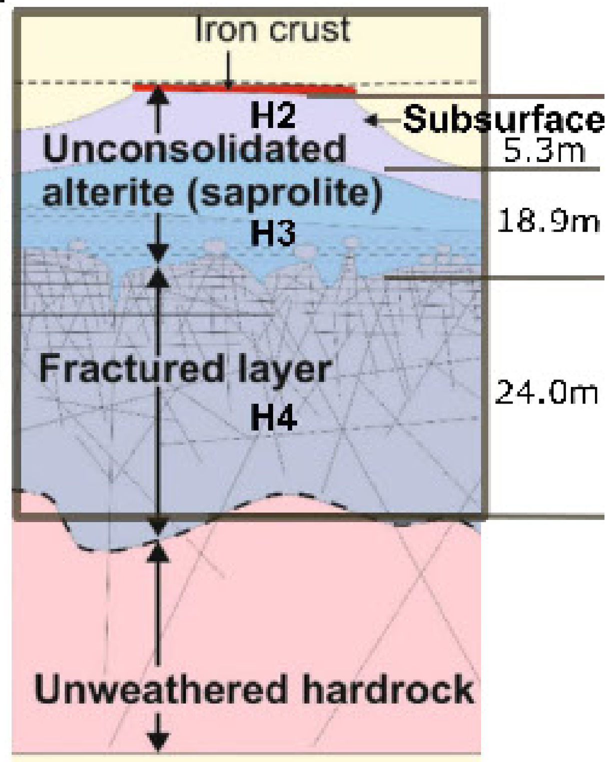

Figure 2: The model experimental design is based on the hydrogeological structure of Hard Rock Aquifers (HRA).

- Parameter estimation in integrated models is limited by enormous numerical efforts.
- We used a parametric sensitivity analysis with 5 experiments to investigate the role of properties and geometry of Hard-Rock aquifers in modeling of groundwater (GW), surface flows (Q) and the total water budget in West Africa.
- We used the integrated model Parflow-CLM at a spatial resolution of 1 km² for the Upper Ouémé.

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A Parametric Sensitivity Analysis of the Representation of Regolith Hydraulic Conductivity for Modeling Water Transfers in the West African Critical Zone

Amelie Herzog[(1)], Basile Hector[(2)], Jean Martial Cohard[(2)], Jean Michel Vouillamoz[(2)], Fabrice Lawson[(3)(2)], Christophe Peugeot[(4)], Inge de Graaf[(5)(1)]

(1) Chair of Environmental Hydrological Systems, Albert-Ludwigs-University of Freiburg
(2) Université Grenoble-Alpes, Institut des Géosciences de l'Environnement(IGE), CNRS, Institut de la Recherche pour le Développement (IRD), Grenoble, France
(3) Université d'Abomey-Calavi, Institut National de l'Eau (INE), Cotonou, Benin.
(4) Hydrosciences Montpellier (HSM), IRD, CNRS, Université de Montpellier, Montpellier, France
(5) Wageningen University, Water Systems and Global Change group, Wageningen, Netherlands

