HOW TO ADAPT CRITICAL ZONE OBSERVATION STRATEGIES TO THE EVOLVING CHALLENGES OF THE AFRICAN CONTINENT ?

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HYDROSCIENCES MONTPELLIER (HSM)

TERENO OZCAR
International Conference
25-28 Sept 2023, Bonn

THE CHALLENGES OF THE AFRICAN CONTINENT

«Temperature increase is accelerating.

Extreme weather worsens food insecurity, displacement and conflict

Agricultural productivity is falling

Adaptation financing is insufficient

Losses and damages are rising

Early warnings must reach everyone»

State of the Climate in Africa, WMO, 2023

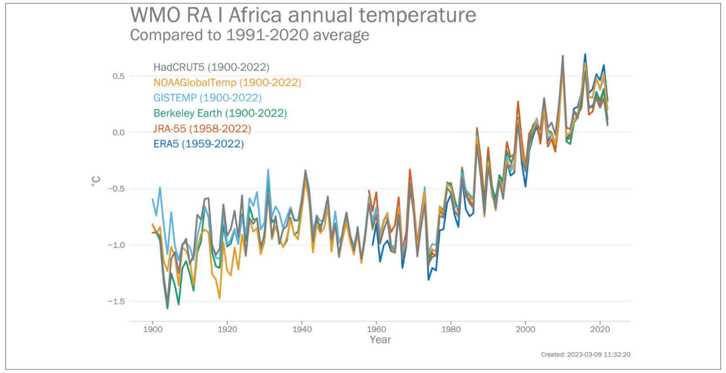
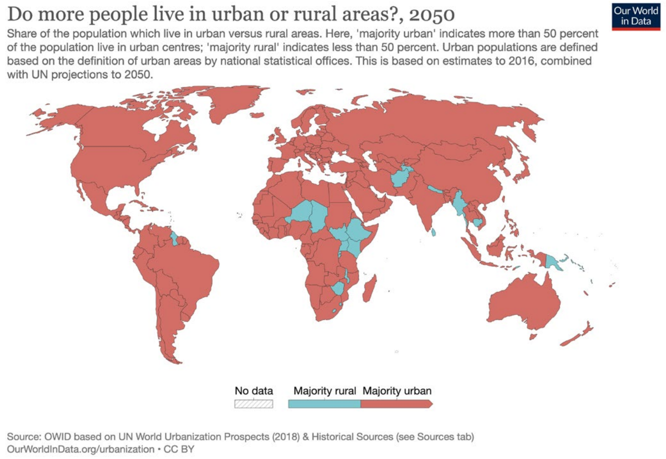
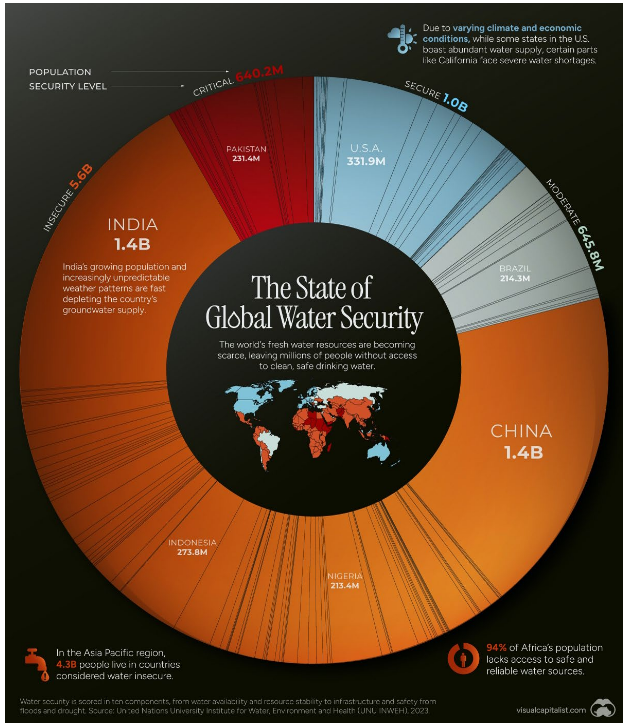


