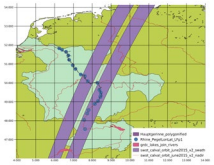


REFECCT-DETECT

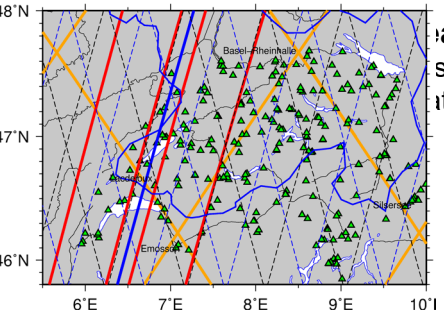
L. Fenoglio[1], J. Chen[1], H. Uyanik[1], J.Kusche[1]

sity with contribution by BfG and BKG

Keywords:
Hydrod. in rivers, discharge –flood - (REFECCT)
Altimetric data processing, CAL/VAL
HR Simulation- Mod/Assimilation – Prediction
Connection with lakes/reservoirs/wetlands

Main scientific objectives – SLOW WG

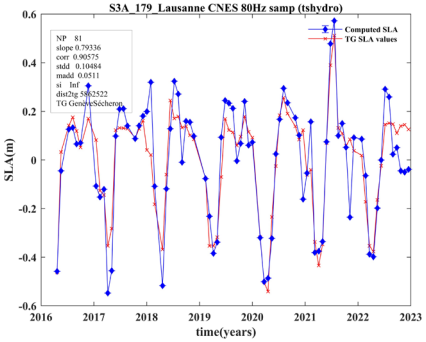
1. Validation of SWOT in the 1-day phase (Swiss lakes)
2. Volume water change
3. Connection of river &lakes (ROIs Lake of Constance and Geneva
4. SWOT and multi-mission nadir-altimeters combination in lakes
5. Glacial Lakes
6. Long- and short term variability in hydrodynamics (climate)



asures:
solute Stage (alti, gauge)
ater extent from Sentinel-1, -2

Instrumention/Model
In-situ RG online, 150 total
Nadir-altimeters

Fig. 1 ROI for cal/val on the Rhine from Speyer to Koblenz



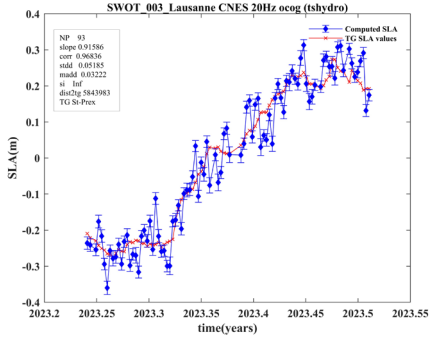


Fig. 2 Water level from FF-SAR and SWOT-nadir, STDD of 5 cm, in Lake of Geneva

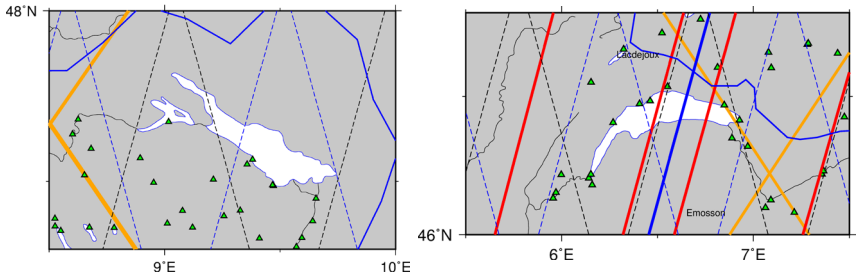


Fig. 3 ROI for Connection inLake of Constance and Lake of Geneva

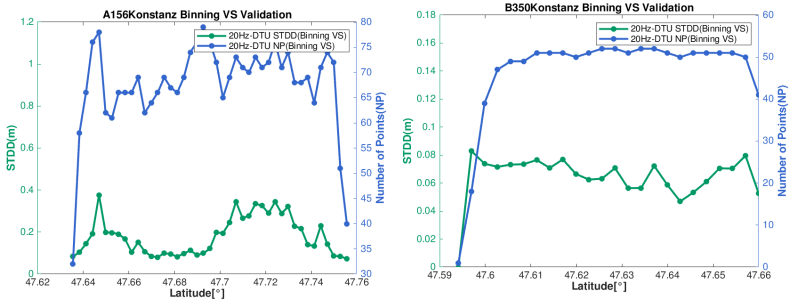


Fig. 4 Accuracy of water level from Sentinel-3 alog two tracks of Lake of Constance

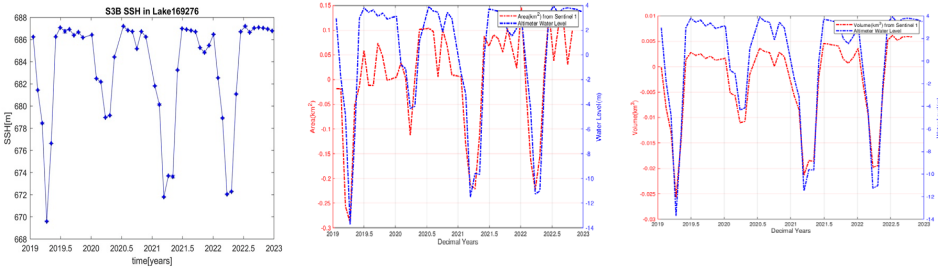


Fig. 5 Water level, water extension and Storage change from Sentinel-3 and Sentinel-1 in small glacial lakes and reservoirs (climate and human change). Here

Next goal:
Water change from SWOT along 1-day Track 3

Keywords:
Hydrod. in rivers, discharge –flood - (REFECCT)
Altimetric data processing, CAL/VAL
HR Simulation- Mod/Assimilation – Prediction
Connection with lakes/reservoirs/wetlands

Item 4 - Discussion on community questions (30 min)

Please feel free to provide feedback to the following questions. If you have additional questions to discuss, please insert the questions below.

