

INBO WEBINAR FROM GROUND TO ORBIT

COMBINING IN-SITU AND SATELLITE MONITORING OF WATER TO IMPROVE BASIN MANAGEMENT



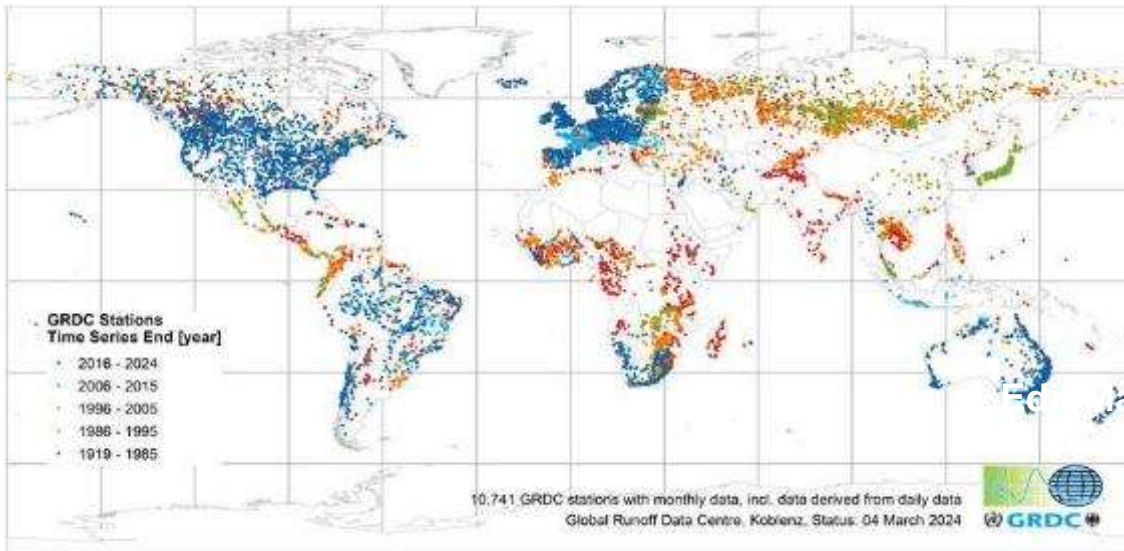
SATELLITES FOR HYDROLOGY

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NEED FOR HYDROLOGICAL DATA



At present time, less than 1% of water levels in the millions of freshwater lakes are monitored.

River and reservoir levels are either unmeasured or are guarded state secrets in much of the world



