IPWG-12

12TH WORKSHOP OF INTERNATIONAL PRECIPITATION WORKING GROUP

JULY 7-10, 2026, KRAKÓW POLAND

Instytut Meteorologii i Gospodarki Wodnej Państwowy Instytut Badawczy

IPWG International Precipitation Working Group

Hydrometeorological monitoring of transboundary basins through multi-source precipitation datasets: assessments and extreme events characterization

Rômulo A. Jucá Oliveira

Adrien Paris, Marielle Gosset, Laetitia Gal, Fatou Guehi, Sly Wongchuig,

Kevin Larnier, Rodrigo Zambrana, Thomas Fiolleau, Modeste Kacou, …

Hydromatters Prendre la mesure de l'eau From space to society

Géosciences Environnement Toulouse

LEGOS

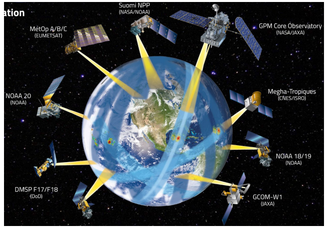
Institut de Recherche pour le Développement FRANCE

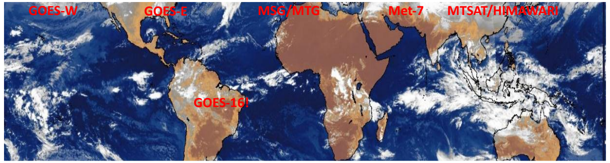
cnes

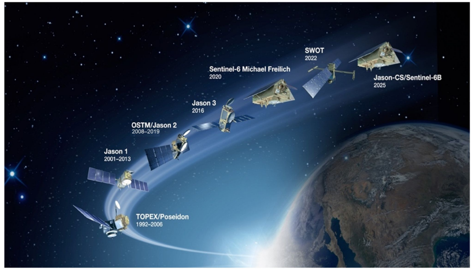
Université Félix Houphouët-Boigny

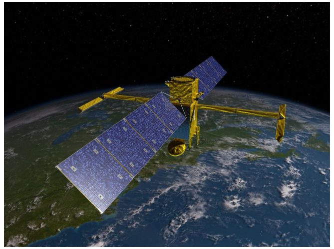
Unveiling extreme hydrometeorological events

★ **The benefits of multiple space missions!**

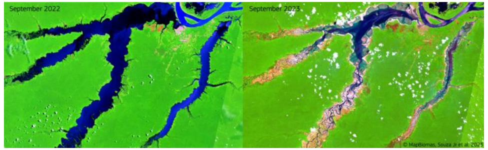




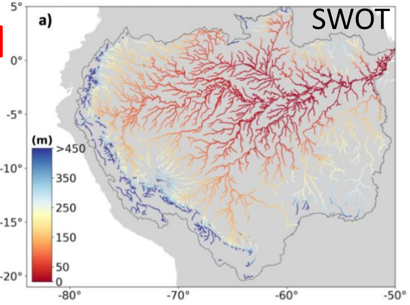




[The 2023 Amazon Drought Case]



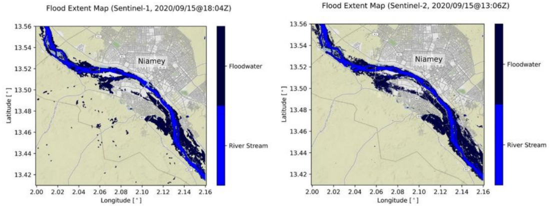
@ MapBiomass, Souza Jr et al. 2023



Moreira et al. (2024)

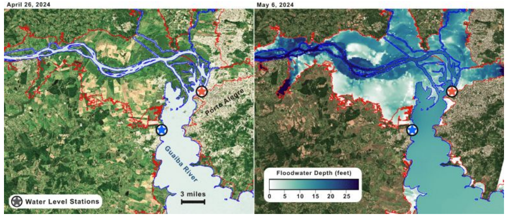
[The 2020 Flood Case]

the Recurring 'Red Floods' Phenomena in Niamey (Niger)