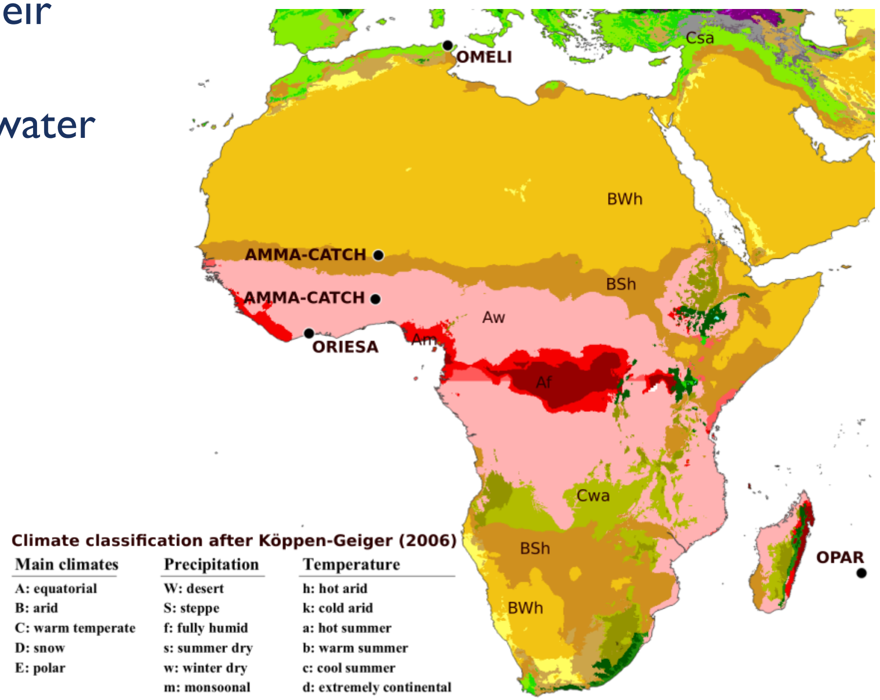
Figure 2. Temperature difference in °C with respect to the 1991–2020 climatological period for Africa (WMO Regional Association I) from 1900 to 2022, based on six data sets, including observational data sets (HadCRUT5 [black], NOAAGlobalTemp [yellow], GISTEMP [light blue], and Berkeley Earth [green]) and reanalyses (JRA-55 [orange] and ERA5 [dark blue])

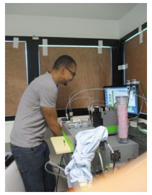
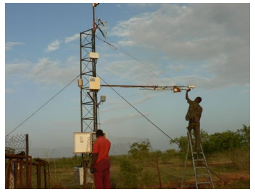




HYDROSCIENCES MONTPELLIER

- Study and predict the impact of climate and human activities on the water cycle and their feedbacks.
- Active and long-term collaborations with water managers and universities over the African continent.
- 4 Observatories :
  - OMELI – Tunisia
  - AMMA-CATCH - Benin and Niger
  - ORIESA - Côte d'Ivoire
  - OPAR - Réunion (France)