Benefits from spatial observation

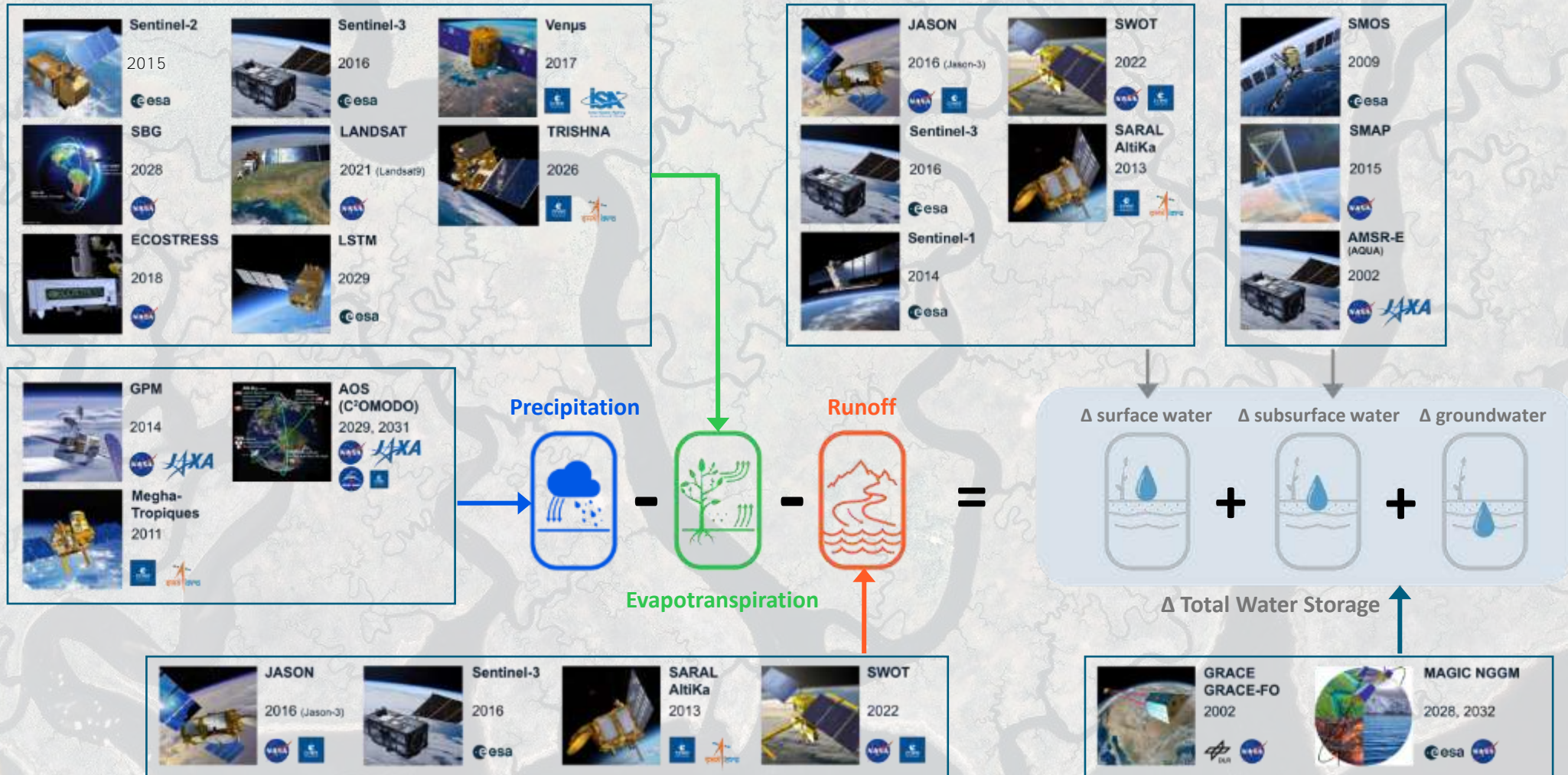
- Addresses all components of the water cycle and provides a full closure for the water budget equation
- Global, free and homogeneous data
- Copernicus missions provide a data continuum (>2030)

Complementary use of in situ measurements

- Calibration/Validation of satellite
- Time & scale complementarity

► Merge and reconcile in-situ and satellite data

HYDROLOGY FROM SPACE: SATELLITES



SWOT – A REVOLUTION BASED ON 3 DECADES OF PARTNERSHIP & EXPERTISE

- Historical partnership between France and USA [CNES & NASA] for more than 30 years + other partners
 - Starting with TOPEX/Poseidon in 1992
 - Currently with SWOT, launched in Dec 2022