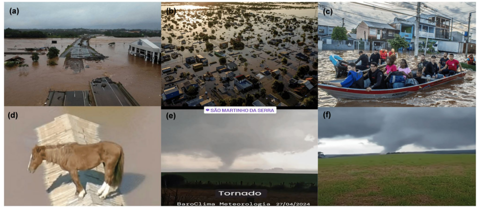


Gosset et al. (2023)

[The 2024 Rio grande do Sul Flood Case]



Simoes-Sousa et al. (2025)



Reboita et al. (2024)

Field measurements
(SWOT CAL/VAL)

Satellite altimetry

Satellite precipitation assessments

Multi-resolution precipitation data

Reanalysis
Satellite precipitation
Merged [w/ MW links]

Hydrology monitoring/forecasting (NRT applications)

long-term Climate analysis/prediction

AI-based discharge Forecasts

MCS link to Hydrology

Hydrological modeling

from Hydrodynamic to Hydraulic
(large to urban scales)

Temporal-Spatial Uncertainty

Data denial experiments OSSES

Data assimilation
Multi-mission satellite altimetry

Short-term forecasts
[Numerical modeling]
*ECMWF (IFS / AIFS)
* ARPEGE (MeteoFrance)

Future projections
Climate scenarios

Hydrology monitoring from space

- **The use of satellite-based precipitation products**

Robust algorithms for rainfall retrieval

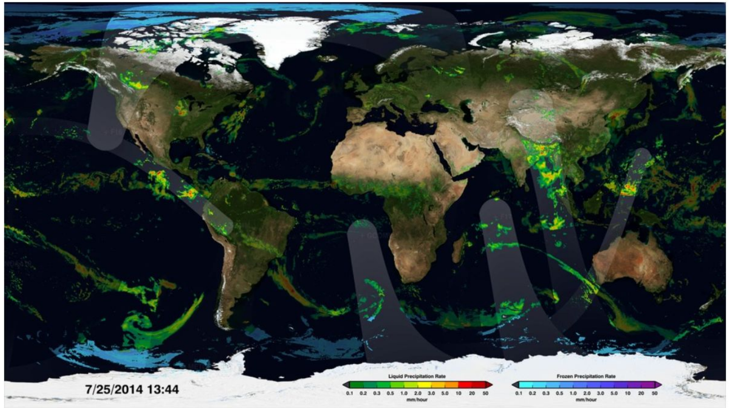
- Multiple techniques (algorithms)

Physically - Statistically – AI approaches

Microphysics processes

Bayesian approach ; assimilation etc…

Combination w/ other sources (gauges, models, …)



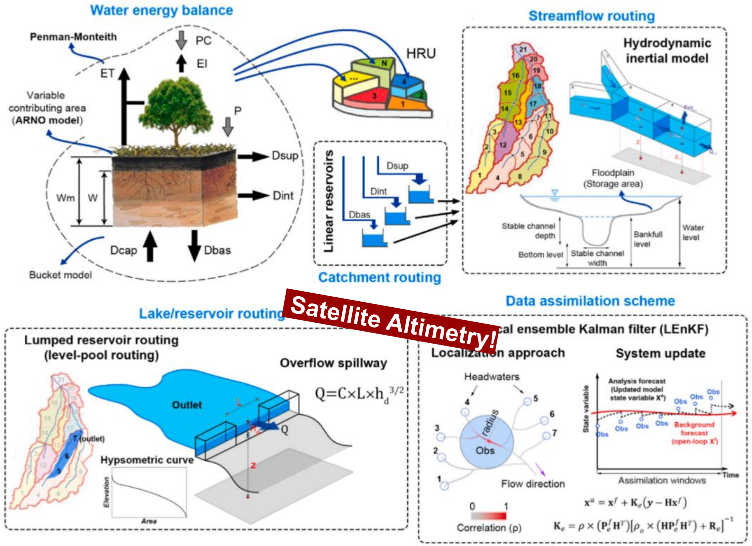
IMERG (NASA) | GSMaP (JAXA) | HSAF (EUMETSAT) | CHIRPS (USGS) | •••

➔ Common for climate and/or meteorological applications

But still not so generalized in hydrology, and especially for operational hydrological applications!