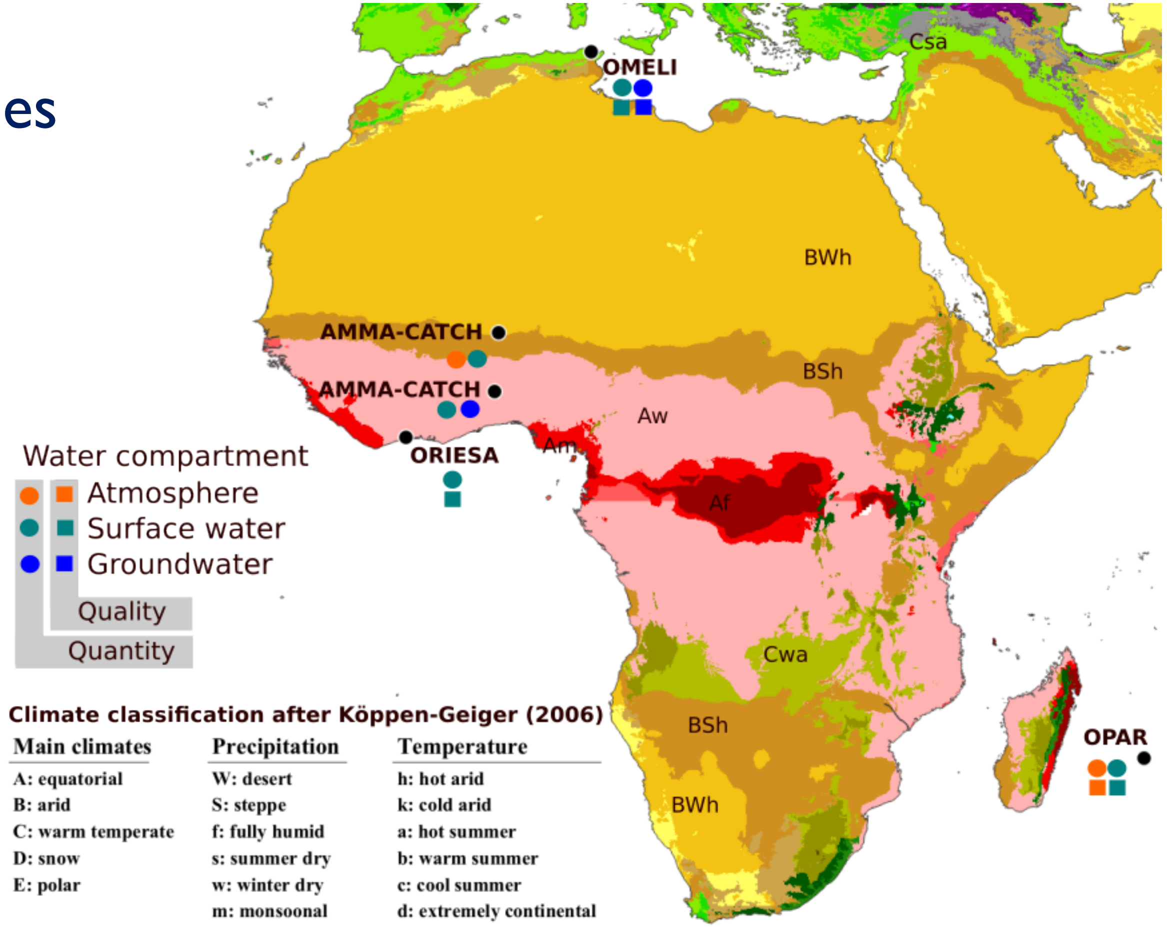






Courtesy of A. Dezetter, G. Mahé M.Oï, C. Peugeot & F.Vimeux

TALK OUTLINE

- Presentation of three observation strategies
  - OMELI
  - AMMA-CATCH NIGER
  - ORIESA
- Common and specific challenges
- The added value of of a pan-European research infrastructure



OMELI - OBSERVATOIRE DE LA LAGUNE ET DU LITTORAL DE GHAR EL MELH
OBSERVATORY OF THE GHAR EL MELH LAGOON AND COASTLINE

Main goals: Sea water and groundwater interactions in a costal environment

- ❑ Sedimentation processes:
  - ❑ Coastal zone: geomorphodynamic evolution of coastal zone

- ❑ Salinization processes:
  - ❑ Groundwater evolution and modelling
  - ❑ Natural (evaporites) and anthropic inputs (irrigation return flows, salt-water intrusion)

- ❑ Impact of human activities:
  - ❑ Quantification of wastewater and polluted water inputs (pesticides, organo-metallic and metal traces)