1992-2005

TOPEX/POSEIDON

2001-2013

JASON 1

2008-2019

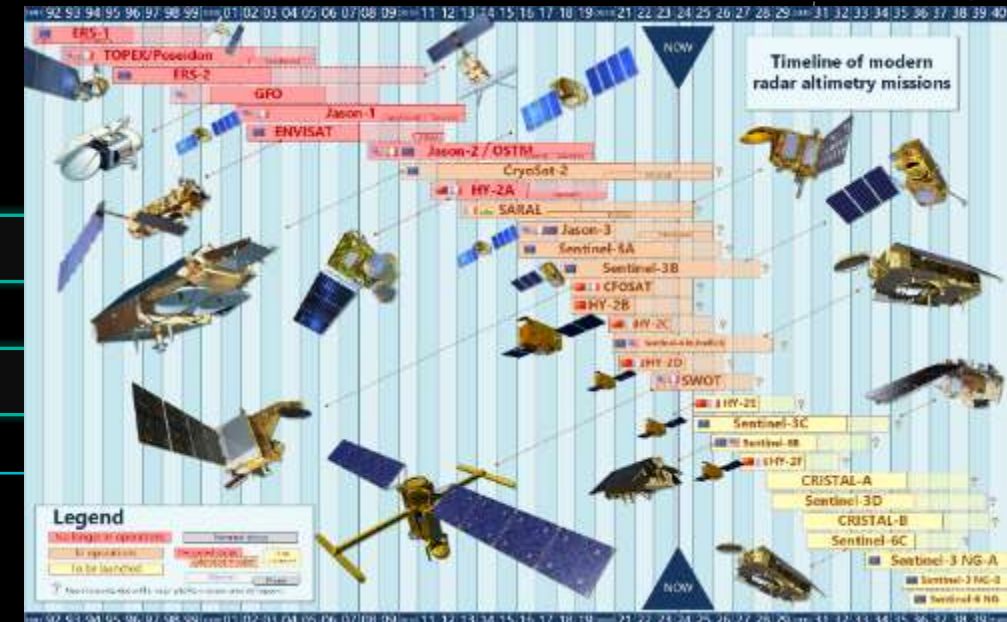
JASON 2

2022-

SWOT

2016-

