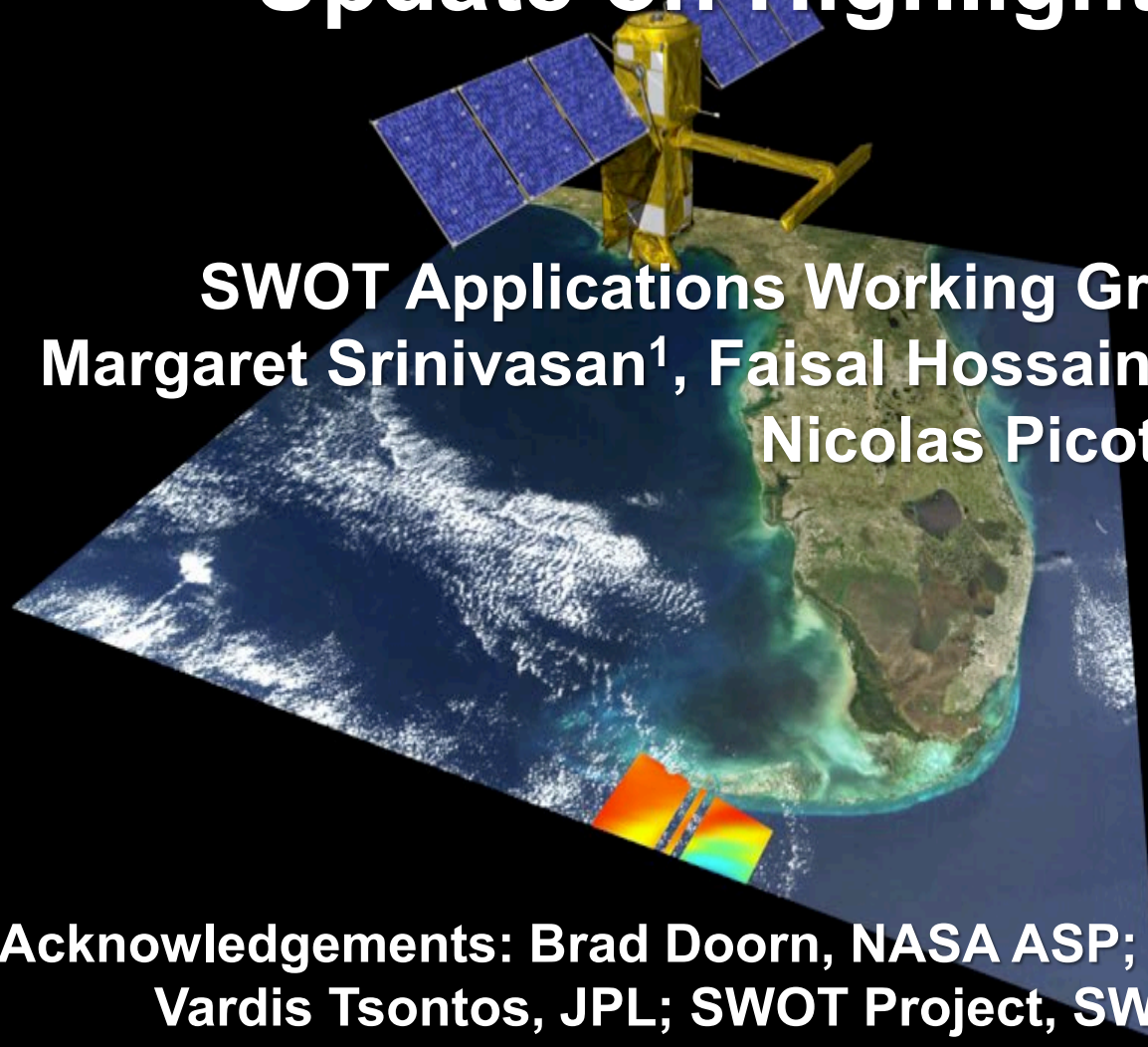
SWOT APPLICATIONS: Update on Highlights and Plans



SWOT Applications Working Group (SAWG) Leads:
Margaret Srinivasan[1], Faisal Hossain[2], Santiago Peña-Luque[3], Nicolas Picot[3]

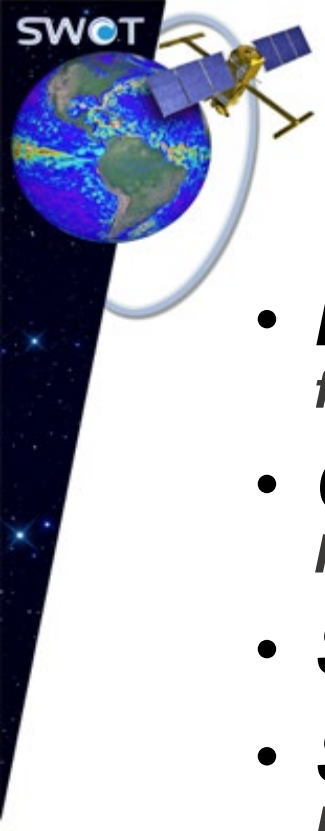
[1]Jet Propulsion Laboratory
California Institute of Technology,
[2]University of Washington
[3] CNES

