River Science Team Summary
SWOT Science Team Meeting

September 13-15, 2021

SWOT Science Team Charter & Composition

Group Charter: Rather than focusing on discharge algorithms, this group will investigate new knowledge that we plan and hope to get from SWOT on the hydrology, hydraulics and morphology of rivers; their role in the water cycle; the connectivity of rivers with wetlands and lakes; the role of rivers in climate change, and the hydraulics of rivers.

- 12 Projects have significant overlap with the SWOT River Science goals
- Overlap/cross-pollination with the following groups:
  - Discharge Algorithm Working Group (DAWG)
  - Global modeling and remote sensing
  - Lake and Wetland Science
  - Coastal/Estuarine group
- Full group membership, project summaries and emails available here:
  - https://docs.google.com/document/d/1eox0L4kpWtKDQkTAn1FMA7QXNjehd76UPE2qwKmzLRQ/edit?usp=sharing
  - At this time, 36 researchers have expressed interest in being in the group

River Science Team Activities to Date

- 3 Monthly Team meetings to date (last Thursday of the month). Highlights:
  - Meeting 1 (April): Team participant summary of team member research.
  - Meeting 2 (May): Bo Wang (Larry Smith's group) presentation on anabranching rivers from SWORD
  - Meeting 3 (June): Tamlin Pavelsky presentation on SWORD
  - Meetings paused during summer-time recess
  - Next meeting, September 30 (agenda after SWOT ST meeting)
- Discussions and polls regarding sharing code and data
  - Discussion leads: C. Gleason, K. Larnier, T. Pavelsky, S. Ricci, E. Rodriguez,
  - Community poll

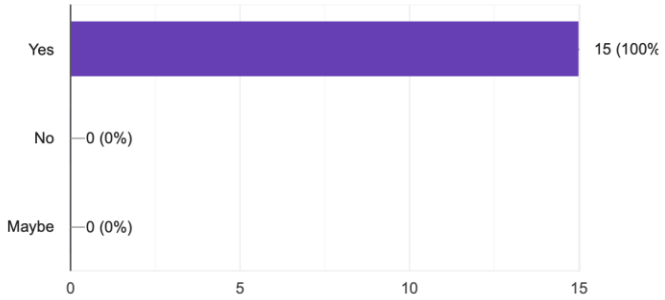
Code and Data Sharing Summary

- Poll had 16 respondents and there were team discussions of results
  - Full poll results available: https://tinyurl.com/SWOTRiverSciencePoll
- There is a strong desire by the majority of the community to have methods to share both code and data.
- The biggest gap found to date in code sharing is the severe lack of documentation and tutorials for the most popular tools
  - River Science team meetings are being used to improve the communication of tool capability. SWORD presentation was first in the line.
- Having a standard way of accessing code of interest (e.g., Github Hydrology Group page) has strong backing. Should support both open source or limited access options.
- Distribution of databases using most traditional methods (e.g., ftp) is desirable, but the community is willing to entertain other methods (e.g., Amazon buckets) for other large datasets, if these methods were funded. SWOT is a potential candidate dataset of Amazon bucket distribution.

Code Sharing Response Highlights

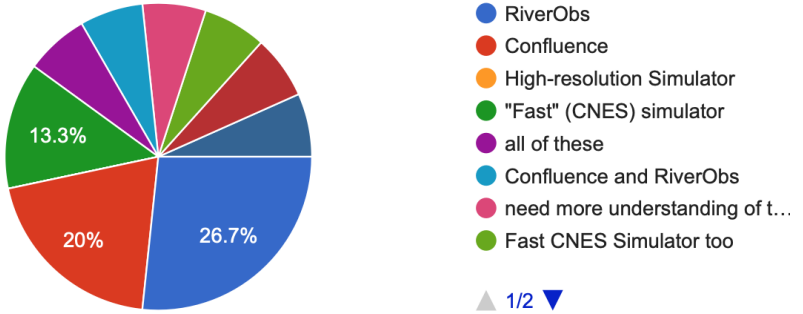
Would a core set of SWOT hydrology tools be useful for your work?