JASON 3

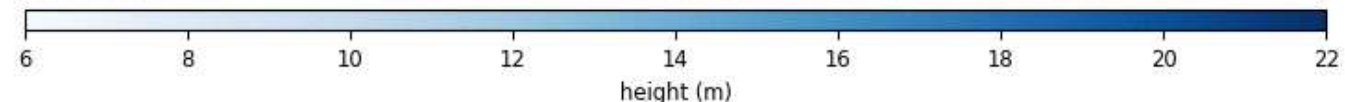
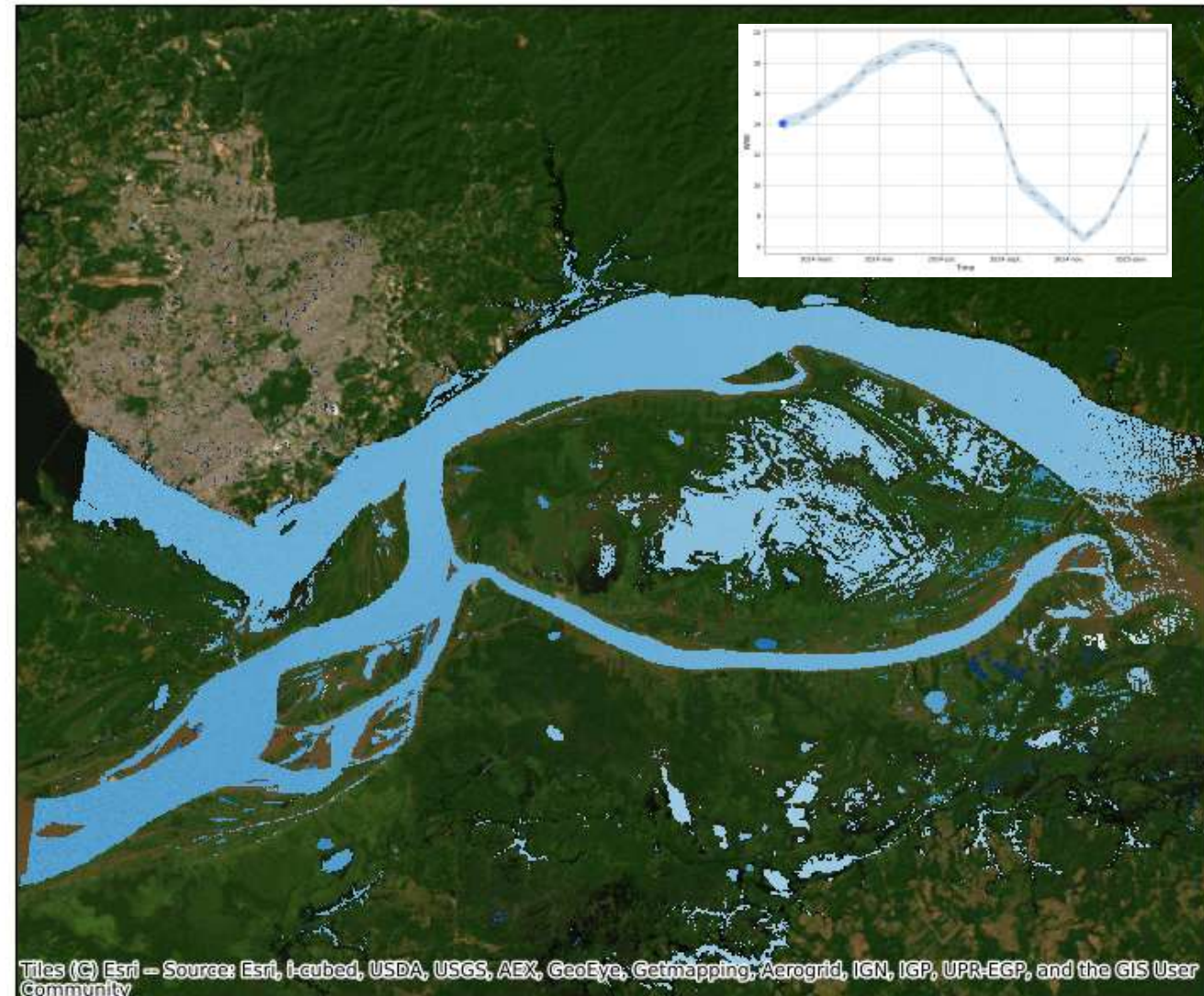
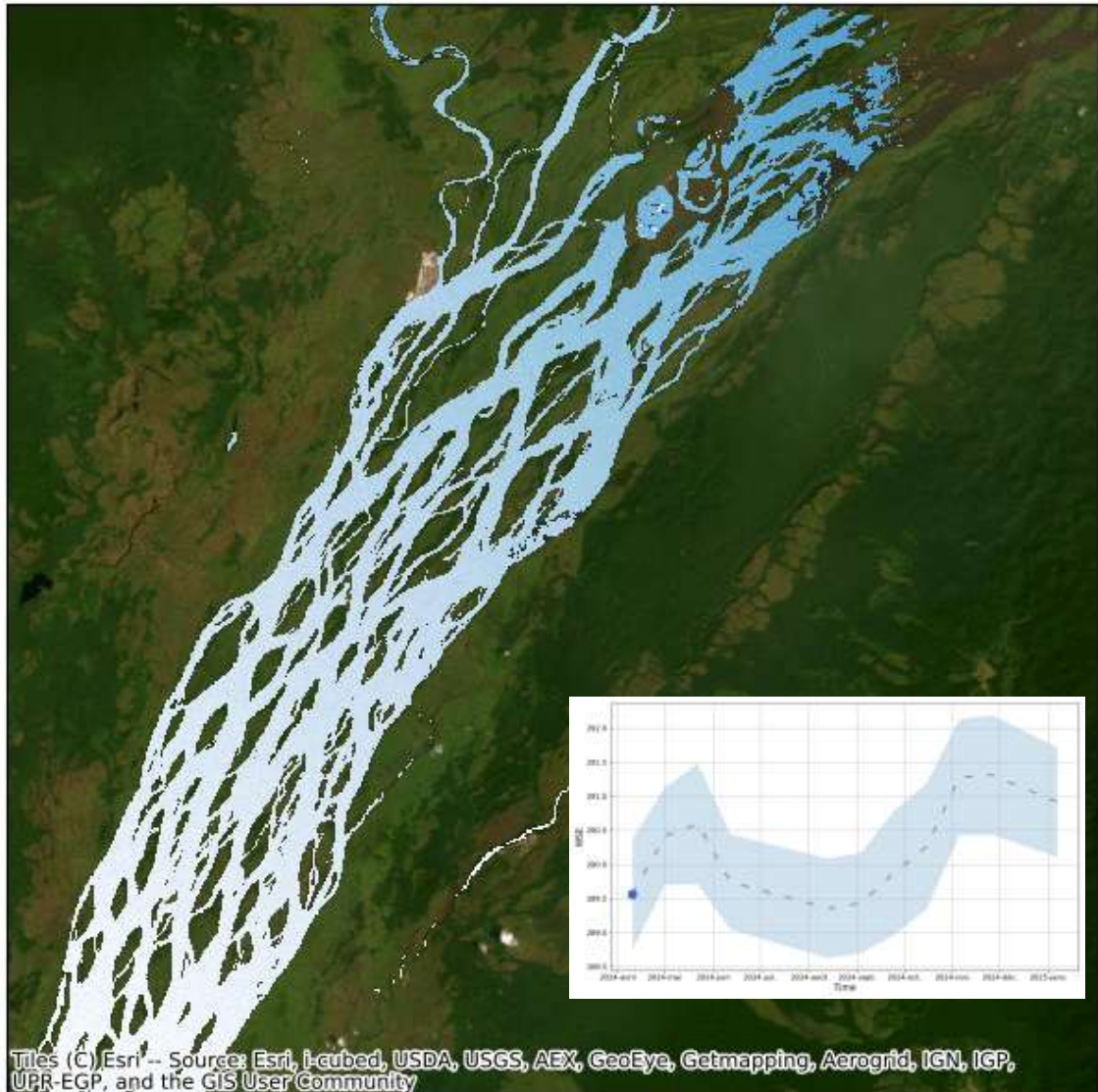