MGB-IPH Hydrological and hydrodynamic model

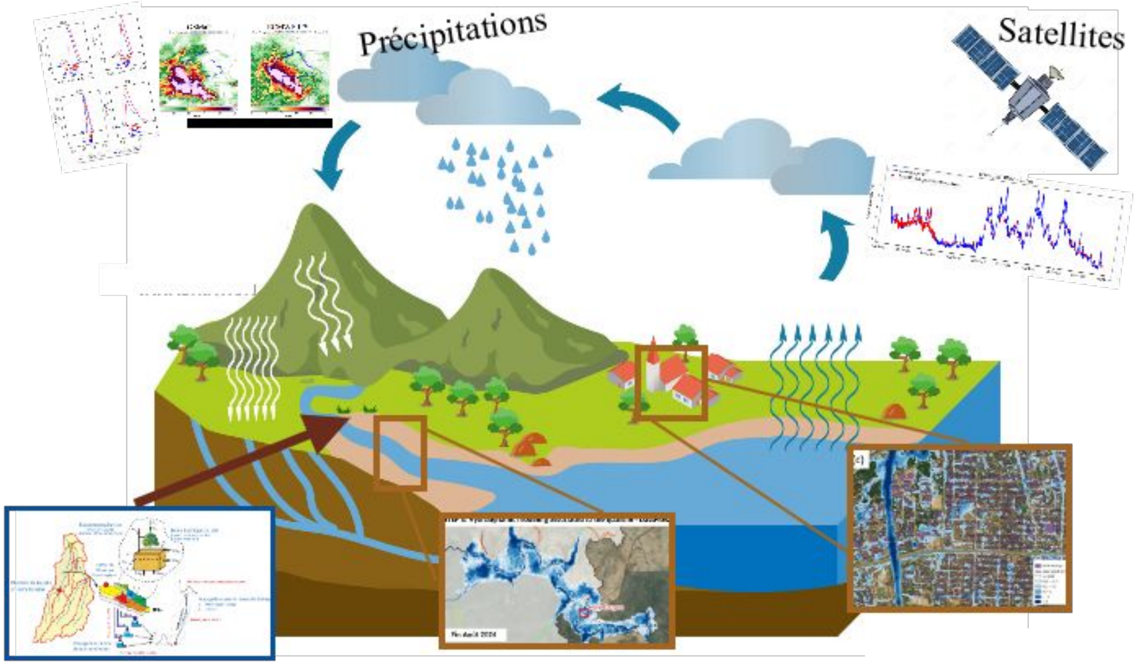
A semi-distributed hydrological model developed for large-scale basins



Schematic of the general structure of the MGB hydrologic-hydrodynamic model.

Collischonn et al. (2007), Paiva et al. (2013), Fleishman et al. (2018), Wongchuig et al. (2023)

Hydrological modelling

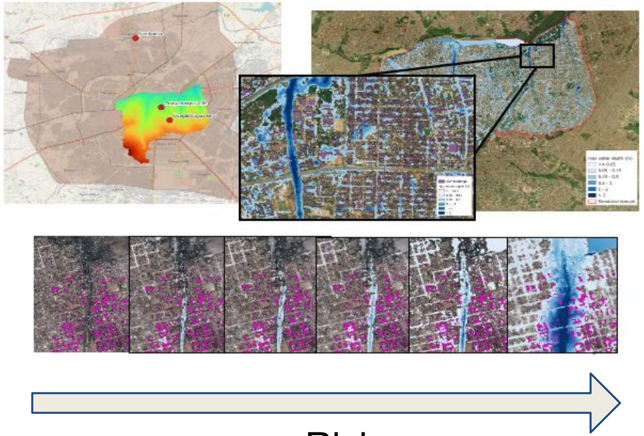


The need of HR precipitation dataset!