1. How do you plan to use the first SWOT science data? For example, who wants to access which level of data? Why is this data important?

Feedback: We would like to access HR data for Lakes and Rivers

4. How should we prototype intercomparison methods and how we can collaborate on lake result comparisons?

Feedback: Discussion of an example at SWOT ST is of interest

5. Other important technique issues: stronger backscatter from wet soil or fields, challenges and potentials for wetland and estuary monitoring, and others?

Feedback: example to be identified

6. What are the topics to prioritize next year? For example, in addition to the generic science data, are there any special products we can improve or develop for the community?

Feedback: lakes ice effects

7. Opportunities and aspects to collaborate with other WGs.

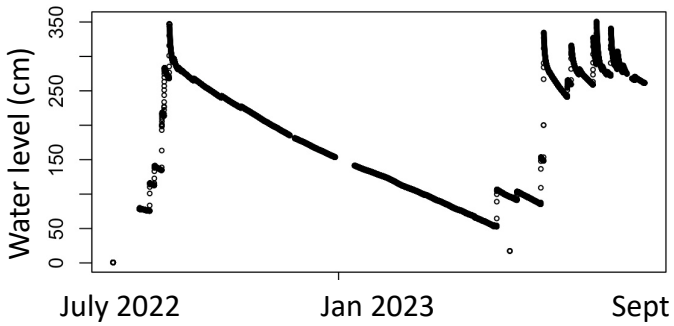
River and lakes connection and connectivity

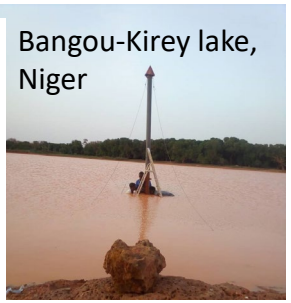
SPLASH: Small Ponds and LAkes in the Sahel by SWOT and High resolution sensors

M. Grippa, M. de Fleury, F. Girard, L. Kergoat, H. Nikiema,J.M. Dipama, M. Wubda, A. Abdourhamane Touré, M. Boubacar Moussa, I. Mainassara, C. Faye, E. Robert

1 - In-situ measurements

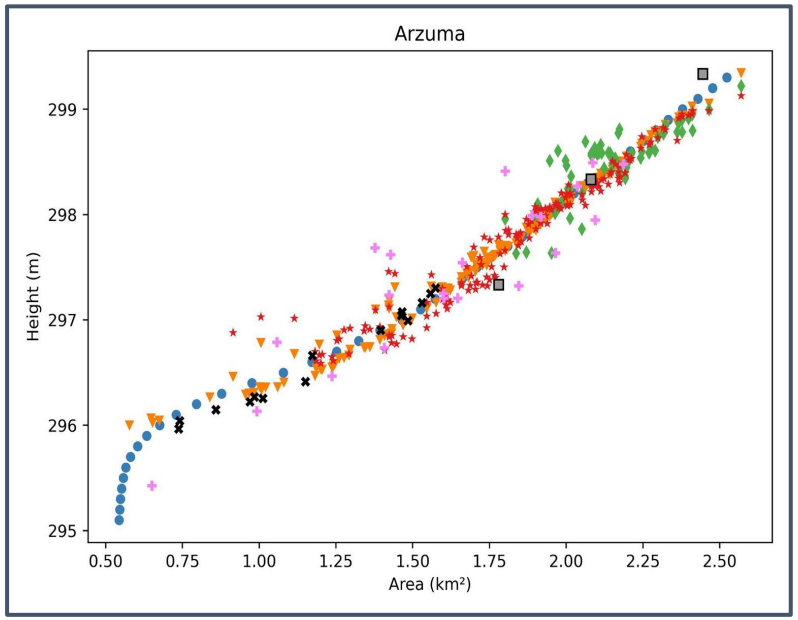
Real time water levels by pressure recorders over two sites (Niger and Burkina Faso), third one planned (Senegal)





2 – Establishments of water height –Area relationships

Intercomparison of h-A estimations by different satellite sensors (lidars, altimeters, optical) over 16 lakes.



× in-situ +S2
◆ ICESat +S2
★ GEDI +S2
+ Sentinel3 +S2
▼ Pleiades +S2
● Pleiades only
■ SRTM only

(Girard et al. , in prep)

3 - Assessement of hydrological regimes

by altimetry and optical remote sensing over 24 lakes

(de Fleury et al. , HESS, 2023)

→ Ready for SWOT evaluation and analysis

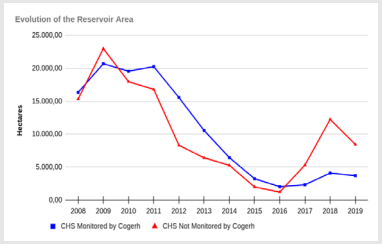
SMALL RESERVOIRS
in the semiarid region of Ceará, Brasil

Rafael Reis (PhD FUNCEME/Un Toulouse-UFC), Marielle Gosset (IRD/GET), Eduardo Martins (FUNCEME)

And many French and Brasilian collaborators

CONTEXT AND OBJECTIVES

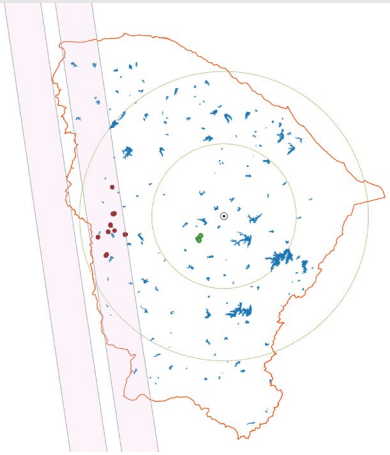
- Water = scarce resource disseminated through thousands of reservoirs
- High hydroclimatic interannual variabilty (droughts)