CASES:

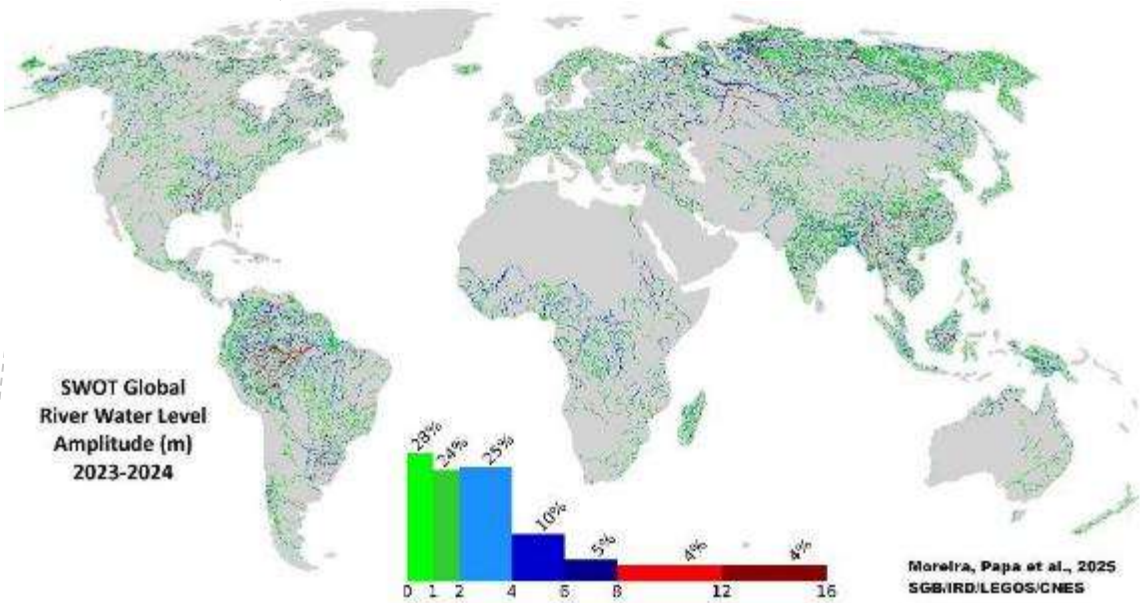
CONGO - AMAZON (MANAUS)