IRD Institut de Recherche pour le Développement FRANCE

INSTM Institut National Des Sciences Et Technologies De La Mer

INRAP Institut National de Recherche et d'Analyse Physico-Chimique

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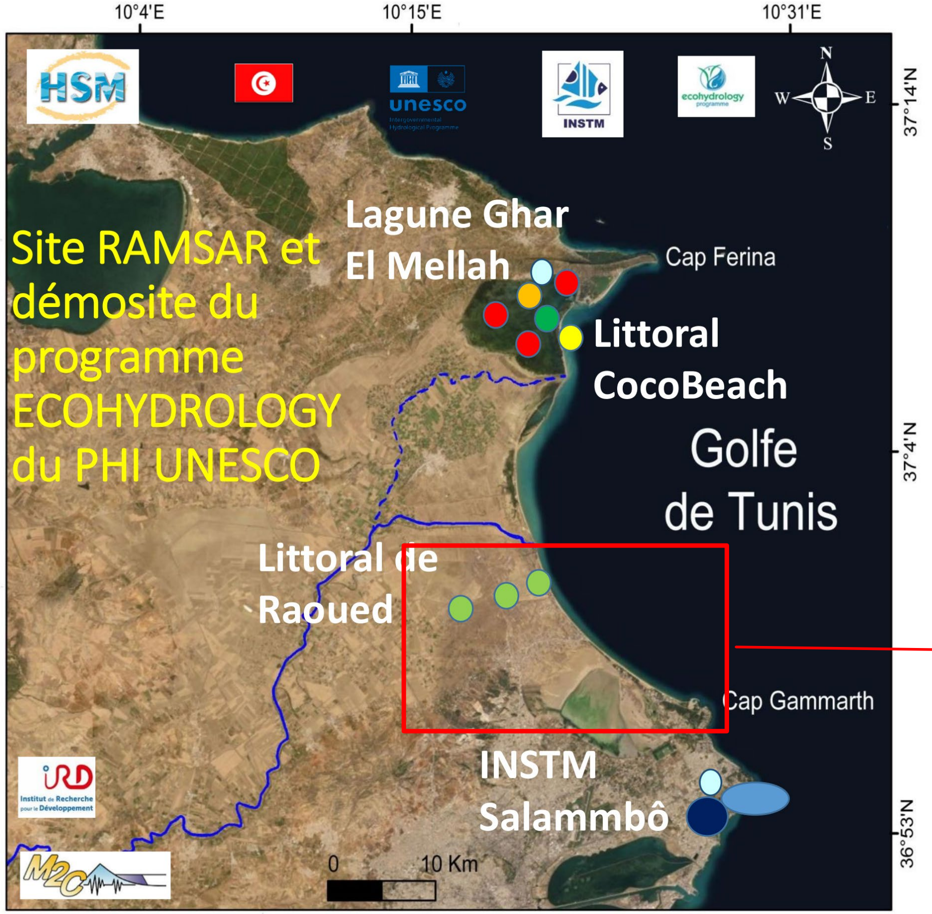
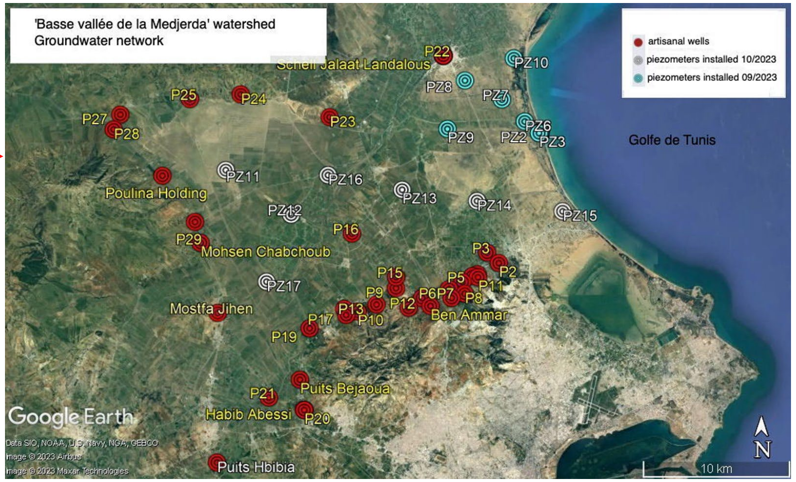


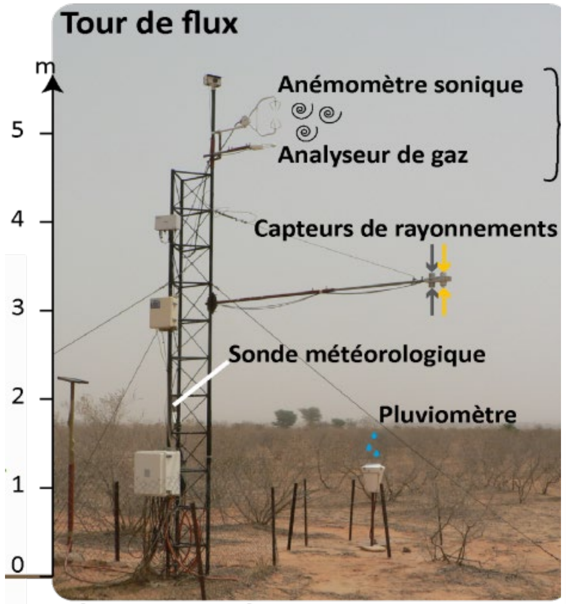
- ❑ Water levels: 50 locations between wells and piezometers
- ❑ Tilde effect on groundwater: 4 piezometers 10 to 150 m from the sea
- ❑ Water quality: monthly monitoring (water level, EC, pH) & high-resolution monitoring at 7 locations