Poorly documented number/water volumes and global rôle of the small reservoirs

➔ Detect and quantify water
➔ Understand hydrological behaviour impact / evolutions

➔ Help FUNCEME / authorities information, planing and decision taking

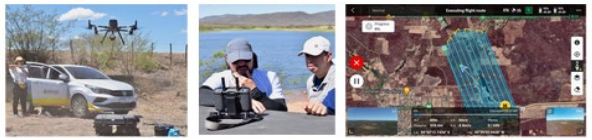


DATA

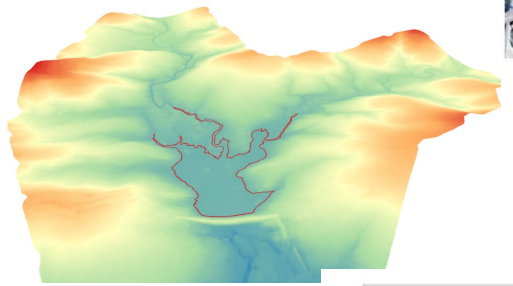
FUNCEME historical/on going data base :
-157 state monitored resevoirs – daily reading of rules (17 under cal/val)
-rain gauges and weather sations and radar

SWOT equipped reservoirs since sept 2022
-8 small reservoirs equipped for cal/val
-3 more for the science phase

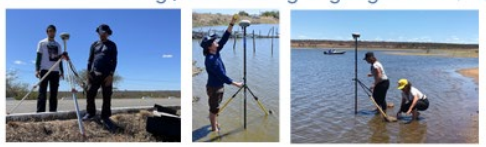
Drone Survey for High Resolution DEM and lake contour

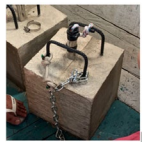


Bathymetry

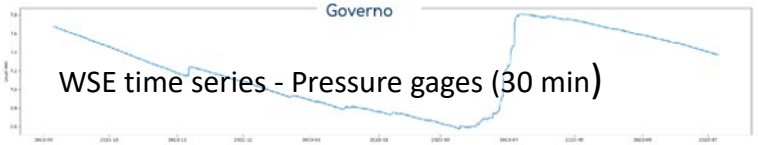


Absolute leveling / referencing of gauges with GNSS





Governo



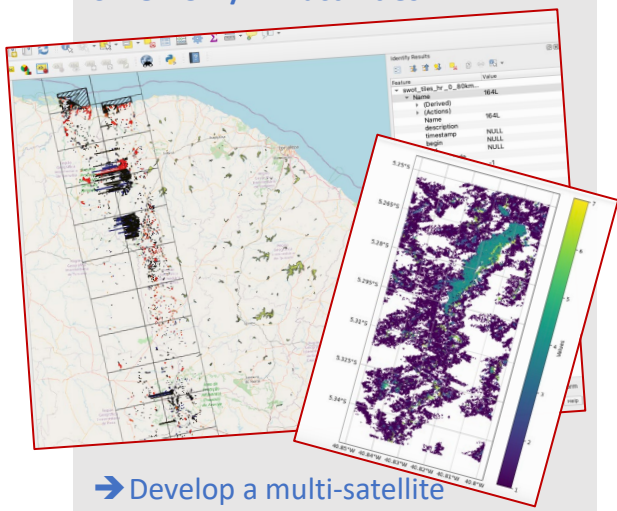
WSE time series - Pressure gages (30 min)

See poster + cal/val talk !!

ONGOING / PLANNED ACTIVITIES :

-Gather/process in situ data
-study water budget / hydrological behaviour
-link with socio-hydrology

SWOT CAL/VAL activities

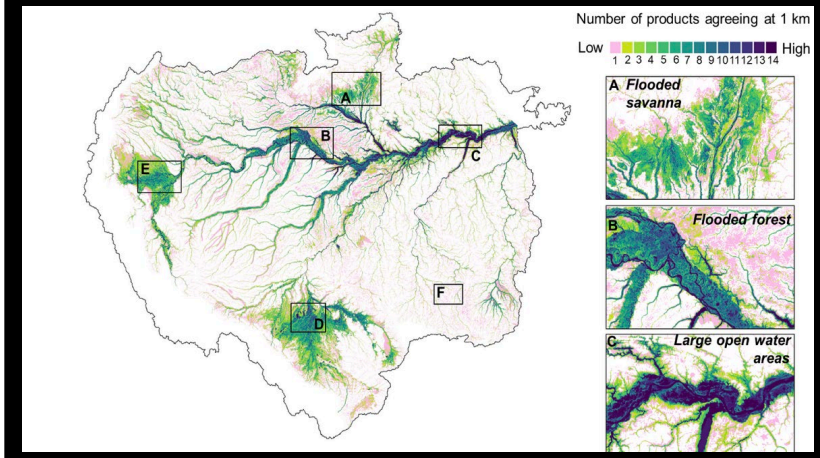


➔ Develop a multi-satellite monitoring system
➔ Understand rôle of small reservoirs in CE water resource system
➔ Transfer to FUNCEME

SWOT ST : SWOT for SOUTH AMERICA (F. PAPA, IRD)

How much inundation occurs in the Amazon?