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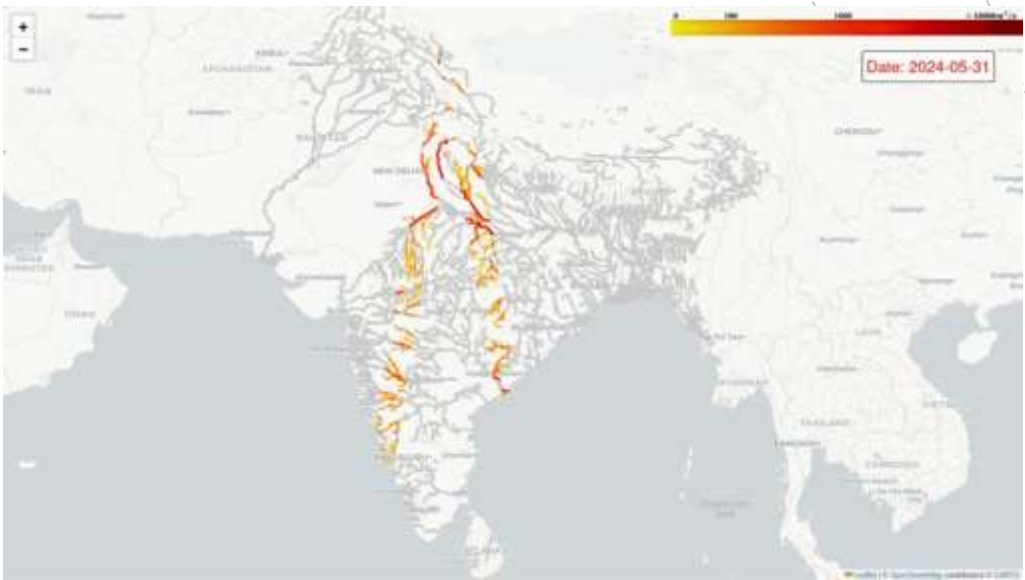
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FROM HEIGHT TO DISCHARGE WITH SWOT

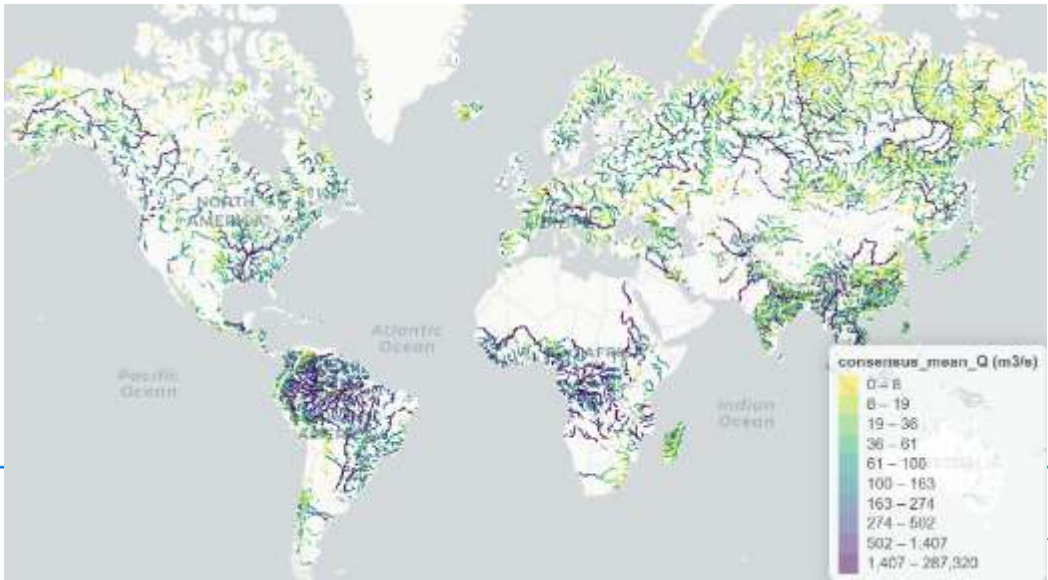


From H
to Q



SWOT discharge over different basins at each SWOT overpass (Credit DAWG-Oubanas H.)