Acknowledgements: Brad Doorn, NASA ASP; Annick Sylvestre-Baron, CNES; Vardis Tsontos, JPL; SWOT Project, SWOT Science Team, SAWG

Supported by NASA Applied Science Program, CNES-French Investment Program

OUTLINE

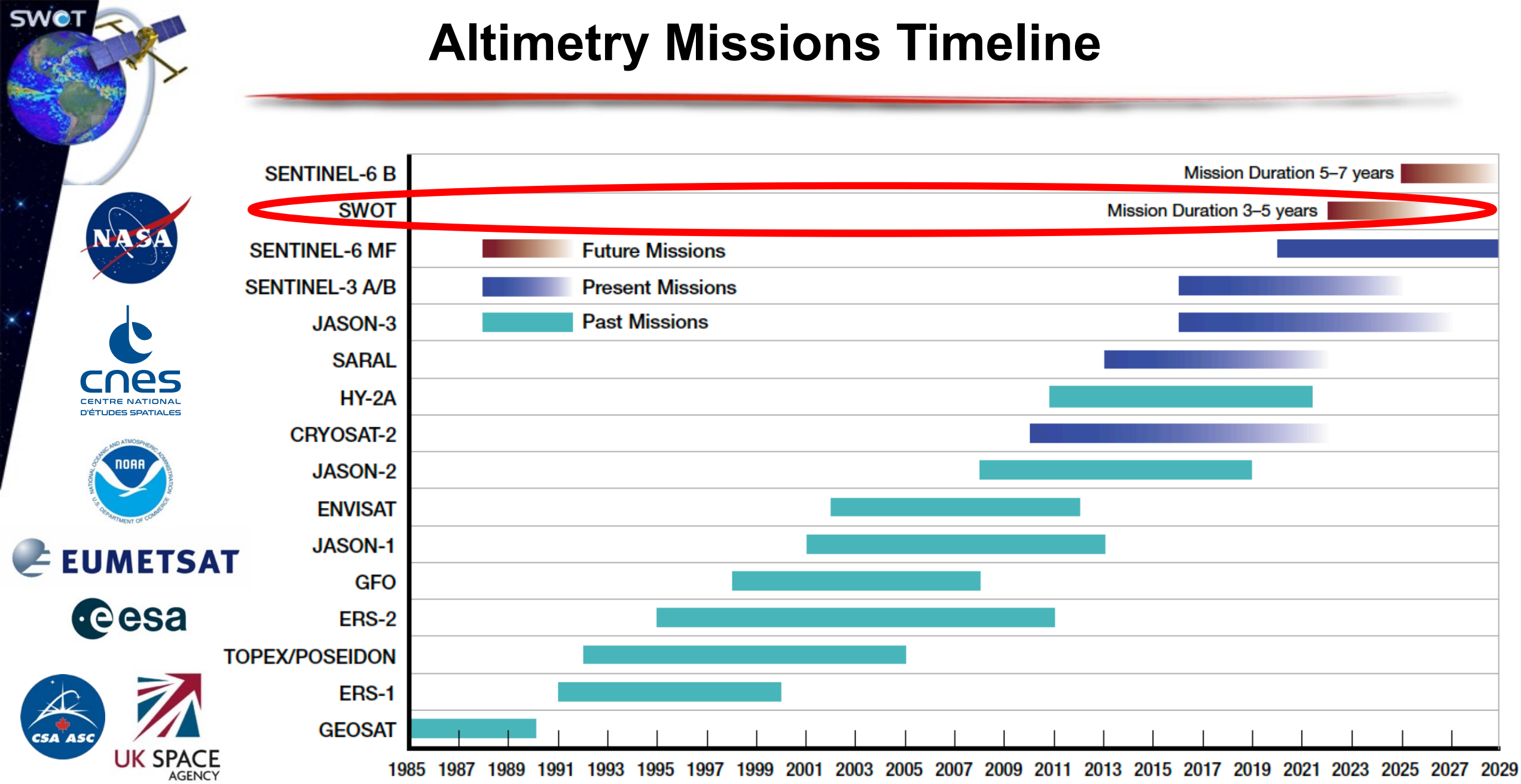
- Programmatic context
- Mission of the SWOT Applications Working Group (SAWG)
- Summary of key activities:
  - MAJOR ACCOMPLISHMENTS AND HIGHLIGHTS
  - STATUS OF THE EARLY ADOPTER PROGRAM
  - TRAINING AND SUPPORT



