



National Aeronautics and  
Space Administration

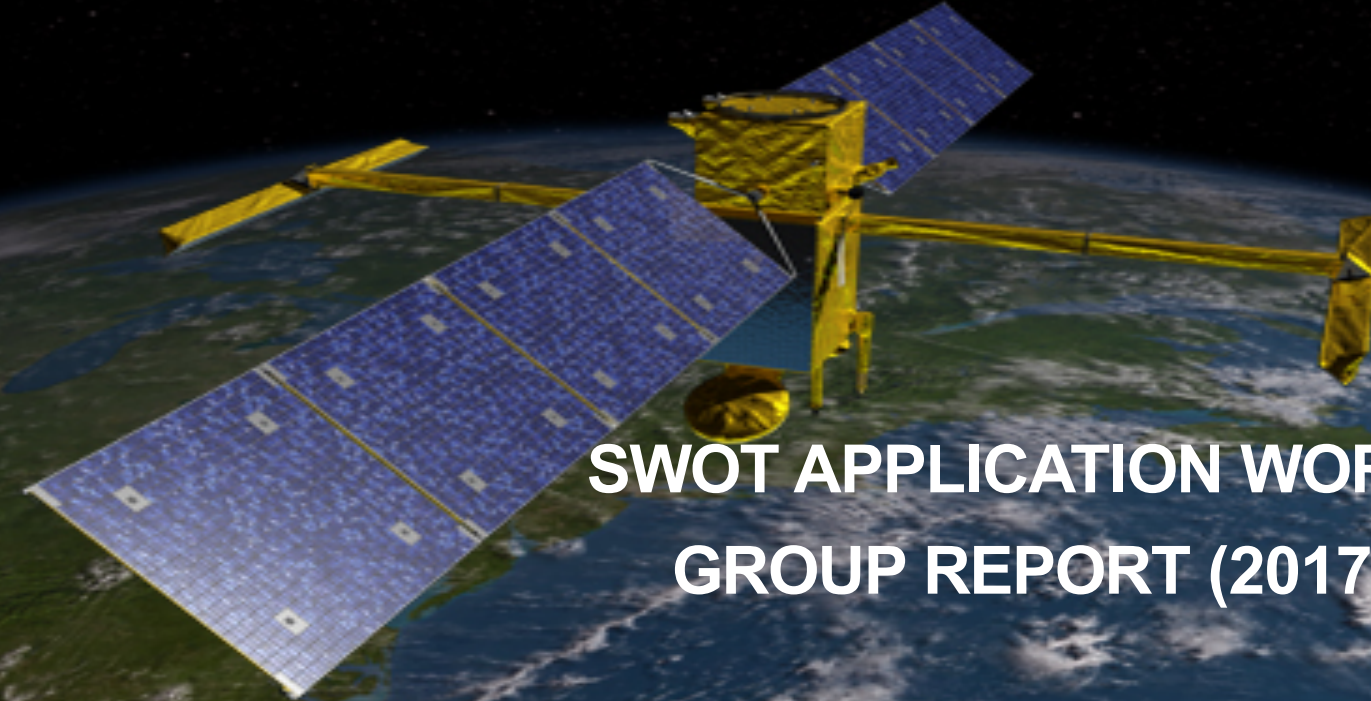
Jet Propulsion Laboratory  
California Institute of Technology  
Pasadena, California



# Surface Water and Ocean Topography (SWOT) Mission

June 26, 2018

SWOT Science Team Meeting



## SWOT APPLICATION WORKING GROUP REPORT (2017-2018)

**SWOT Applications Working Group (SAWG) Leads**  
Alice Andral, Margaret Srinivasan, Ed Beighley and Faisal Hossain

*Special Thanks to Annette deCharon, Carla Lauter, Jessica Hausman, Natasha Stavros, Shailen Desai, Nicolas Picot*

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# OUTLINE



- MISSION OF SWOT APPLICATION WORKING GROUP (SAWG)
- SUMMARY OF KEY ACTIVITIES BY SAWG IN 2017-2018- Present
- EARLY ADOPTER PROGRAM
- EARLY ADOPTER (1<sup>st</sup>) APPLICATION (3<sup>rd</sup>) SWOT WORKSHOP
- PLANS FOR 2018-2019



# SAWG MISSION (Quick Reminder)



1. To maximize the real-world application of SWOT data for solving critical societal problems after SWOT's launch in 2021/2022.
2. To build, maintain, and grow a critical mass of early adopters and a community of scientists, stakeholder agencies and end users interested in SWOT's unique capability for driving societal applications.
3. To stay close (but not ahead) of SWOT Science Team and Project and be aware of application-critical information (science, engineering and data issues).