RESULTS

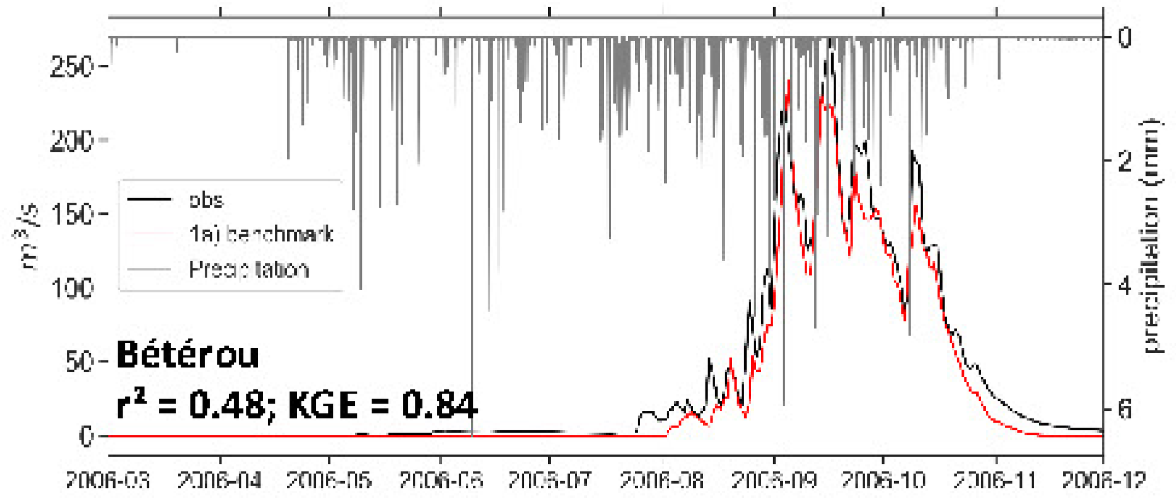