15 responses



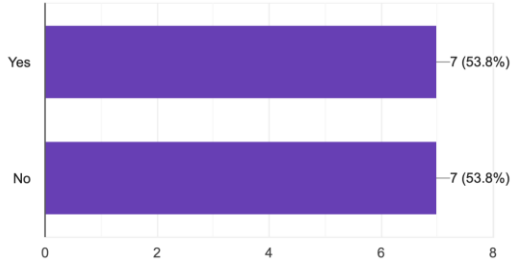
Which of these SWOT tools do you expect to use:

15 responses



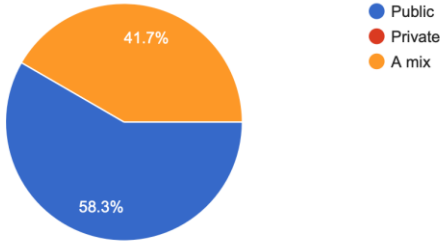
Do you have or plan to have a set of tools (open source or not) that you would consider sharing with the SWOT science team?

13 responses



Would you like code you share to be public, private, or a mixture

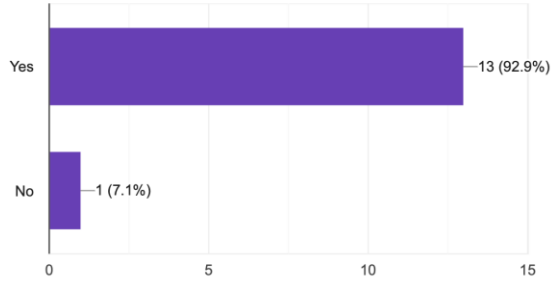
12 responses



Data Sharing Response highlights

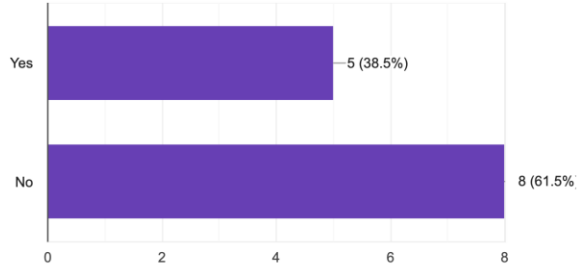
Do you think that having a common set of databases not already in the public domain would help your SWOT hydrology work?

14 responses



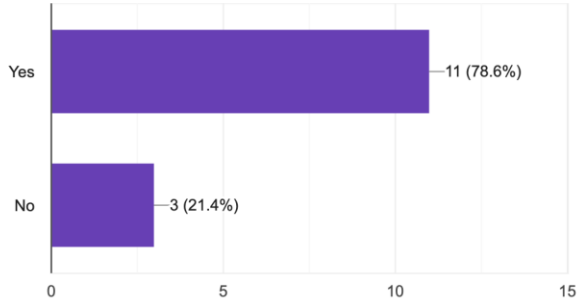
Will you be producing a database as part of your SWOT project that you would like to share with the SWOT science team?

13 responses



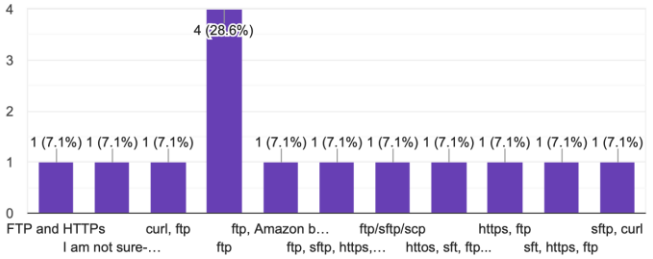
Do you think that hosting a SWOT science team Amazon S3 data bucket (or equivalent) containing common data sets would be useful for your work?

14 responses



What methods do you usually use for downloading data (e.g., ftp, sft, https, curl, Special Purpose Web Application)?