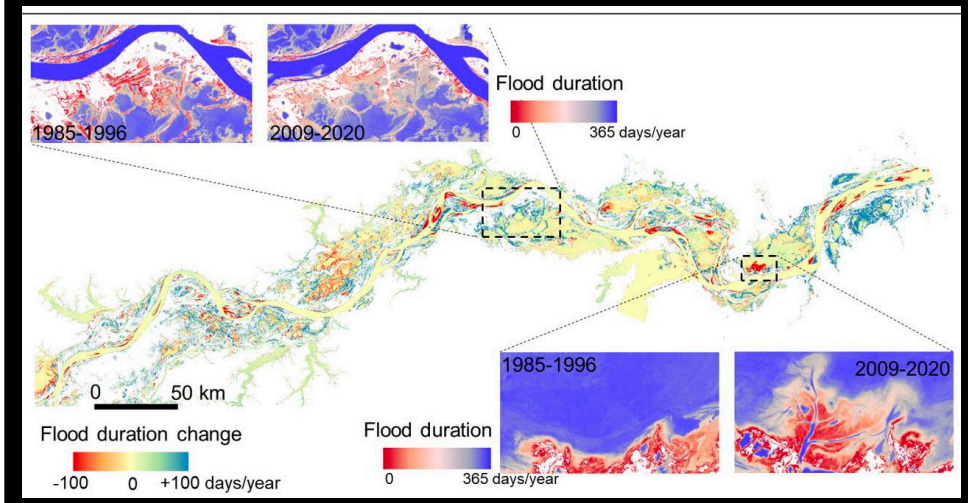
Comparison of more than 30 dataset at the Amazon basin scale and local scale



- Good agreement for open water
- Less agreement for other systems (inundated savannha, interfluvial wetlands)
- Recommandations provided in Fleischmann et al., 2022, RSE

Increased floodplain inundation in the Amazon since 1980

Satellite observations and models reveal a 26% inundation increase in the Amazon



- Changes in extent but also flood duration
- Large changes in the connectivity rivers/floodplains/lakes
- Strong implications for ecosystems, carbon cycle, life adaptation and local population

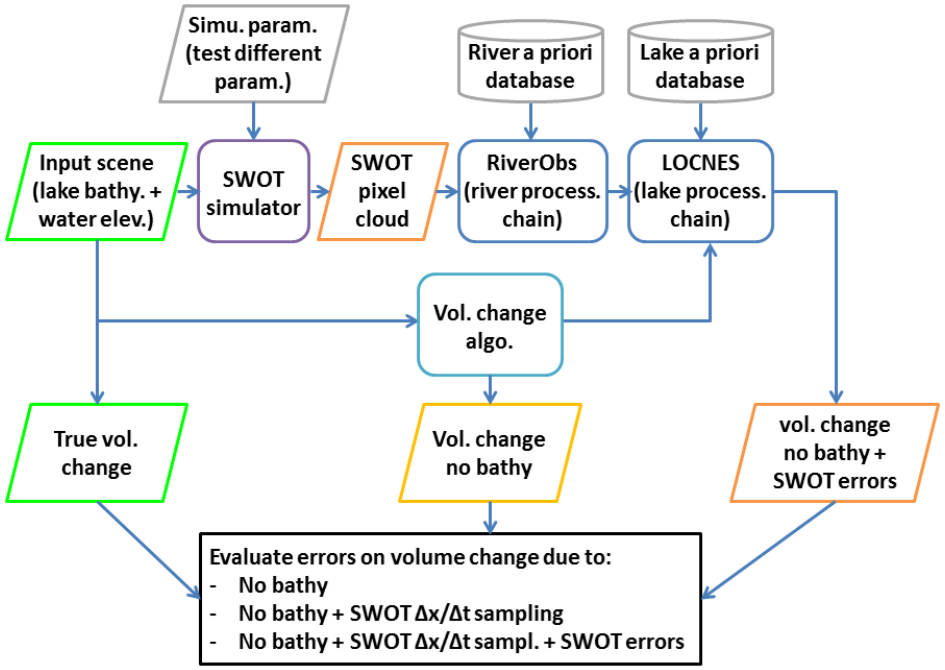
(Fleischmann et al., 2023, ERL)

SWOT and NORthern laKeS (SNROKS)

Biancamaria, M. Trudel, J.-F. Crétaux, M. Delhoume, C. Pottier, D. Peters, G. Siles, N. Desrochers, E. Cauvier-Charest

- Goals: evaluate SWOT lake products on realistic cases+ feedbacks to CNES/JPL
- Quebec:
  - synthetic cases for 18 lakes (lidar DEM + bathy map + in situ water elev.) from 60 ha to 11,000ha -> Large scale SWOT sim. -> RiverObs+LOCNES process = SWOT lake vol. change
  - Results = error vol. change comes mainly from error on water extent (which depends of the location in the swath)
  - In situ data (water elev profile, ADCP, camera…) under cla/val orbit collected by U. Sherbrooke (see M. Trudel's pres. In cal/val session)

Methodology:



Study domain:

- PAD: SWOT JPL sim. on Mamawi lake (160 km^2) + different backscatter coeff scenarios from AirSWOT = negligible effect of aquatic veg., water extent misclass. due to emergent riparian veg. with wetland around lake (Desrochers et al., 2021)
- **From these studies : error on water extent important on volume change error + error budget/water classif. depends on the location of the lake in the swath**

Canadian SWOT Cal/Val Site

Peace-Athabasca Delta & Lake Athabasca

PI: Daniel Peters

Environment & Climate Change Canada (ECCC)

- **SWOT Cal/Val activities funded by Canadian Space Agency (CSA) & ECCC**

Environment and Climate Change Canada
Environnement et Changement climatique Canada