# WHERE WERE WE AT THE LAST ST MEETING?



- SWOT APPLICATION WORKSHOP (April 5-6, 2017, Reston, Virginia)
- **Key issue addressed:** *identify and document acceptable data **latency**, **application** and **support needs** of SWOT data of user community.*
- Several wide-audience articles published on user community's needs on SWOT (BAMS, EOS, ASCE Civil Engineering, GRL(AGU) by *Allen et al., 2018*)
  - *Tremendous demand and interest in an NRT/STC product, with latencies desired between less than one day to five days.*
  - *Data latency of ~ **two days** was the most requested product.*
  - *Compromise between accuracy and latency acceptable.*
  - *Many applications that not latency-critical.*



# QUANTITATIVE IMPACT OF LOW-LATENCY SWOT DATA



<https://www.nasa.gov/feature/inl/before-the-flood-arrives>

## Geophysical Research Letters

AN AGU JOURNAL

Research Letter

### Global Estimates of River Flow Wave Travel Times and Implications for Low-Latency Satellite Data

George H. Allen , Cédric H. David, Konstantinos M. Andreadis, Faisal Hossain, James S. Famiglietti

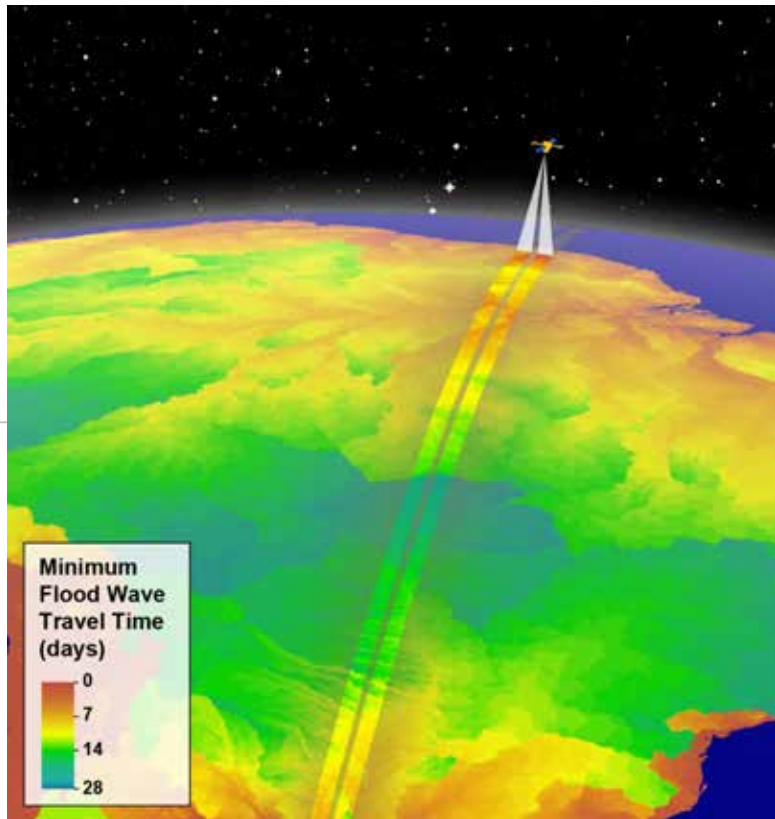
First published: 26 April 2018 | <https://doi.org/10.1029/2018GL077914>

[Read the full text >](#)

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### Abstract

Earth-orbiting satellites provide valuable observations of upstream river conditions worldwide. These observations can be used in real-time applications like early flood warning systems and reservoir operations, provided they are made available to users with sufficient lead time. Yet the temporal requirements for access to satellite-based river data remain uncharacterized for time-sensitive applications. Here we present a global approximation of flow wave travel time to assess the utility of existing and future low-latency/near-real-time satellite products, with an emphasis on the forthcoming SWOT