14 responses



Larry Smith's group:
one paper studying prevalence, intensity, and broad-scale controls on anabranching of 20 largest rivers in the world was submitted to *Nature Geoscience* on 09/05/2021

Broad-scale controls on large river anabranching

Bo Wang[1,2], Laurence C. Smith[1,2], Xiao Yang[3], Tamlin M. Pavelsky[3], Elizabeth H. Altenau[3], Colin J. Gleason[4], Alain Pietroniro[5], Ernesto Rodriguez[6], Paul D. Bates[7]

[1]Institute at Brown for Environment and Society, Brown University, Providence, RI, USA

[2]Department of Earth, Environmental and Planetary Sciences, Brown University, Providence, RI, USA

[3]Department of Geological Sciences, University of North Carolina, Chapel Hill, NC, USA

[4]Department of Civil and Environmental Engineering, University of Massachusetts Amherst, Amherst, MA, USA

[5]Department of Civil Engineering, University of Calgary, Calgary, Alberta, CANADA

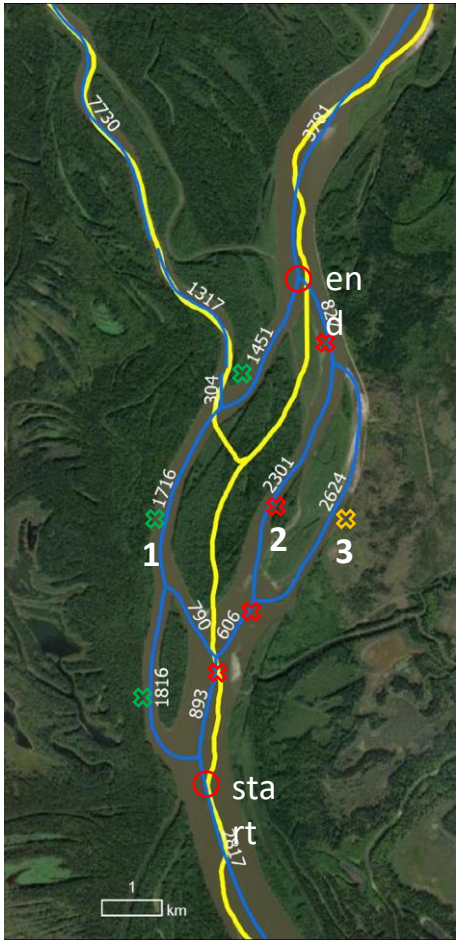
[6]Jet Propulsion Laboratory, Pasadena, CA, USA

[7]School of Geographical Sciences, University of Bristol, Bristol, UK

Bo gave a nice overview of the work during the May WG meeting (request recording if needed)