CANADIAN SPACE AGENCY
AGENCE SPATIALE CANADIENNE

- **Key Activities**
- Suite of small to large lake - wetland monitoring sites in a cold regions
  - Water levels, GNSS-IR, cameras, meteorological towers - ice and open water periods
- Remotely sensed mapping of water surface areas
- Dynamics of water storage, surface area, seasonal connectivity, and water body database
- Development of 1D/2D hydraulic models
- SWOT simulations
- Examination of wind, emergent vegetation, and snow/ice effects on SWOT

- **Collaborating with a multi-agency/academic institution SWOT Science Team efforts**
- SWOT scientists Tamlin Pavelsky (U North Carolina), Colin Gleason (U Massachusetts), Larry Smith (Brown U) + others on US team funded by various NASA projects
- SWOT scientists Mélanie Trudel, Robert Leconte + others funded by CSA at University of Sherbrooke
- SWOT scientists Sylvain Biancamaria and Melanie Trudel + others funded by CNES (SNORKS project)
- SWOT scientists Pascal Matte & Mohammed Dabboor (ECCC) and François Anctil (INRS) and Laval U scientists

Assessing the added value of SWOT lake observations to enhance Canadian hydrological forecasting : Data assimilation accounting for latency, revisit time and error

Mohammed Amine Bessar[a], Étienne Gaborit[b], François Anctil[a], Pascal Matte[b], Mohammed Dabboor[b], Vincent Fortin[b]

[a] Université Laval, Department of Civil and Water Engineering, Québec, Canada

[b] Environment and Climate Change Canada (ECCC), Québec, Canada

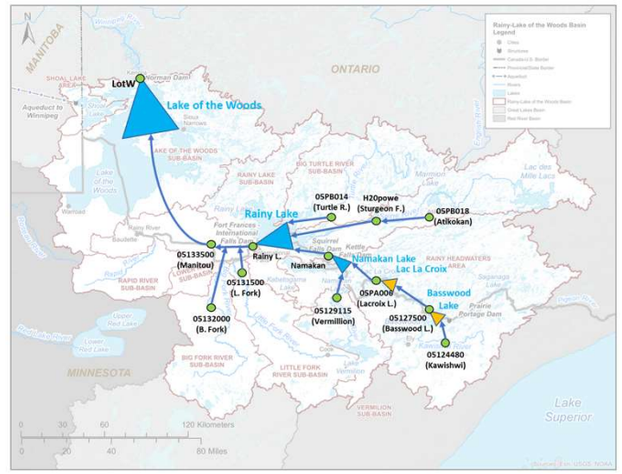
Objective : Evaluate the added value of SWOT lake observations by data assimilation (DA) and the impact of data latency, revisit time, as well as observational errors on the performance and sensitivity of the GEM-Hydro model developed at ECCC (Gaborit et al., 2017).

Challenges :

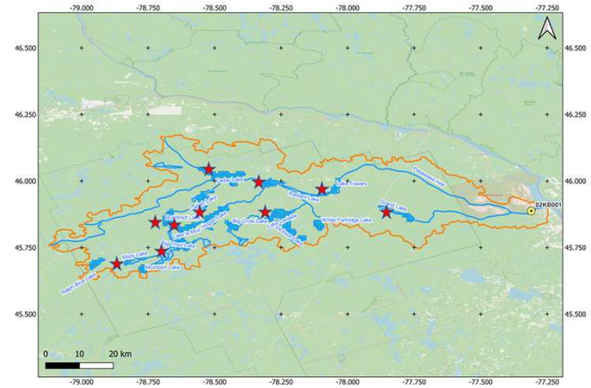
- Data assimilation of observed water levels
- Flow regime (natural/regulated)
- Routing dynamics
- Performance sensitivity to latency and revisit time
- Error related to observed data

Preliminary results : Water level assimilation do not only improve the performance of simulated water levels for all the lakes but most importantly improves downstream streamflow.

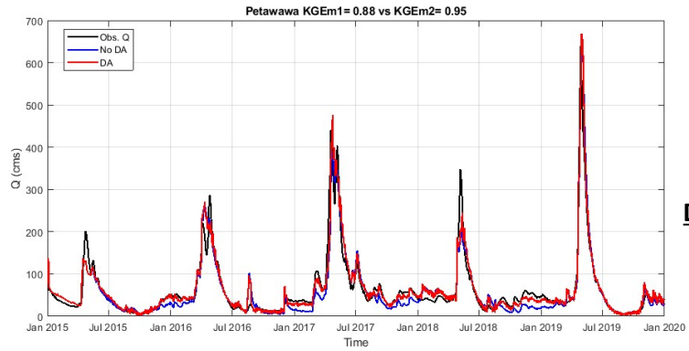
Regulated flow system – Lake of the Woods (~70000Km^2)



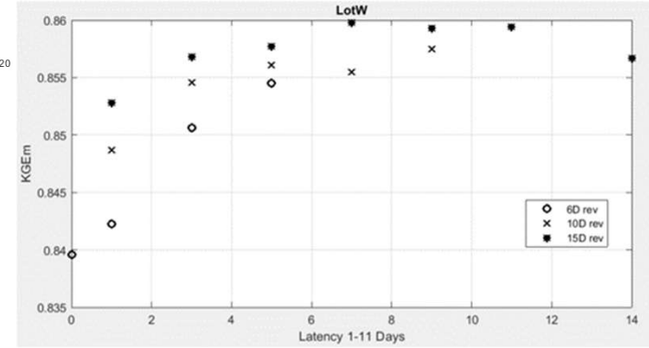
Natural flow system – Petawawa (~4000Km^2)



Improvement of streamflow simulation at the Petawawa outlet with DA



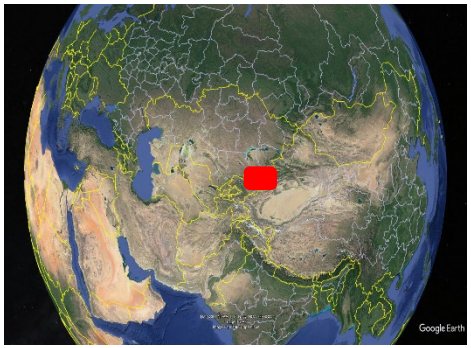
DA Performance & sensitivity of simulated streamflow to latency and revisit time