SWOT mean discharge at the global scale (Credit DAWG-Gleason C.)



From daily Q
to mean Q

DATA SERVICES FOR HYDROLOGY



A multi-sensors/multi-variables
integrated approach for hydrology

- Bring observations at different scales: from large to small watersheds
- Improve our understanding of the distribution and monitoring of water in the various parts of land surfaces
- Ambition to provide in-situ measurements, model results, airborne
- Contribute to decision making

Water surfaces

Water quality, temperature

Snow surfaces

Rainfall

Water height and discharge

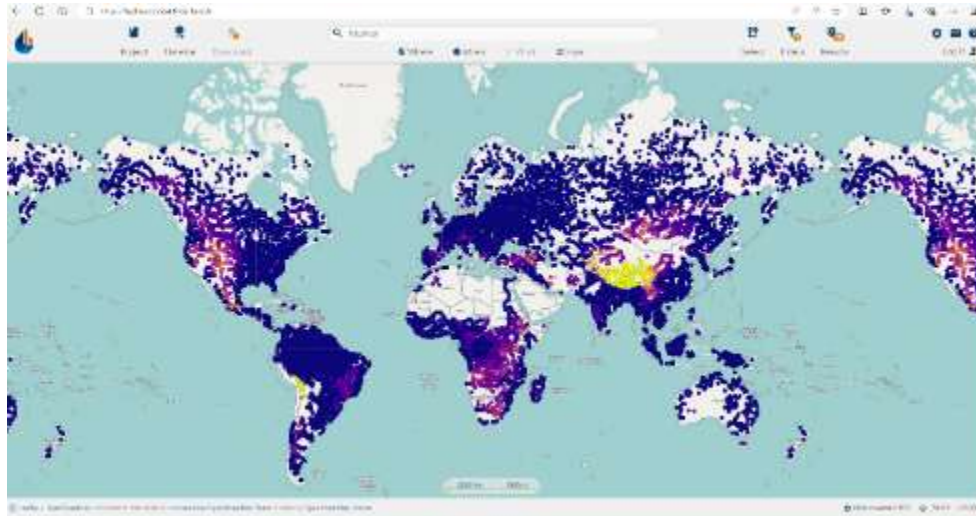
Land cover

Soil moisture and humidity

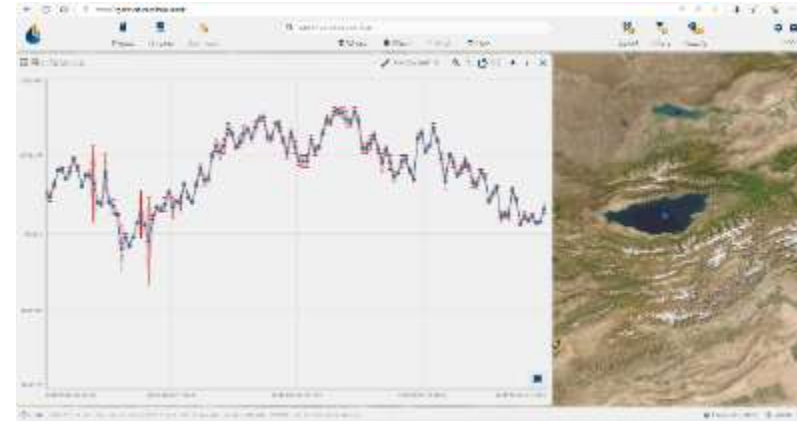
Gravimetry

DEM

Map of monitored lakes

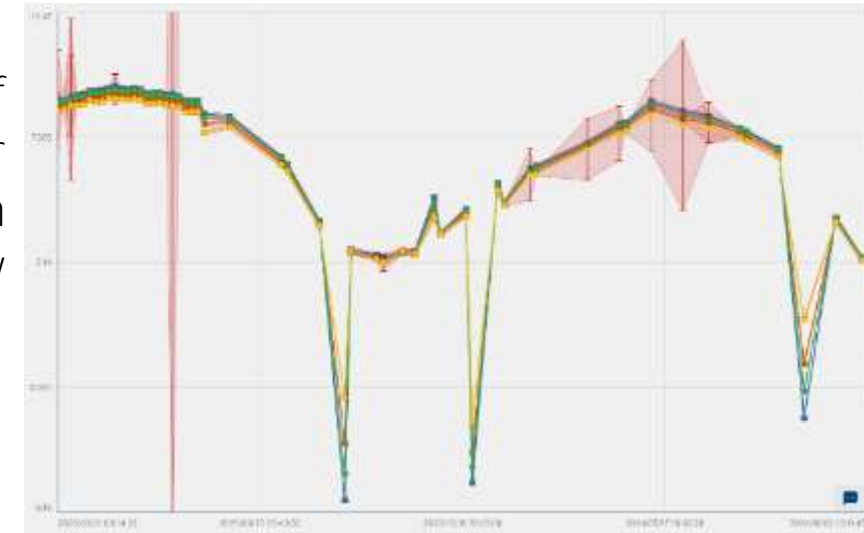


- SWOT + other sources
- Download data
- Visuals: maps, time series with uncertainties, multiple points



Water surface elevation of Lake Issykkul, Kirghizstan, from September 1992 until now

SWOT water elevation of Amazon river near Santarem, Brazil, from March 2023 until now



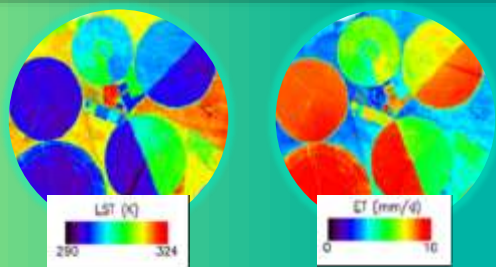
In-situ & airborne validation campaigns in **2023** (ocean research campaigns, river and lake validation, ...)



BILATERAL PROGRAMS AND INNOVATION



Ground surface temperature
and daily evapotranspiration



Launch scheduled in 2026-27

Bilateral programs devoted to water

Land, Coastal, Ocean