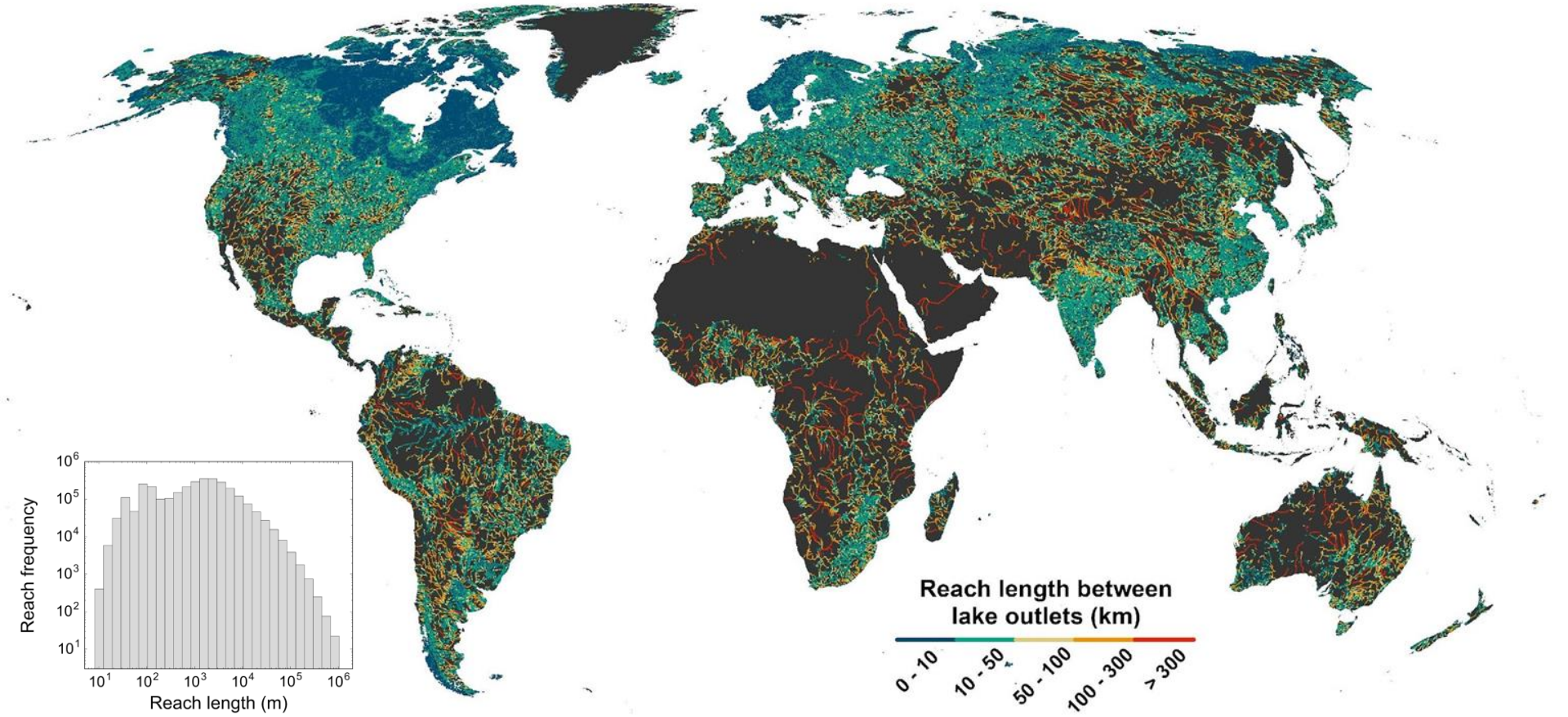
Working on updating SWORD for northern anabranching river segments

Yellow lines: Original SWORD centerlines
Blue lines: Three new centerlines reflecting anabranching characteristics



How are rivers segmented by SWOT-visible lakes?

(S. Sikder, J. Wang, Y. Sheng, G. H. Allen, D. Yamazaki, T. M. Pavelsky)