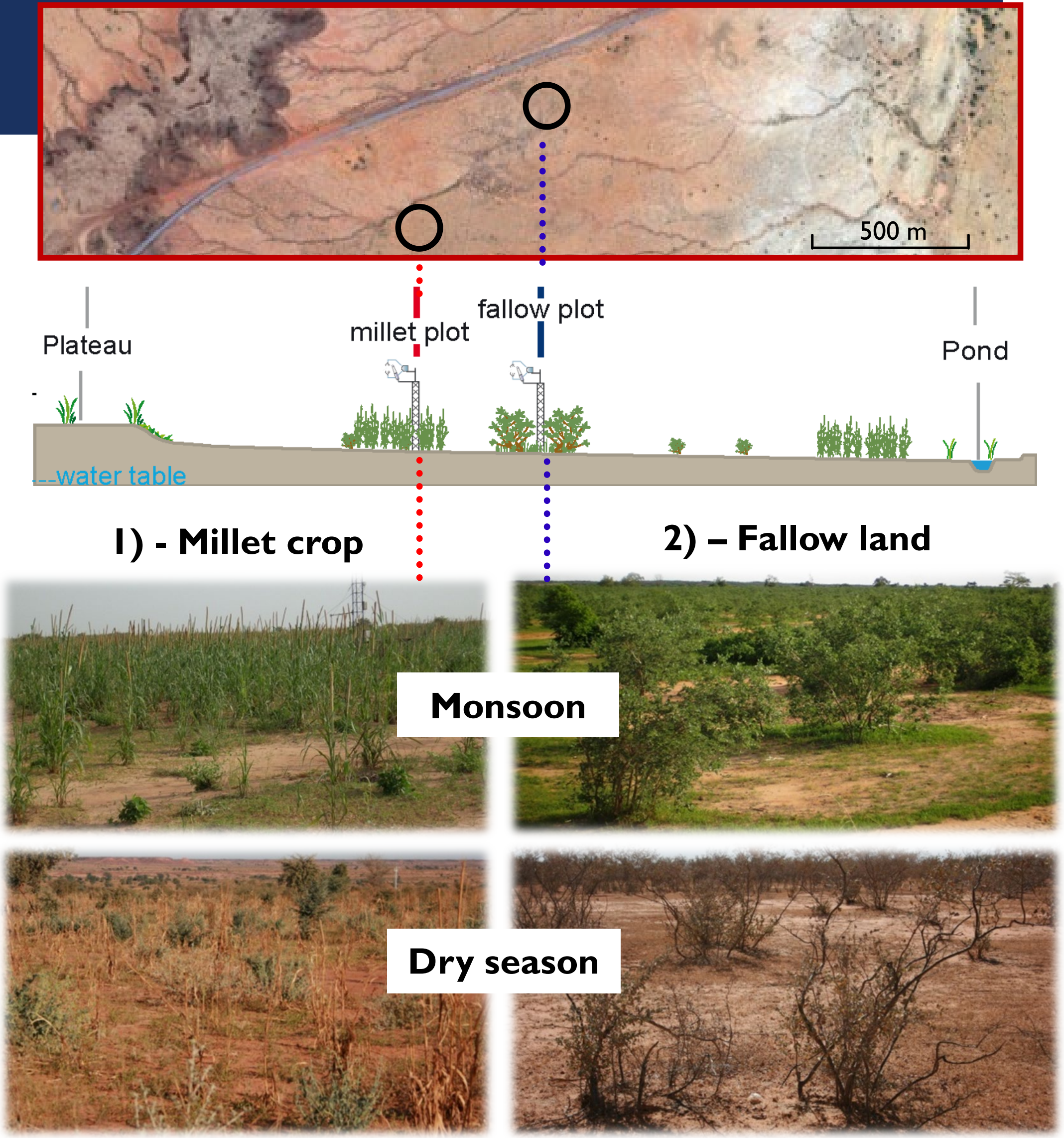


- ❑ Water and sediments
  - ❑ Geochemistry, trace elements, organo-metallic compounds.
  - ❑ Pesticides, ^{14}C, ^{3}H.
- ❑ Planned:
  - ❑ Dating: CFC's/SF6
  - ❑ Salinization: Sr and B isotopes

AMMA-CATCH – NIGER : MONITORING AND EVOLUTION OF ECO-HYDROLOGICAL RESOURCES IN THE AGROPASTORAL SAHEL

- **Meteorology:** rainfall, wind, temperature, humidity
- **Water and energy fluxes:** radiation, sensible and latent heat, soil heat, moisture content (0-10m), piezometry, etc.
- **Soil properties:** granulometry, density, albedo
- **Phenology:** composition, height, seasonality, LAI, biomass, yield
- **Ecophysiology:** stomatal conductance, water potential