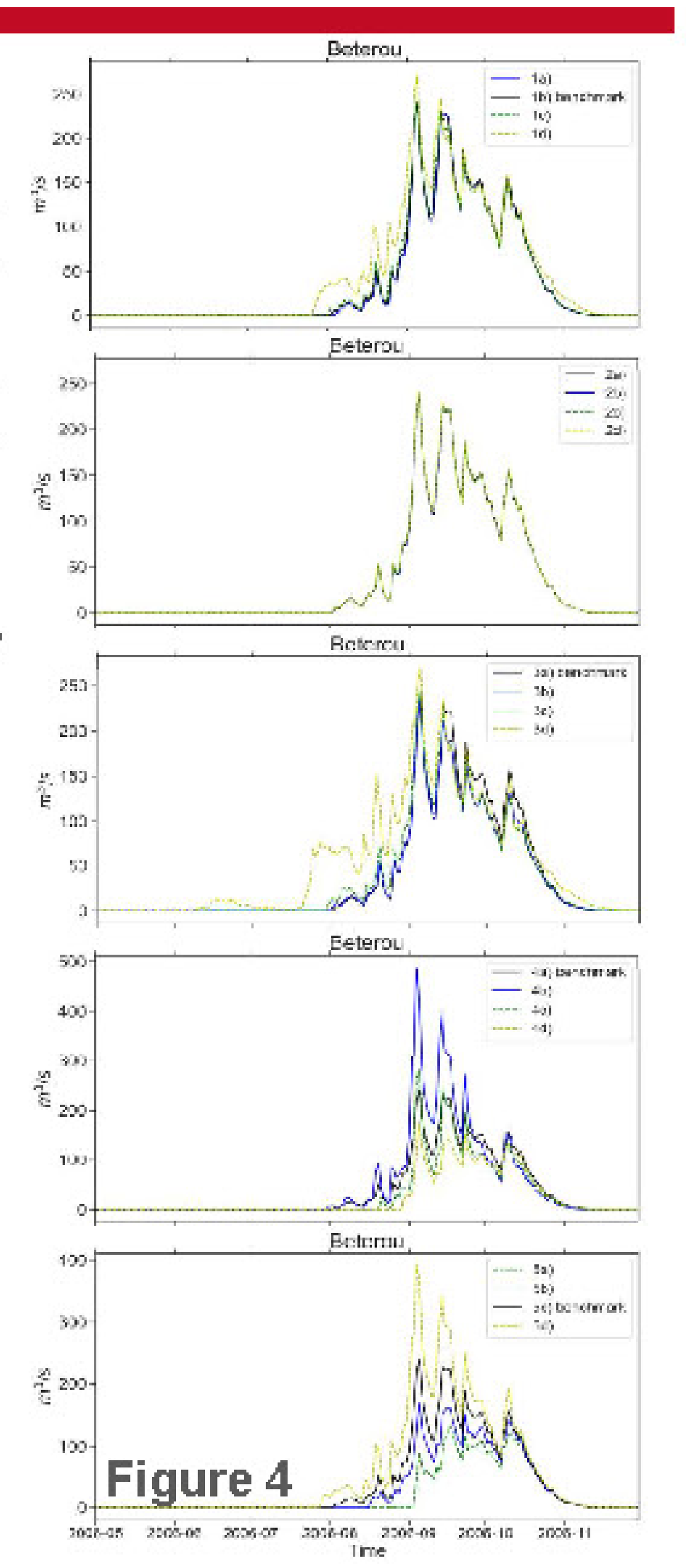
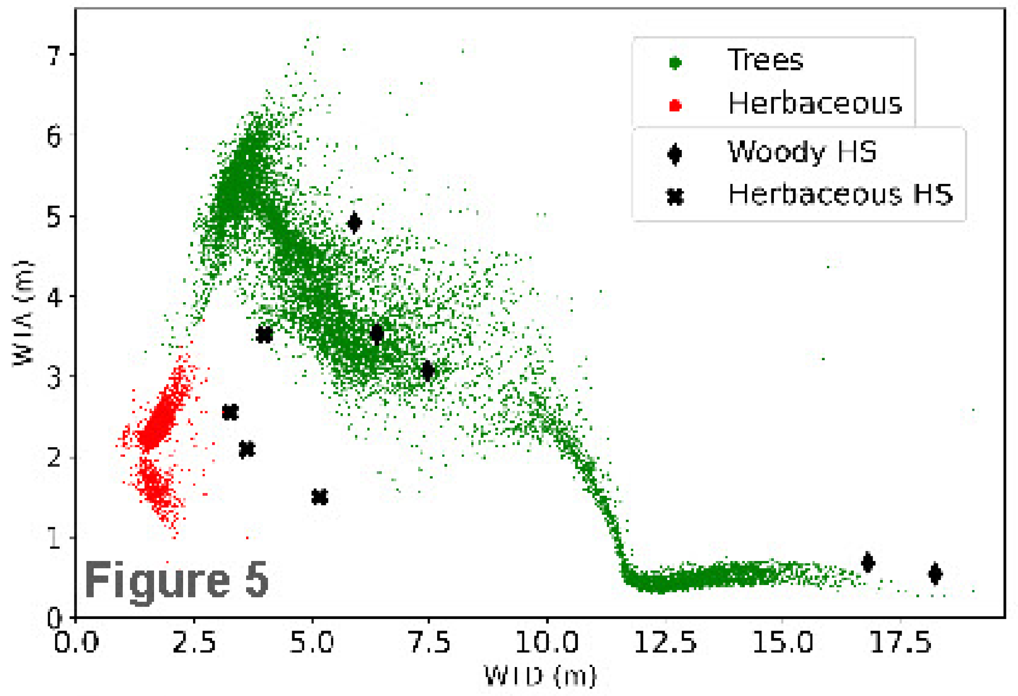