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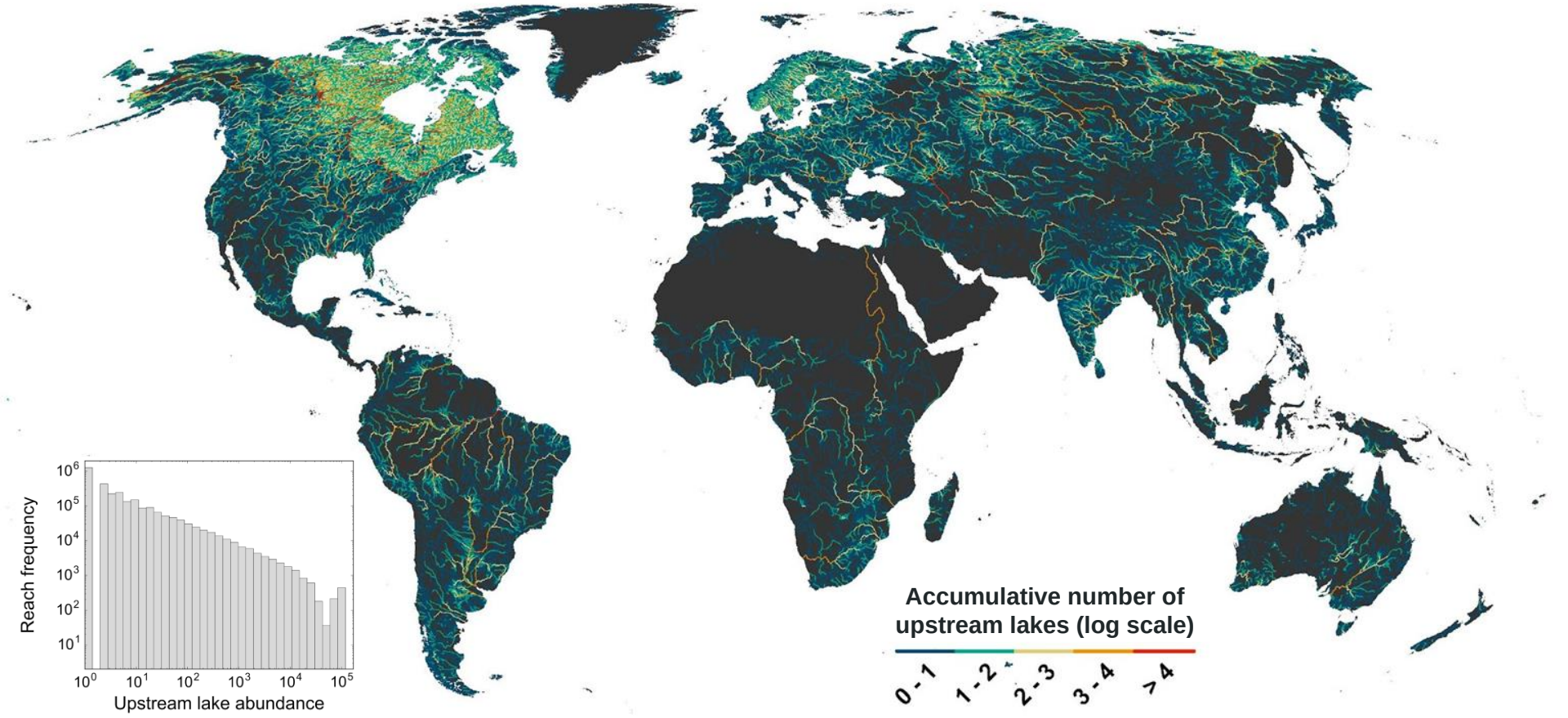
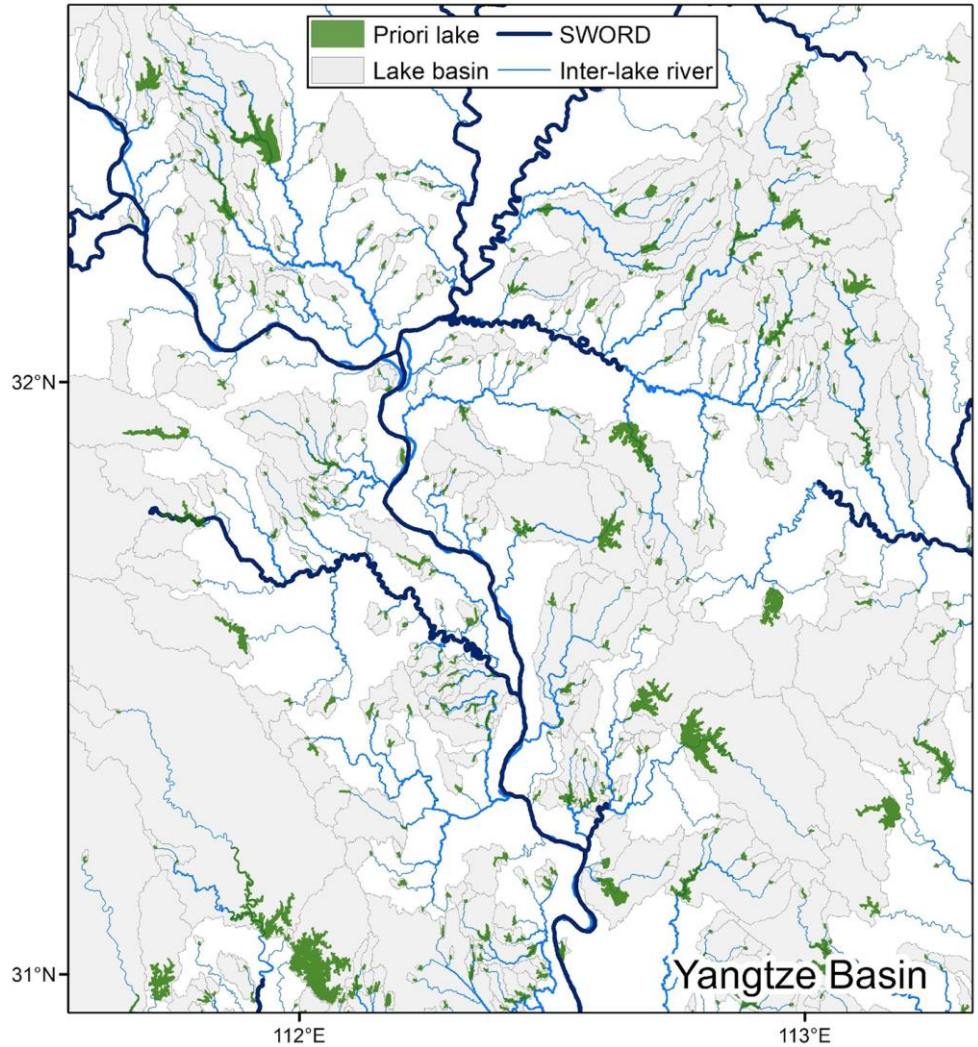