★ **1D/2D modelling**

★ **Urban 2D modelling**

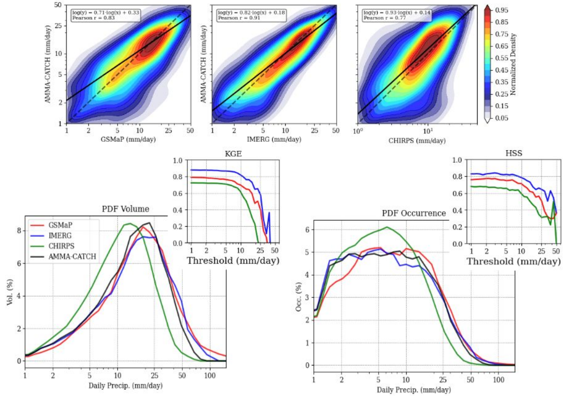
- Spatialized hydrodynamic modeling
- Generation of flood zones

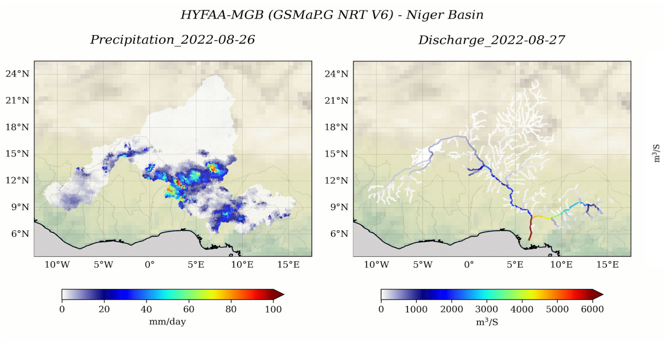


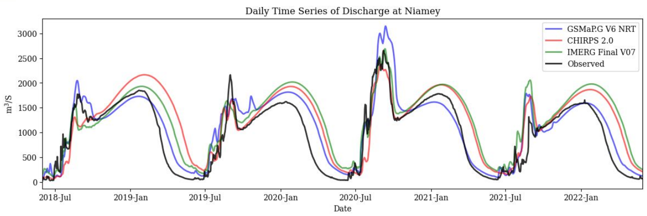
Courtesy of Larnier, K (2025)

Overall analysis of satellite precipitation products uncertainties - Simulated discharges

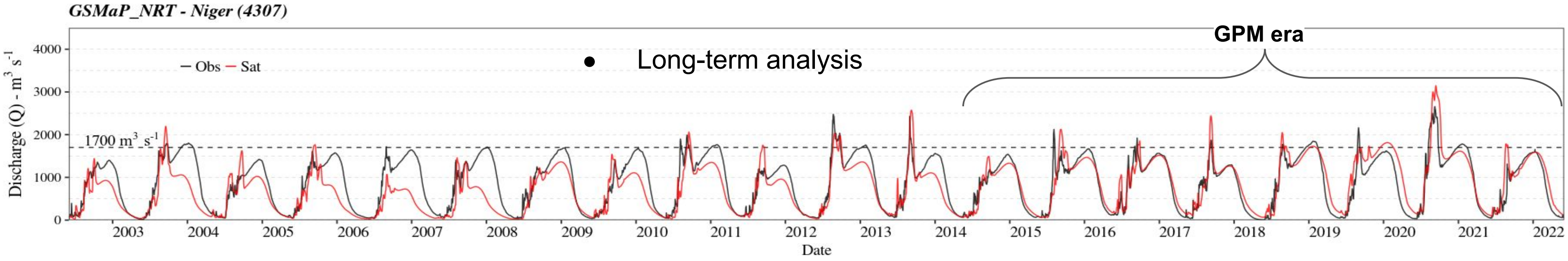
- Performance linked to the physical characteristics of products + precipitation regime