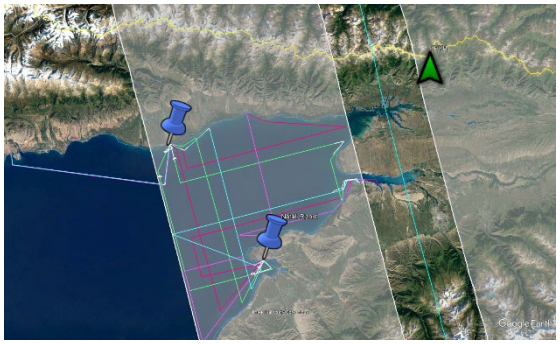


References

Gaborit, É., Fortin, V., Xu, X., Seglenieks, F., Tolson, B., Fry, L.M., Hunter, T., Anctil, F., and Gronewold, A.D. 2017. A Hydrological Prediction System Based on the SVS Land-Surface Scheme: efficient calibration of GEM-Hydro for streamflow simulation over the Lake Ontario basin. *Hydrology and Earth System Sciences,* 21(9):4825-4839. https://doi.org/10.5194/hess-21-4825-2017

Issyk Kul Inland Water cal/val (LEGOS, GFZ, CAIAG)

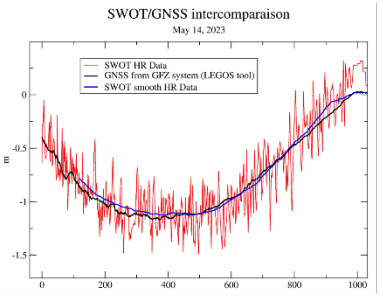


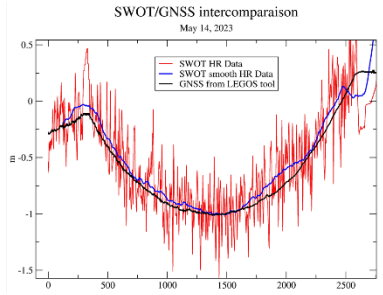


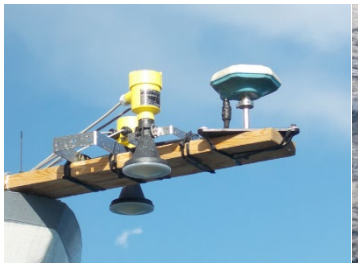
During the 1-day cal/val phase, the lake was passed on a descending arc with the right swath. Two teams jointly performed surveys and in-situ work at Issyk Kul.

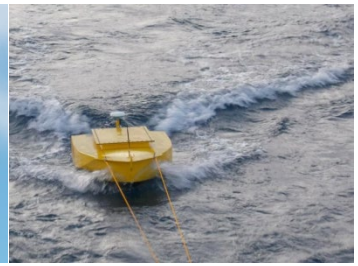
For the characterization of the SWOT cross- & along-track stability both vessels followed a S-N and E-W tracks. Each early morning SWOT passage was observed at the lake by the two vessels and two buoys. With several ITRF-controlled tide gauges, it is also possible to study the near-shore performance and establish a routine QM during the science orbit.

First results show still differences between the SWOT-HR results and the ship tracks.







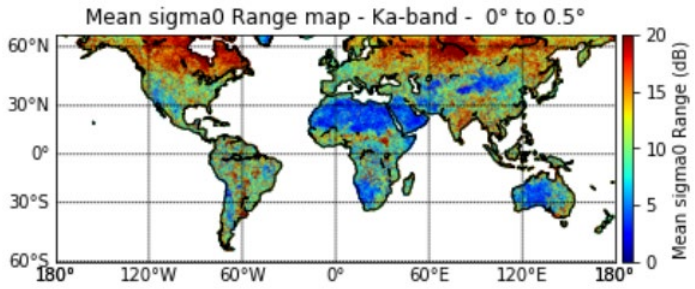


SWOT Wetlands Hydrology Monitoring – SWHYM

F. Frappart, C. Normandin, J-P. Wigneron, S. Biancamaria, J-F. Crétaux, F. Papa, P. Zeiger, C.Prigent, F. Aires, M-P. Bonnet, T. Catry, F. Satgé,, L. Bourrel, J. Darrozes, E. Mougin

1. Understanding backscattering over wetlands

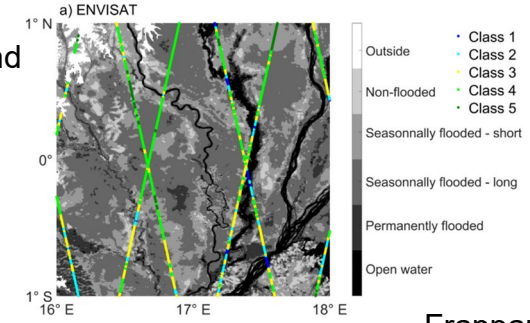
at Ka-band using GPM



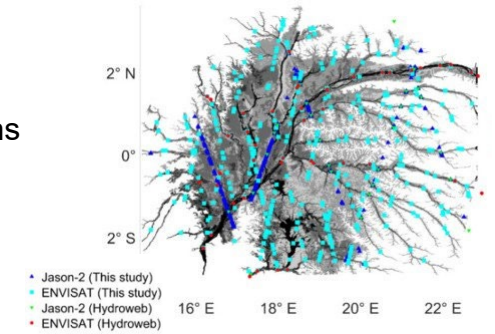
Internship of K. Gerouate

at Ku-band using LRM altimetry missions

to identify open water and flooded areas



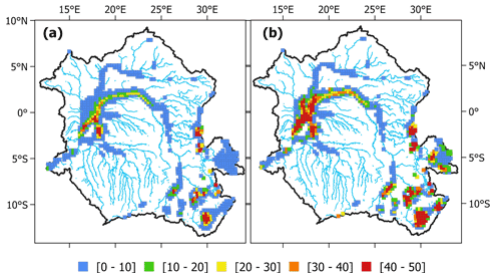
and densify virtual stations networks



Frappart et al., Remote Sens. (2021)