SWOT-visible lakes and reservoirs segment the global drainage system to 3+ million reaches.

More than 50% of the reaches are shorter than 1.5 km and more than 90% are shorter than 10 km.

Accumulatively, these reaches stretch ~10 million kilometers, at least 4.6 times longer than SWOT-visible river reaches (SWORD).

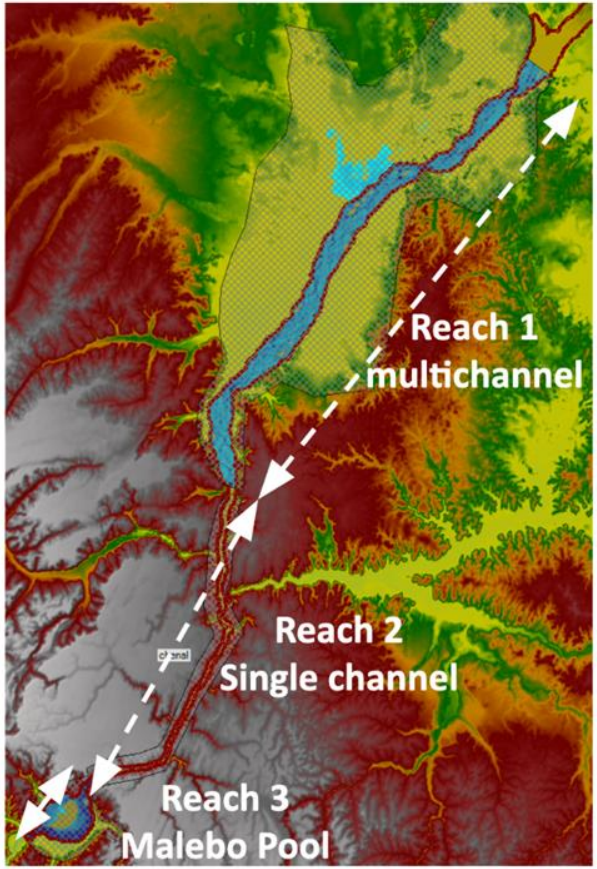
These results accentuate the roles of water stores in fragmenting (and integrating) river systems.

The new lake topology will help SWOT teach us: how lake and reservoir storage changes can propagate downstream and modulate river discharge.