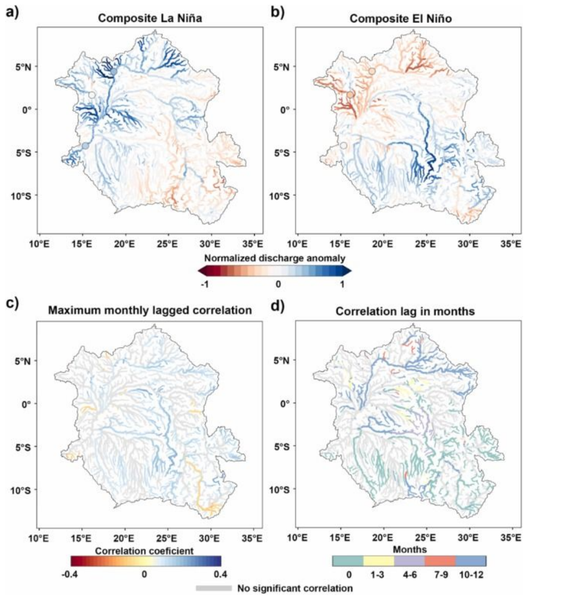




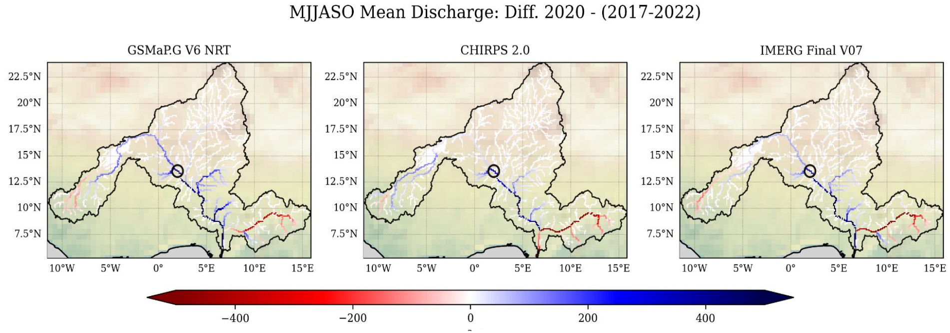
- Long-term analysis

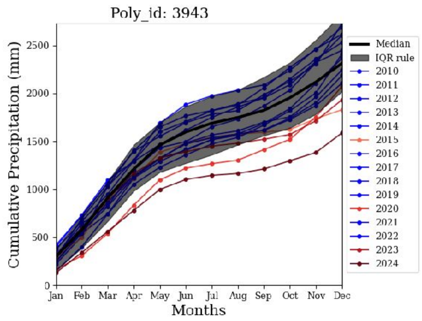


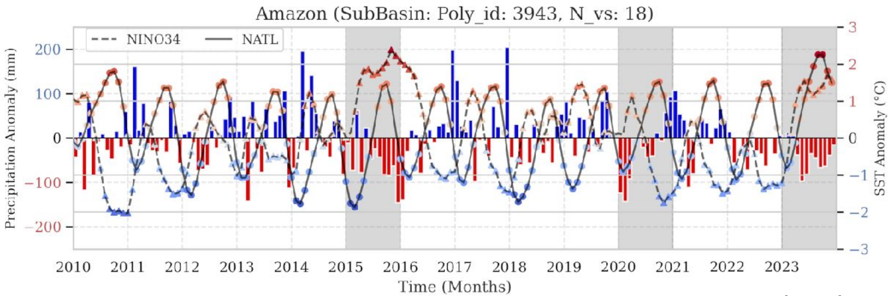
- Extreme Hydrological events over Niger
- Influence of El Niño/La Niña over Congo discharges
- Impact of satellite altimetry on the discharges sim. over Guyane
- Increasing of hydrological-extreme events - distinct future scenarios (Chad)
- Extreme anomalous years (ex.: the 2023 Amazon droughts)



Wongchuig et al. (2023)







Paris et al. (2026)

Hydrological impact of individual Convective Cloud/rain Systems

Fatou et al. (2026)

→ Intensification of daily tropical precipitation extremes from more organized convection

[increasing of organization and duration]

Bal et al. (2024)

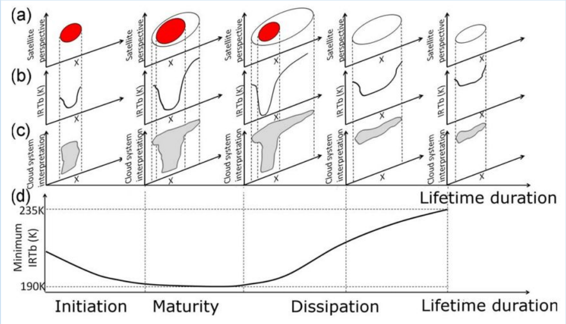
- **Organized convection linked to Precipitation**

→ Scenarios of daily rain and discharges, according to the morphology of precipitating systems