*“≤2-day latency would allow a SWOT NRT product to be available before at least  $63_{-6}^{+6}\%$  and  $53_{-7}^{+5}\%$  of SWOT-observable flow waves reach the next downstream city and dam respectively.”*



# KEY ACTIVITIES: 2017- Present



- *Early Adopter Call for Proposals and Launch (March 2018)*
  - *Organize and prepare sample pre-SWOT and proxy datasets for Early Adopters*
  - *Develop application tutorials on SWOT mission*
  - *Organize Early Adopter (User) Workshop*
- 
- *Main theme for 2017-2018 “VISUAL BEFORE ACTUAL”*
  - *VISUAL – FOCUS ON SWOT’S SAMPLING (orbit, repeat, coverage) rather than quantitative performance issues on estimating water elevations (ACTUAL)*



# EARLY ADOPTER PLAN AND CALL FOR PROPOSALS



- Call for submittals announced March 2018
- Five proposals received to date, some pending, others expected.
- EA Submittal Review: Project, NASA, CNES, SWOT Leads
- Rolling submissions





# EARLY ADOPTER (EA) WORKSHOP



**May 29-30, 2018 Webinar & Northeastern University, Boston**  
Focus on **hydrology** only

## GOALS:

- **Engage** EAs in an instructive and hands-on activity to broaden their experience with the mission and with satellite data.
- **Increase** outreach and user engagement for SWOT mission.
- **Introduce** the “2018 SWOT Early Adopters cohort” to the SWOT mission, its capabilities, and remote sensing for hydrology
- **Provide** hands-on experience to understand the potential & limitations of SWOT mission
- “Hearing from our EAs”-- their planned use of SWOT data, feedback, needs etc.

*Also develop protocols/templates for online delivery of training workshop for repurposing and greater outreach to the global community more cost-effectively*





# WORKSHOP PARTICIPANTS



1. United States Geological Survey - USA
2. CLS- FRANCE
3. National Geospatial Agency- USA
4. CNR - FRANCE
5. FM Global - USA
6. Indian Institute Of Technology – INDIA
7. BRL Group - FRANCE
8. Pakistan Council of Research In Water Resources- PAKISTAN
9. Asian Disaster Preparedness Center (ADPC) – THAILAND
10. NASA-SPoRT – Marshall Space Center – USA
11. University of Bonn - GERMANY
12. National Center for Water Planning And Investigation – VIETNAM
13. U.S. Navy – USA
14. National Research Inst. of Science & Technology for Environment & Agriculture  
(IRSTEA) – FRANCE
15. CERFACS - FRANCE

Total 48+ participants (primarily online)



# WORKSHOP VENUE

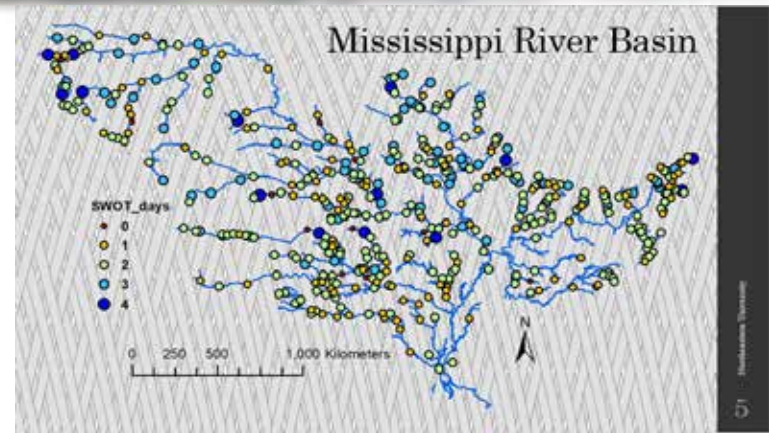
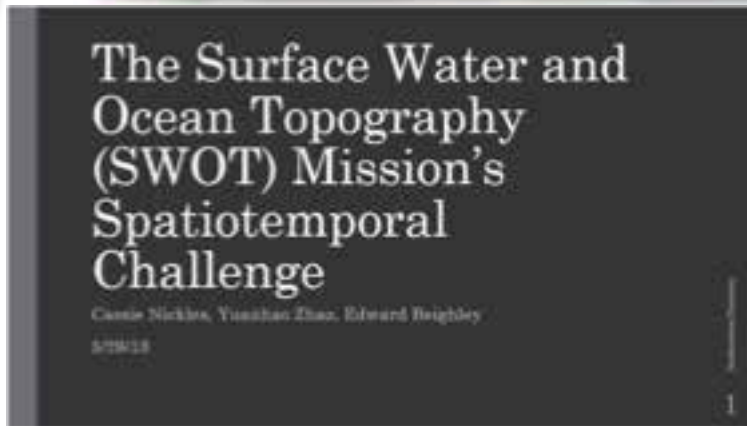