CRISP Congo Project progress update 1/2

Contact: M. Trigg or R. Tshimanga
UNIVERSITY OF LEEDS

- Model is being built over 3 separate reaches due to different morphology and data availability. Will be combined as one model at the end.
- Reach 1: The upstream multichannel reach. ~300 km length with ~1500 islands. Best bathymetry data for this reach 1km cross-sections spacing and full 2D bathymetry interpolation.
- Reach 2: Second reach is the single channel “Chenal” section (~ 200 km long). Using a few key ADCP cross-sections and river width to derive representative channel bathymetry based on conveyance.
- Reach 3: Malebo pool area ~60 km. Combining recent ADCP measurements and sonar data, together with a a depth relationship derived from Landsat observed water occurrence and observations to derive a representative 2d bathymetry.

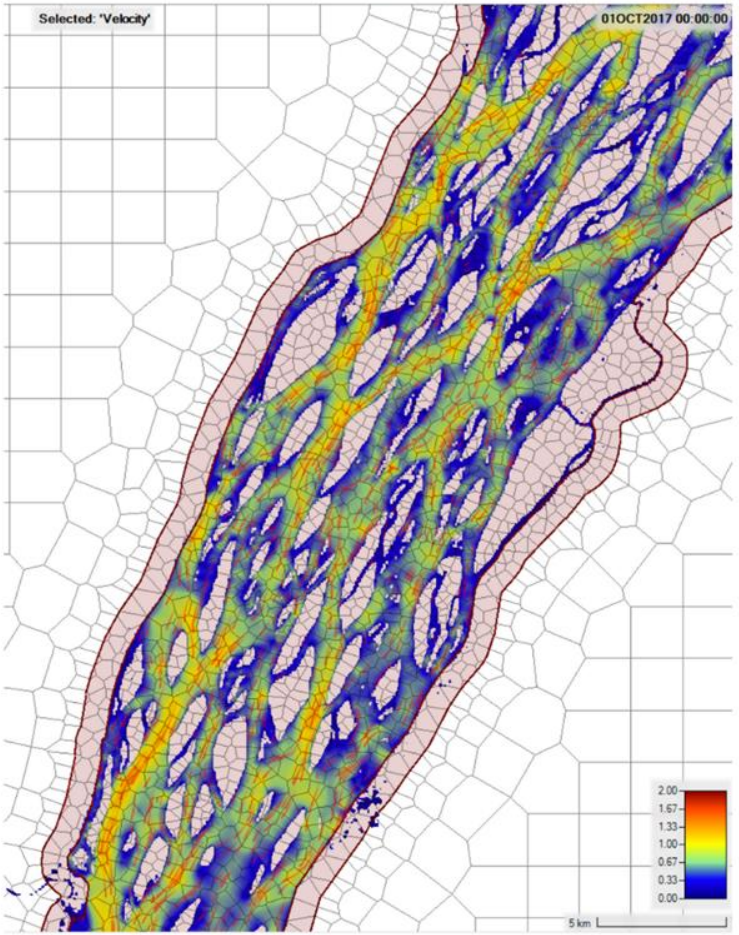


CRISP Congo Project progress update 2/2

Contact: M. Trigg or R. Tshimanga

UNIVERSITY OF LEEDS

- First reach model build is complete. Initial calibration to < 8cm water surface elevation observed in the field. Requires downstream boundary reach before completion of cal/val. Model has been optimised (~3 months in 10 minutes).
- Second reach model complete but runs show there is a strong sensitivity to downstream boundary (i.e. Malebo pool reach), so need d/s reach calibrated first.
- Third reach (Malebo pool) model is now working, but needs conveyance calibrating to match measurements in May this year. Adjustment of depth verses Landsat water occurrence relationship.
- Currently awaiting some level data for gauge at Kinshasa to allow boundary condition at outlet of pool to be defined as an explicite boundary condition due to sensitivity of model to this hydraulic control point.
- Plan is for model to be complete in next couple of months and ready for use.