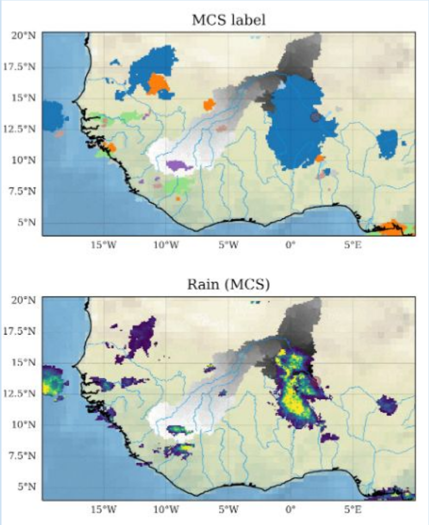
→ Helps understanding genesis and prediction of flood by nowcasting rainy events (tracking through satellite)

→ Tracking of organized convection algorithms (e.g., TOOCAN)

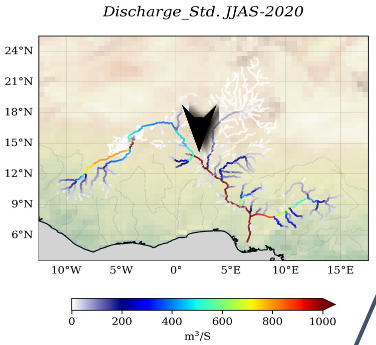
- Life cycle/morphological properties

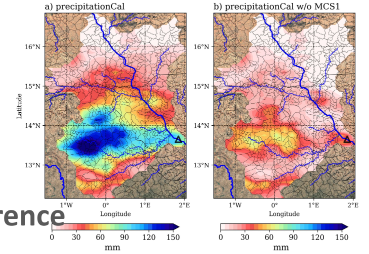


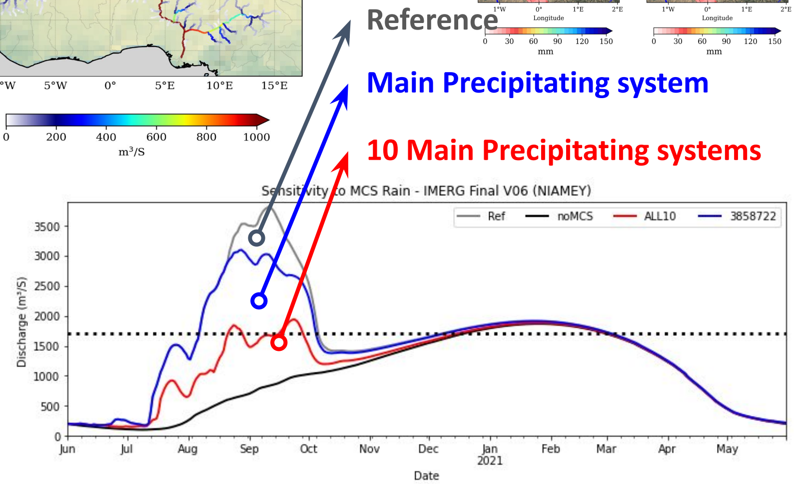
Fiolleau and Roca (2013)



→ ***TOOCAN-IMERG matching***







Takeaway messages

➔ Short latency satellite observations are crucial for hydrological monitoring!

➔ Precipitation is the entry of the hydrological system

- ➔ Precipitation varies temporally, spatially and its intensities/occurrences (complex involving processes).
- ➔ **Short-latency satellite precipitation products can effectively serve for Flood Analysis and Prediction**
- ➔ Uncertainties in Satellite-based precipitation products vary regionally! But it can be minimized for better (model) applications.
- ➔ **Convective Systems' occurrences/characteristics drive the hydrological regime, specially the extreme scenario of exceptional droughts and floods!**

- ➔ **Understanding the cloud/rain systems and the physics of rainfall measurement helps understanding why there are uncertainties and how the uncertainties propagates in the basin.**
- ➔ **Changes in the constellation of satellites/algorithm can create instabilities on the precipitation distributions (timeseries) that can propagate to the hydrology (e.g., discharge simulations)!**

➔ **New technologies and Perspectives (support of Hydro Monitoring):**
IA (Merging) + MWLinks + Radar + Lightning

➔ **Xavier et al. [S 5.6]**

Audio-based approach for rainfall detection and monitoring

Thank you for your attention

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