## Northeastern University, Boston & Webinar





# HANDS-ON TUTORIAL ON SWOT



## Demo in ArcGIS: Part 1

- Finding days SWOT will measure in a certain location within 21-day cycle.
- Need:
  - Shapefile of SWOT swaths (provided)
  - Shapefile of desired point(s)
- Output:
  - Shapefiles joined to create one table out of both attribute tables



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## Demo in ArcGIS: Part 2

- Creating a timeseries of measurements per location for only days SWOT will capture
- Adding uncertainty if discharge
- Need:
  - Output table from part 1
  - csv file of a timeseries desired (metric units)
  - If adding uncertainty for multiple points: csv file of USGS yearly mean flow per site

Site	Day	Discharge	Uncertainty
1	0	1000	100
1	1	1000	100
1	2	1000	100
1	3	1000	100
1	4	1000	100
2	0	2000	200
2	1	2000	200
2	2	2000	200
2	3	2000	200
2	4	2000	200

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- Using a newly developed ArcGIS 10.5.1 toolbox, participants were shown how to find days SWOT will measure a given location within the 21-day orbit.
- Participants can use the toolbox to create a timeseries of discharge measurements per location for SWOT days including published uncertainties.



# HANDS-ON TUTORIAL ON SWOT



## Potential Applications of SWOT Mission to Mekong River Basin

Matthew Bonnema and Faisal Hossain  
University of Washington

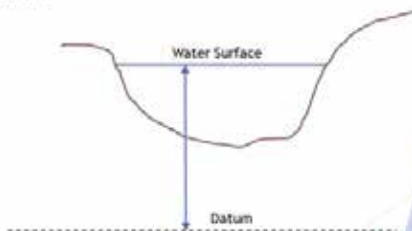
### Mekong Basin

- ▶ Located in South East Asia
- ▶ Drains from 6 countries
- ▶ Tropical monsoon climate
  - ▶ Wet season: June through October
  - ▶ Dry season: November through May
- ▶ 60 million people live in lower basin, depend on river for food and livelihood



### What is SWOT Measuring?

- ▶ Water Surface Area
- ▶ Water Surface Elevation



### Problem 1: Calculate Storage Change for Sirindhorn Reservoir

Objective: Estimate storage change of Sirindhorn Reservoir

Instructions:

1. Open "HandsOn.xlsx" and navigate to "Problem 1" tab
2. Calculate elevation difference, average area and storage change
3. Calculate average storage change per day by dividing by the number of days between passes

We will reconvene in 10 minutes



- Using reservoirs of Mekong & SWOT Visualizer, participants were shown the visual aspects of SWOT (sampling, swath, coverage).
- Participants completed 2 problems, took a multiple-choice question.
- Many used what they learned in their EA session (Hearing from EAs).



## Class of 2018

**USGS** – *“Better access to SWOT simulated data and timely engagement with NASA/SWOT expertise would bolster SWOT success and help meet USGS science and resource management objectives (of being the nation’s hydrologic data repository)”*

**NASA SPoRT (EA)**– *“Assimilation of SWOT Water Surface Elevation may have potential to improve initialization of National Water Model & Discharge prediction.”*

**CNR** – France – *“SWOT Data should be available in GIS format (e.g. Hydroweb Theia)• Historical data should be easy to download with uncertainty information• Discharge estimation needs to be worked on.”*

**BRL** – France – *“SWOT Data has value for practitioners and water managers in both Europe and Africa if latency and uncertainty are known a priori.”*