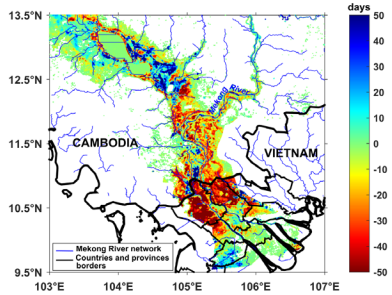
2. Monitoring floods in river basins with extensive wetlands

using GIEMS (global, 0.25°, since 1992)



Kitambo et al., Hydrol. Earth Syst. Sci. (2022)

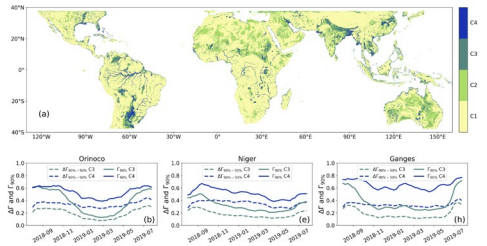
MODIS (some river basins, 500 m, since 2000)



Flood duration 2011-2020 vs. 2000-2010

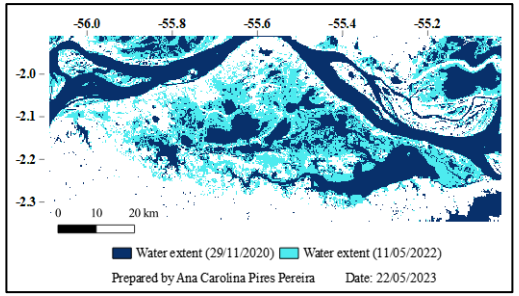
Normandin et al., Sci. Report (sub)

CYGNSS (Tropics, 0.1°, since 2016)



Zeiger et al., Remote Sens. (2022)
Zeiger et al., J. Hydrol. (rev)

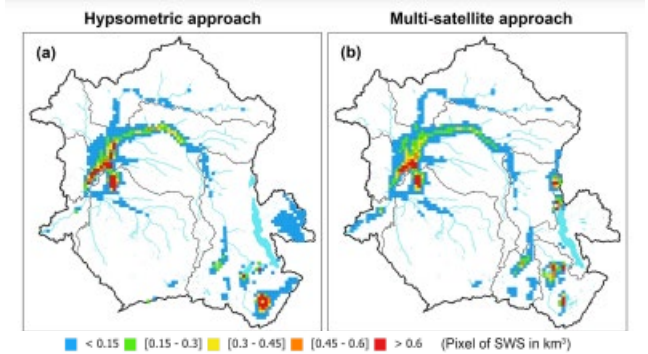
Sentinel-1 (local, 10 m, since 2014)



Internship of A-C. Pires Pereira

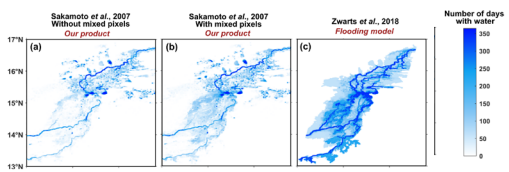
2. Monitoring floods in river basins with extensive wetlands

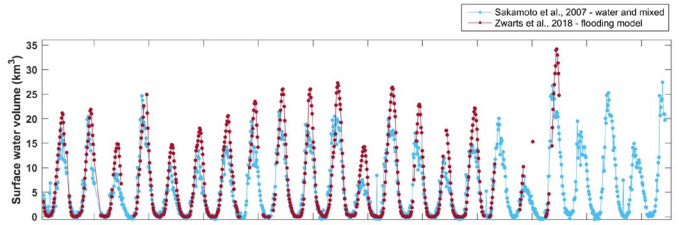
using surface water extent and DEM



Kitambo et al.
Earth Syst. Sci. Data
(2023)

surface water extent and surface water levels





Normandin et al., Geocato Int. (sub)

ISPA
LEGOS
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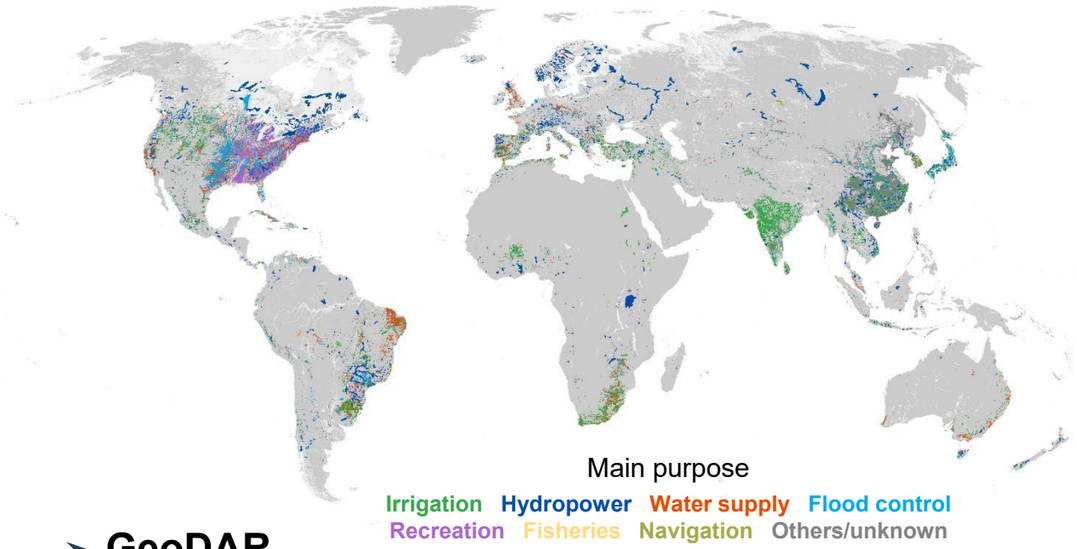
ESPACE-DEV
GET