Figure 3: The best simulation result for streamflow at Beterou (benchmark simulation)

Streamflow

- Best results were obtained with:
  - 24 % of clay content spreading from river cells in the subsurface
  - a single aquifer layer with a constant Ks = 0.015 m h^{-1}.
- Streamflow is not sensitive to regolith Ks except in the narrow range between 1×10^{-4} mh^{-1} and 4×10^{-4} mh^{-1} in the near subsurface **(Figure 4).**





Groundwater

- Figure 5 suggests that there are important feedbacks between vegetation and the GW table.
- A limit of Ks is visible, where the impact of 1D processes on WT dynamics ceases.

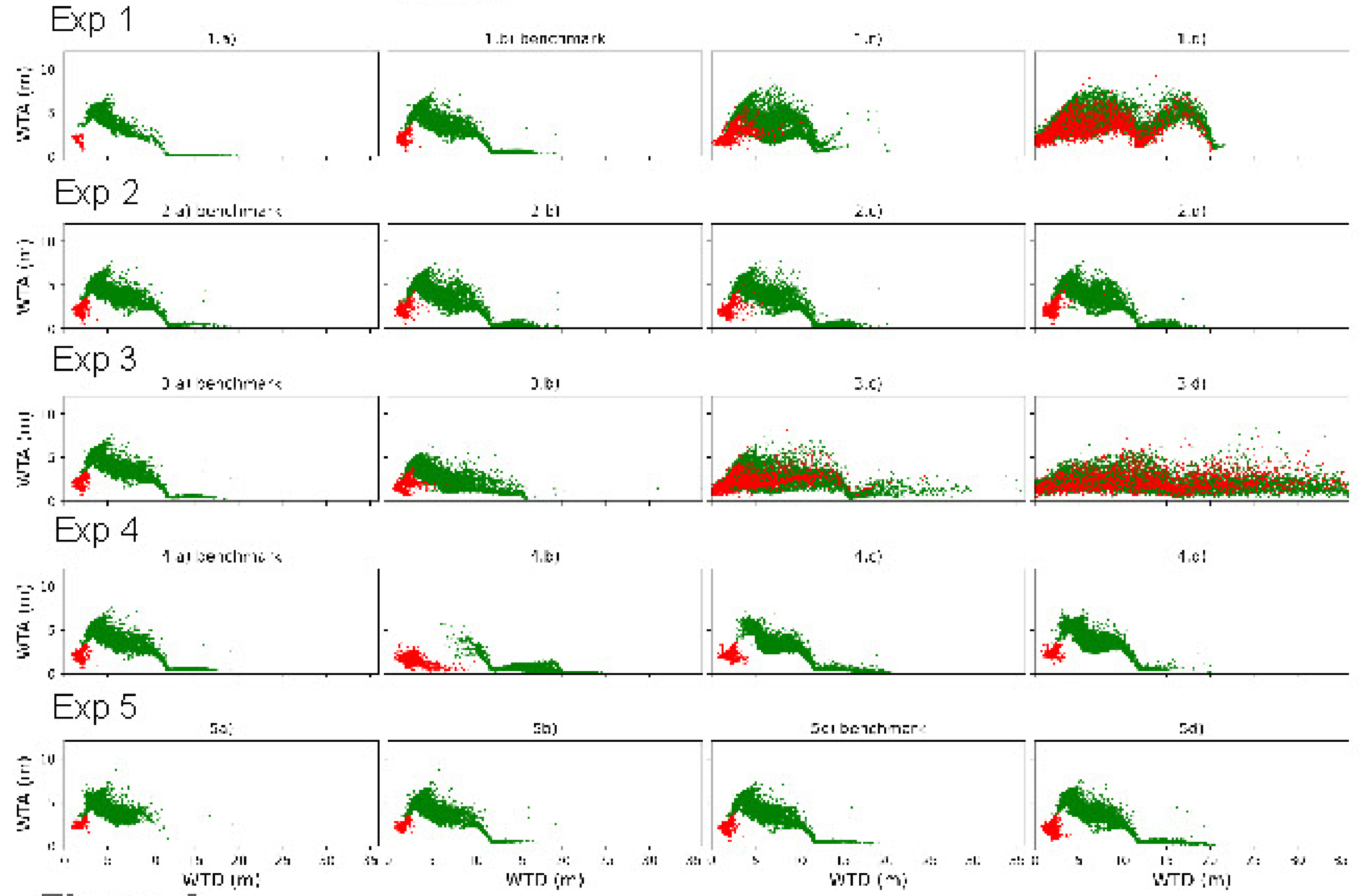
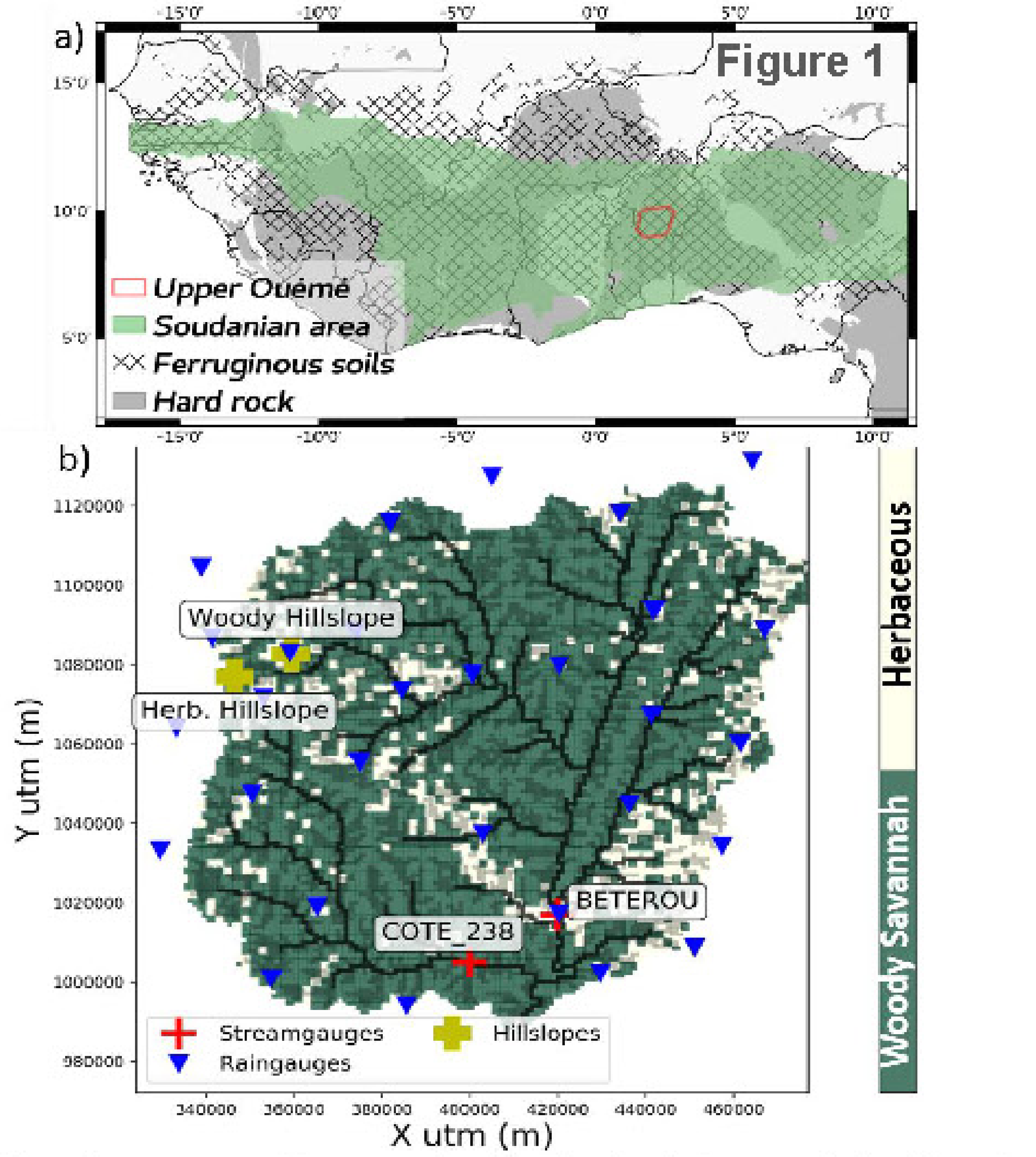


Figure 6

STUDY AREA



- **Study area:** Upper Ouémé Catchment in Benin (14,000 km²), representative of the HRA under Ferruginous soils in Soudanian climate area
- **Climate and Hydrology:** Rainfall is 1200 mm yr^{-1}. Evapotranspiration (ET) is the most important discharge mechanism, Q is the second discharge component.
- **Evaluation Data:** We used Q data from two subcatchments at Beterou (10,131 km²) and Cote_238 (3,126 km²) close to the catchment outlet and GW and ET (Flux tower) data from a woody and a herbaceous hillslope.

Key findings

- Subsurface (0.3 to 5 m depth) exerts stronger control on streamflow than deeper regolith. For process representation information on near subsurface is necessary before evaluating deeper subsurface.
- Lateral variation of Ks within known ranges as well as including a high permeability fissured zone. show little impact on the simulations.
- Magnitude of Ks determines transition from topography-controlled to recharge controlled water table dynamics.
- Patterns of water table depth and amplitude for different vegetation classes identified.