# HEARING FROM OUR PARTICIPANTS/EAs



**Indian Institute of Technology - Bombay (EA)**– *“Need to focus on examining real-time urban flood forecasting scenario with SWOT and explore calibration of hydrodynamic models.”*

**PCRWR (EA)** – *“SWOT can be useful in transboundary river and reservoir monitoring & for precise assessment of regulation paradigm in Indian reservoirs. SWOT should be explored for optimizing reservoir operations and monitoring wetlands formed due to waterlogging.”*

**ADPC (EA)**– *“SWOT can improve current altimeter-based virtual stream-gauging system in Southeast Asia. •Agricultural DSS needs to be ready for ingesting SWOT data.”*

**NAWAPI** – *“SWOT data are needed for improving operational monitoring and forecasting of water, improving hydrologic models and monitoring transboundary rivers and reservoirs.”*



# SAMPLE SURVEY QUESTIONS FOR PARTICIPANTS/EAs



1. What do you consider to be the biggest challenge to incorporating satellite data for improved operational capacity?
2. Do you see any critical gaps around freshwater observations from space (time latency, spatial/temporal resolution, non-observed or poorly-observed hydrological variable)?

Yes

No

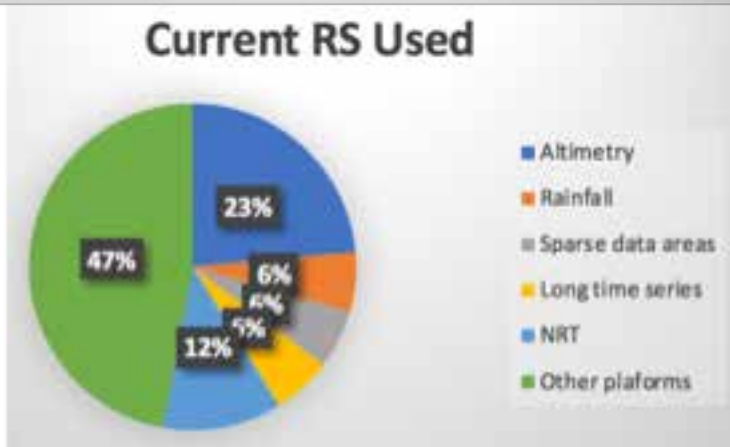
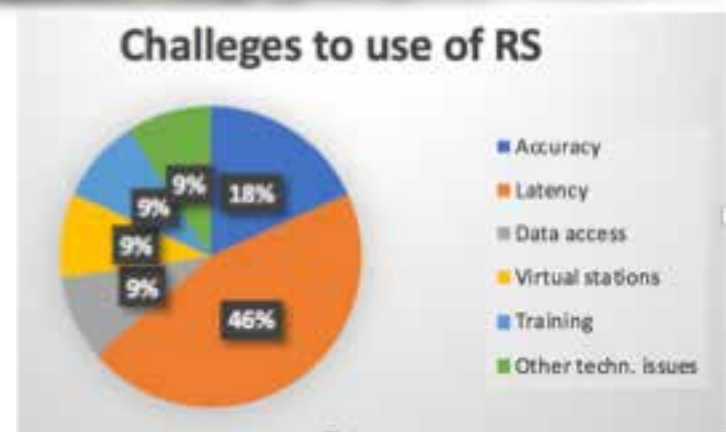
Not sure

If yes, please explain your answer.

3. How can we enhance and support involvement from private industry, state agencies, and universities in NASA and CNES Applications effort?



# SUMMARY OF FEEDBACK



## Enhanced support:

- Technical & financial support for R&D project in "small" private companies
- Convenient data access
- Funding for universities, pilot projects
- Germany involvement in SWOT (to support funding)
- Research collaborative programs





# PLANS FOR 2018-2019



1. Complete Workshop Report.
2. Disseminate key outcomes of workshop in wide-audience forums (EOS, BAMS etc.).
3. Continue implementation of Early Adopter Program (5+ proposals received) and Provide guidance to EAs.
4. Maintain engagement and continue outreach with user community.
5. Prepare for a May-2019 SWOT USER WORKSHOP (Quantitative – Simulator-based)



# QUESTIONS?