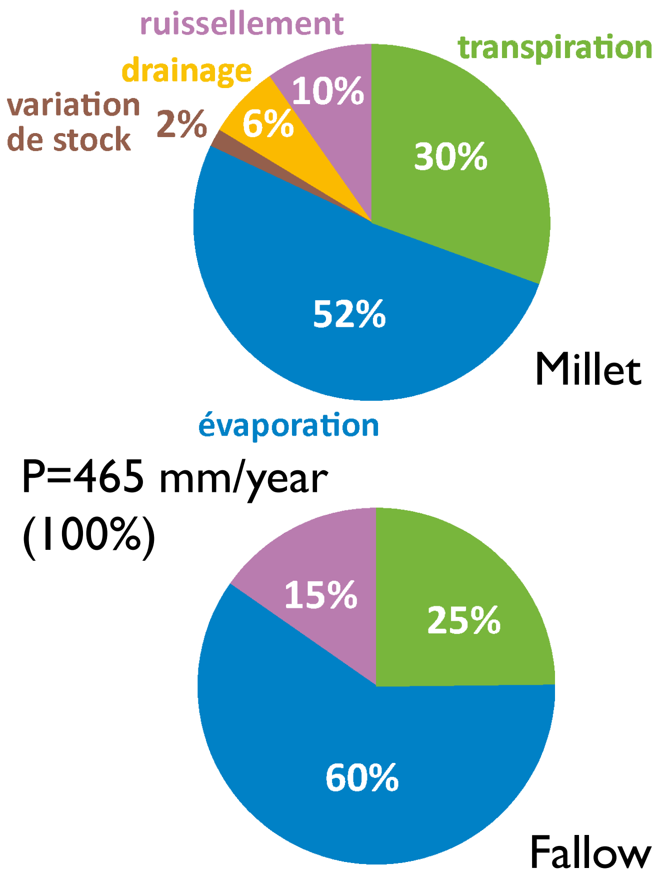


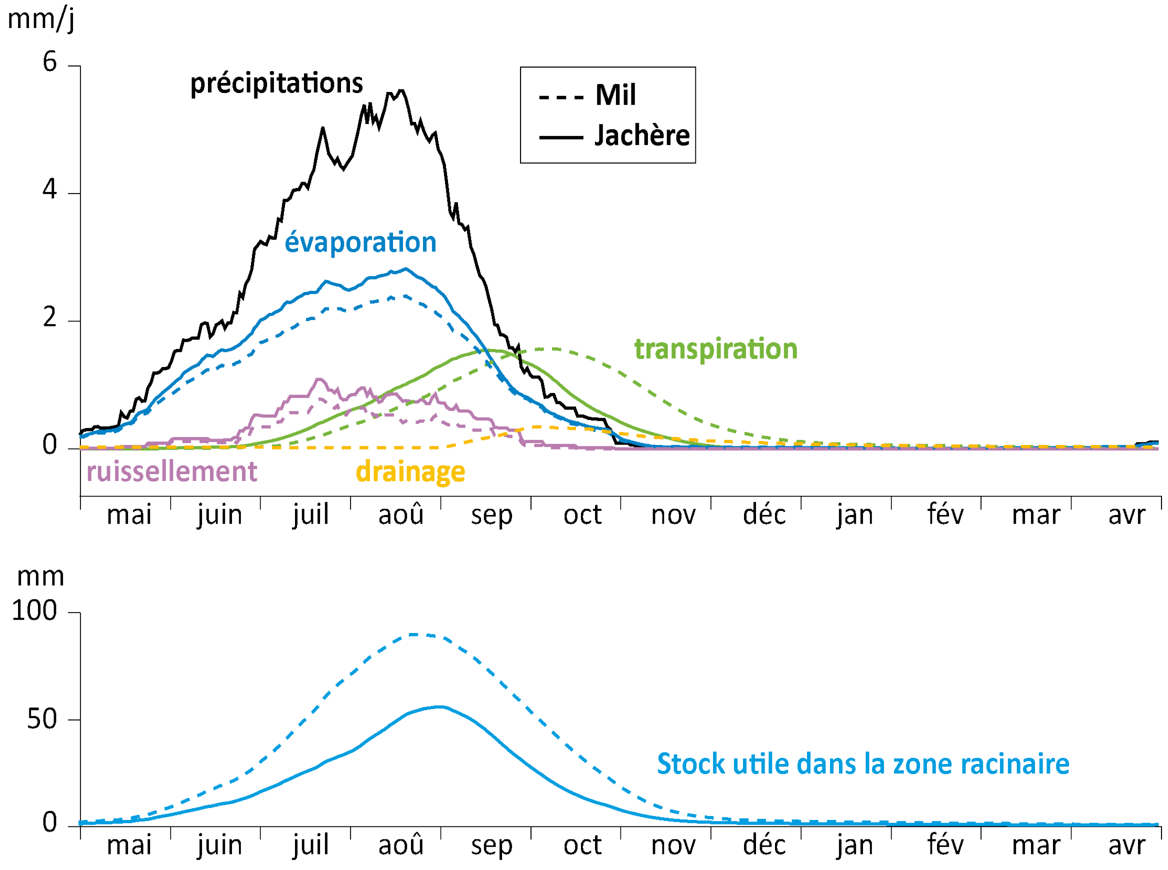


AMMA CATCH
Observatoire éco-hydro-météo en Afrique de l'Ouest

OZCAR

AMMA-CATCH – NIGER : MONITORING AND EVOLUTION OF ECO-HYDROLOGICAL RESOURCES IN THE AGROPASTORAL SAHEL



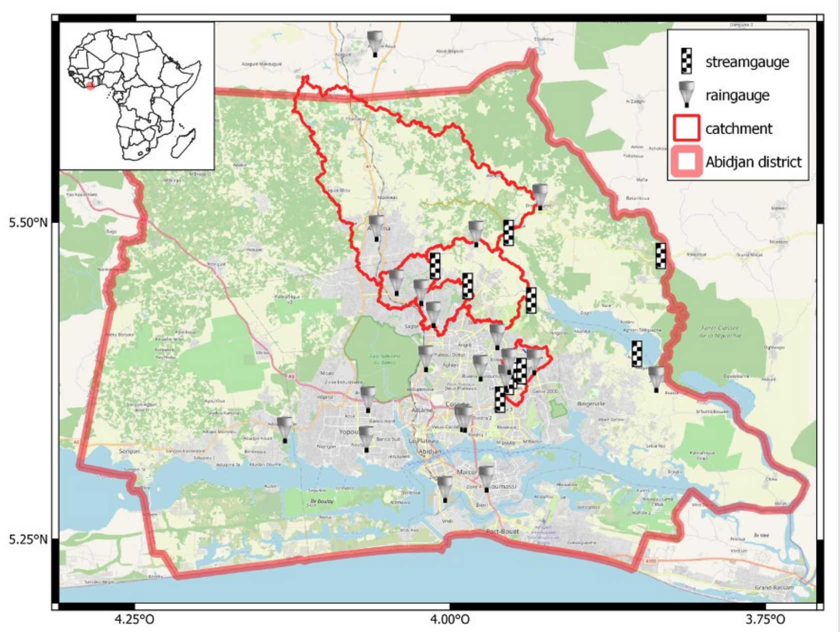


Velluet et al, HESS, 2014

- Soil impact: agricultural practices and crusting.
- Runoff over fallow, infiltration over crop.
- Fallow's evaporation >> Millet crop => biomass shade effect
- End of rainy season, transpiration becomes dominant.

ORIESA - RESEARCH OBSERVATORY ON WATER AND SOCIETY INTERACTIONS IN THE ABIDJAN DISTRICT (IVORY COAST)

- ❑ **Objectives** : Improved knowledge on Abidjan's urban hydro-socio-system for:
  - ❑ Risk management (flooding and pollution),
  - ❑ Drinking water access
  - ❑ Sustainable urban policies
- ❑ **Equipment**
  - ❑ Water quantity
    - ❑ 23 rain gauges: 12 tele transmitted, dt=5min.
    - ❑ 10 stream gauges: dt=10 min-1 hr, depending on the watershed,
  - ❑ Water quality
    - ❑ 1 field turbidity and 1 conductivity meter: dt=5 minutes
    - ❑ 1 automatic water sampler : major ions, nutriments, trace elements during floods