Water

Satellite precursors
LSTM, S3-NG TOPO
Downstream Programs



First global survey of Earth's
surface waters



Launched Dec 16, 2022

OUR FUTURE MISSIONS

IN THE NEXT DECADE



Missions addressing **GEWEX** scientific challenges:

"to observe, understand, and model the hydrological cycle and energy fluxes in the Earth's atmosphere at and below its surface"



2025

MICROCARB

TRISHNA

IASI-NG

C3IEL

GENESIS

High-revisit
Hydrology

ODYSEA

2030

AOS

NGGM

S-3-NG
Topo

2035

CARIOQA

Other CNES missions addressing various EO scientific challenges: Carbon cycle, numerical weather prediction, geodesy, quantum gravity...

CONCLUSION

- Observations from space deliver quality data for hydrology
→ Increased temporal resolution is key to observe the fast dynamics processes of the water cycle
- New data access services are developed to improve data access in Data Terra / THEIA Land data Center, e.g. hydroweb.next
- Combining in situ and satellite for a better understanding at local scale and basin management in a complementary way
- CNES is supporting this dynamic by:
 - Contributing to innovative missions such as SWOT, TRISHNA and the Copernicus Sentinel missions
 - Supporting and contributing to research activities
 - Building ambitious downstream program for science and applications, to optimize mission data use, where SWOT sets an example



Thank you