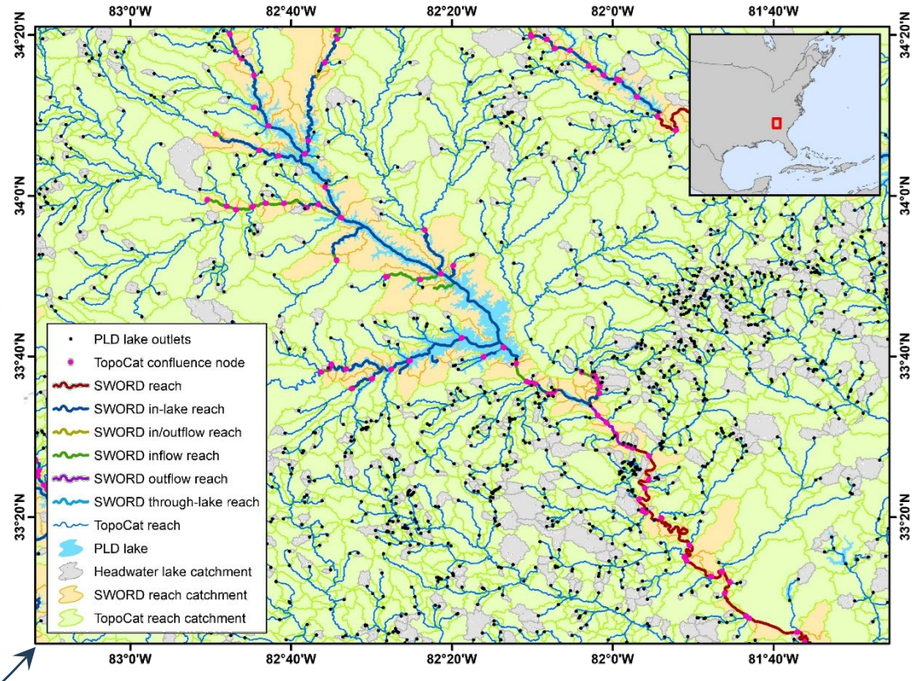
Integrating reservoirs into SWOT's global surface water storage and discharge monitoring

Jida Wang (UIUC), George Allen (VirginiaTech), Yongwei Sheng (UCLA), Safat Sikder (KSU), Ryan Riggs (TAMU), Jean-François Crétaux (LEGOS/CNES), and others



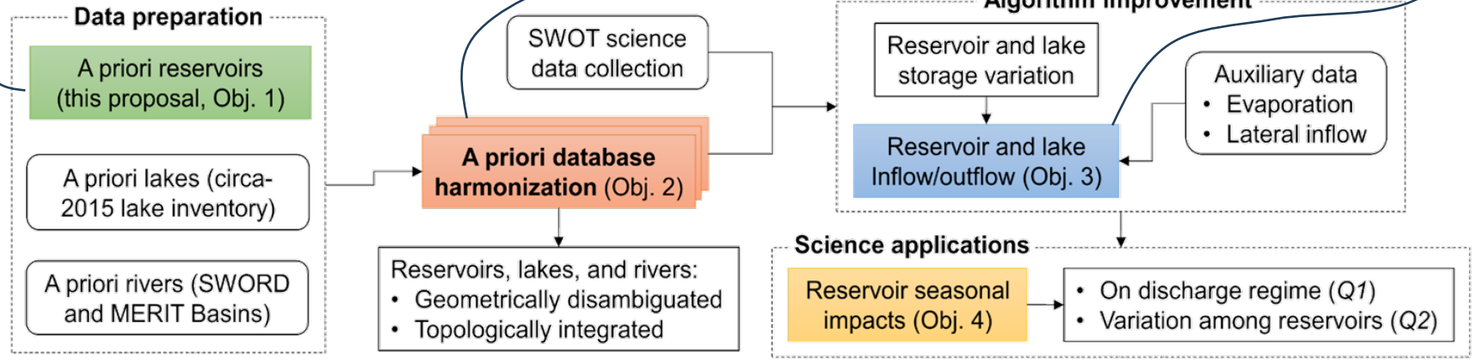
GeoDAR

- **v1.1** (*21,515 reservoirs*), doi:10.5194/essd-14-1869-2022
- Update: **v2.0β** (*169,319 reservoirs* with detailed prior attributes) registered to the PLD



Lake-river harmonization

- Established Lake-TopoCat (drainage topology & catchments for prior lakes) (doi:10.5194/essd-15-3483-2023)
- Configured topology attributes between SWORD and on-SWORD prior lakes
- Aligned SWORD reaches to hydrography data (MERIT) to harmonize drainage relationships between prior lakes and rivers



LakeFlow (doi:10.1029/2023GL103924)

- SWOT-algorithm to estimate river inflow and outflow at lakes visa mass conservation
- Tested on three sample lake systems, with promising performance (median NSE = 0.88)
- Potentially applicable to more than 16,000 lake-river intersections.