Datasets: https://dataverse.ird.fr/dataverse/oriesa

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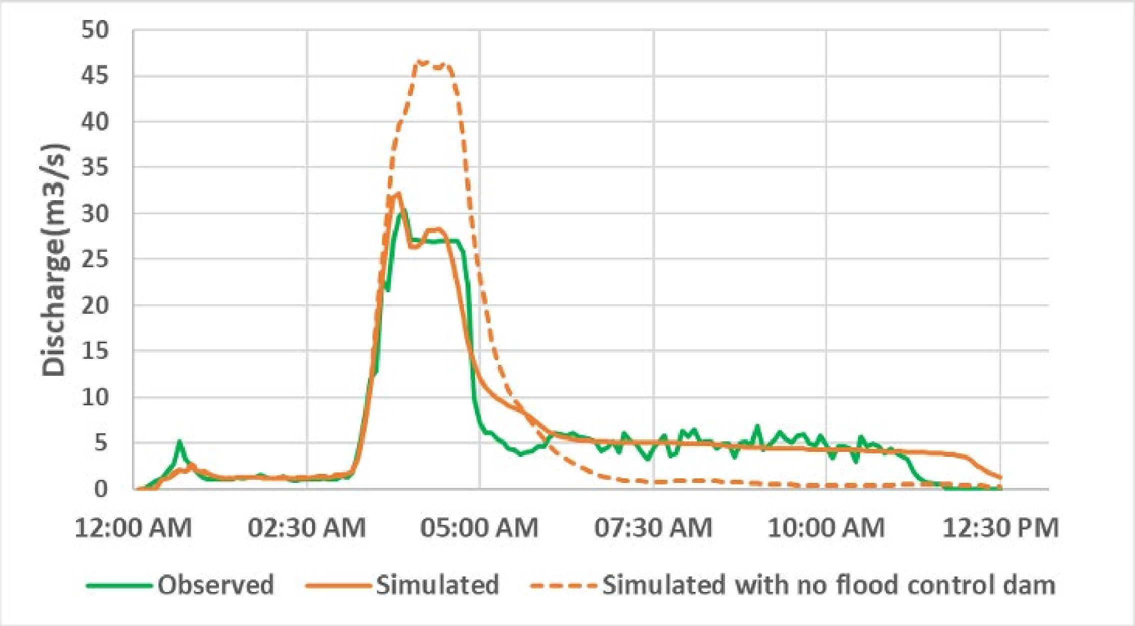
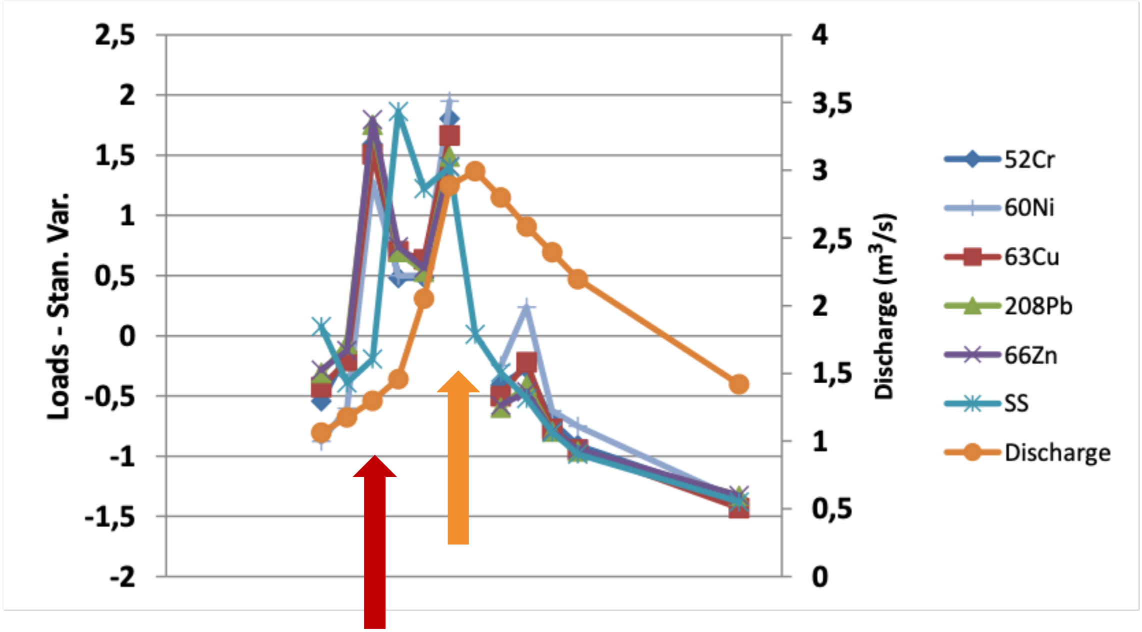
FLOW AND POLLUTANT LOADS DURING FLOODS

- Impact of urban infrastructure



- Without the dam, maximum simulated flow is increased by a ≈ 50%.

- Particulate load dynamics



- Two peaks: before and another during the flood peak

CHALLENGES REPORTED BY HSM PARTICIPANTS IN AFRICAN OBSERVATORIES

- Common challenges
  - Safety of personnel and equipment
  - Maintenance to keep networks operational
  - Support mostly financial but also institutional
  - Involvement to insure knowledge transfer to local populations
  - No technical staff for field work at local universities
  - Co-construction with local partners to fight scientific colonialism

- Specific challenges
  - Political unrest and terrorism
  - Customs costs, delays and formalities
  - Local administrative rules
  - Fast urbanization catches up with measurement sites => changes in observation conditions

Hopes for the future: higher interactions with social sciences & more compartments per site

OBSERVATIONAL STRATEGIES TO OVERCOME THE CHALLENGES

- Insure recurrent funding by
  - Integrating monitoring networks, Mixed International Laboratories
  - Using local funding schemes even partially
- Resort to remote sensing and low maintenance equipment
- Limit field work and increase capacity building at institutional* and individual level
- Observe what/where you can rather than what/where you want

* African Center of Excellence project (World Bank, Agence Française pour le Développement, IRD)

THE ADDED VALUE OF A PAN-EUROPEAN RESEARCH INFRASTRUCTURE

Can such a research infrastructure be useful to harmonise the various observatories and create real integrated observations of the critical zone in Africa?

Advantages

- ❑ More financial and human resources to ensure continuous monitoring.
- ❑ Broader scientific questions
- ❑ Better visibility for southern partners

Drawbacks

- ❑ Complication EU administration and more paperwork
- ❑ Difficulty in complying with uniformization requirements
- ❑ Divergent cooperation policies between member states

What is your take on this ?

THANK YOU

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