Deutsches Geodätisches Forschungsinstitut
Fakultät für Luftfahrt, Raumfahrt und Geodäsie
Technische Universität München

Contact: Christian Schwatke

SWOT for Monitoring Terrestrial Water Storage Changes: Quality Assessment and Combination with other Remote Sensing Data

Christian Schwatke, Denise Dettmering

Preparation of DAHITI for the upcoming SWOT mission includes currently the integration of the SWORD dataset (v1.1)

- All DAHITI targets were assigned to reach ids and river km
- SWORD dataset is used to connect water level time series along rivers for an improved quality assessment without in-situ data
- SWORD dataset is also used for the automated creation of new virtual stations in DAHITI
- DAHITI contains currently more than 20.000 new targets which have been already computed. However, a quality assessment still has to be carried out before releasing the water level time series to the public.

Map with SWORD dataset, altimeter tracks and DAHITI targets

Additionally, the processing of new surface area data sets of lakes and reservoirs based on Landsat and Sentinel-2 is still ongoing. In future, this product will be used for the quality assessment of the SWOT surface data set

Project: Estimation of River Discharges from SWOT Observations using Data Assimilation and Hydraulic Models

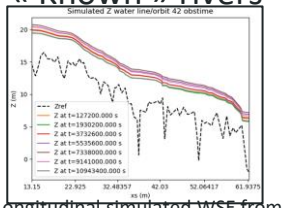
Contact: Sophie Ricci and Hind Oubanas

⇒ **Need of river-based SWOT-like products to develop SWOT discharge algorithm (e.g. SIC2VAR , HiVDI, McFli) and prepare for data assimilation of SWOT products in hydraulic models (e.g. Mascaret-SMURF, Telemac2D-EnKF)**

Hydraulic simulations (1D, no geolocalisation) → **ToolBoxSWOT** → *True scene*: WSE map (2D, raster, WGS84) → SWOT-HR simulator (JPL) → SWOT-like river products

⇒ **ToolBoxSWOT:** Processing chain (Python) to turn hydraulic model outputs into SWOT-HR input format:
https://gitlab.com/cerfacs/toolboxswot

- « Known » rivers – e.g. here downstream Garonne with Mascaret



Longitudinal simulated WSE from Mascaret seen by SWOT (orbit CNES 42)

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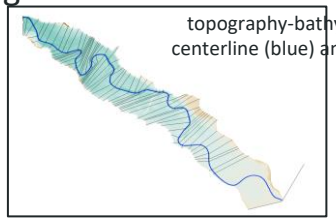
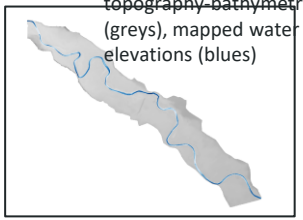


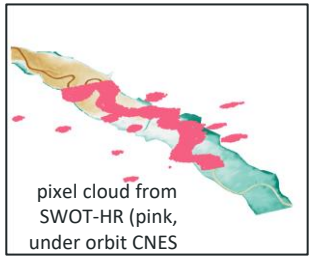
topography-bathymetry (colors), centerline (blue) and cross-section (black)

ToolBoxSWOT →



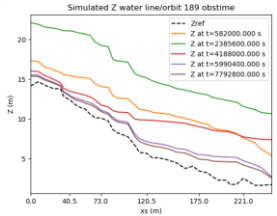
topography-bathymetry (greys), mapped water elevations (blues)

SWOT-HR →



pixel cloud from SWOT-HR (pink, under orbit CNES 42)

- « Unknown » rivers – e.g. here Brahmaputra reach from PEPSI data and SIC



Longitudinal simulated WSE from SIC seen by SWOT (orbit CNES 189)

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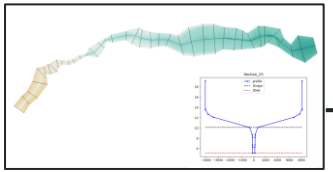
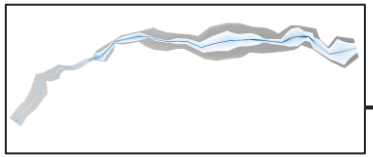


Reconstructed topography-bathymetry (colors) from cross-section (black + corner plot)

ToolBoxSWOT →



topography-bathymetry (greys), mapped water elevations (blues)

SWOT-HR →

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INRAE, UMR G-eau – CECI, CERFACS/CNRS UMR 5318, CSGROUP-France