Programmatic Scope for Applications

- ***NASA Applied Sciences Program –*** *Brad Doorn, Program Executive for Water Resources*
- ***CNES, French Investment Program –*** *Annick Sylvestre-Baron, Program Manager*
- ***SWOT Project –*** *Project Managers Parag Vaze, JPL; Thierry Lafon, CNES*
- ***SWOT Science Team –*** *Lee Fu, JPL; Tamlin Pavelsky, UNC; Rosemary Morrow, LEGOS; Jean-Francois Cretaux, LEGOS Science Leadership*
- ***SWOT Applications Working Group –*** *Margaret Srinivasan, JPL; Faisal Hossain, UW; Nicolas Picot & Santiago Peña-Luque, CNES; SWOT ST members; SWOT Project; PO.DAAC; interested colleagues*

Altimetry Missions Timeline



SWOT Applications Program Goals

→ Maximize the societal impact of SWOT post launch.

→ Make data available and accessible to a broad community of users: SWOT Early Adopters

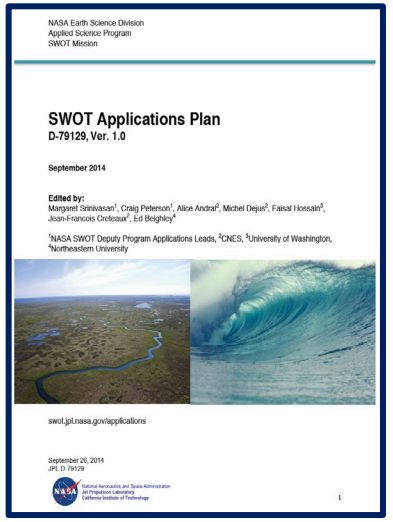
→ Support SWOT mission goals – communicate applications-critical information and outcomes

→ Build awareness and literacy of the SWOT mission

- ***Why, what and how SWOT will measure***
- ***Expected SWOT data -- format/structure and access***
- ***Expected ancillary services and functions for data handling***
- ***User-centric application potential & relevance to current missions/resources***

Applications Program Key Elements

- **SWOT Applications Working Group (SAWG)** – DPA & CNES Appl Lead, Project Applications Scientists, SWOT Science Team (ST) members, SWOT Project (U.S. & French), Partner orgs
- **Data Access & Capacity Building** – Supporting PODAAC Architecture Development, User Surveys, Training
- **Early Adopters** – 25 international EAs
- **SWOT Applications Plan**
- **SWOT Early Adopters Program Guide**


NASA Earth Science Division
Applied Science Program
SWOT Mission

SWOT Applications Plan
D-79129, Ver. 1.0

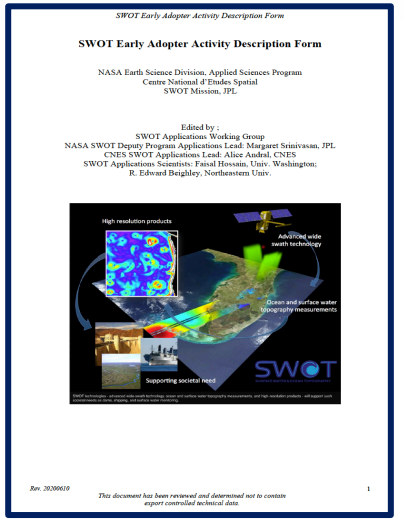
September 2014

Edited by:
Margaret Srinivasan[1], Craig Peterson[1], Alice Andral[2], Michel Dejus[2], Faisal Hossain[3], Jean-Francois Crefeaux[2], Ed Beighley[4]

[1]NASA SWOT Deputy Program Applications Leads, [2]CNES, [3]University of Washington, [4]Northeastern University

swot.jpl.nasa.gov/applications

September 26, 2014
JPL D-79129


SWOT Early Adopter Activity Description Form

SWOT Early Adopter Activity Description Form

NASA Earth Science Division, Applied Sciences Program
Centre National d'Etudes Spatial
SWOT Mission, JPL

Edited by :
SWOT Applications Working Group
NASA SWOT Deputy Program Applications Lead: Margaret Srinivasan, JPL
CNES SWOT Applications Lead: Alice Andral, CNES
SWOT Applications Scientists: Faisal Hossain, Univ. Washington;
R. Edward Beighley, Northeastern Univ.

High resolution products
Advanced wide swath technology
Ocean and surface water topography measurements
Supporting societal need
SWOT

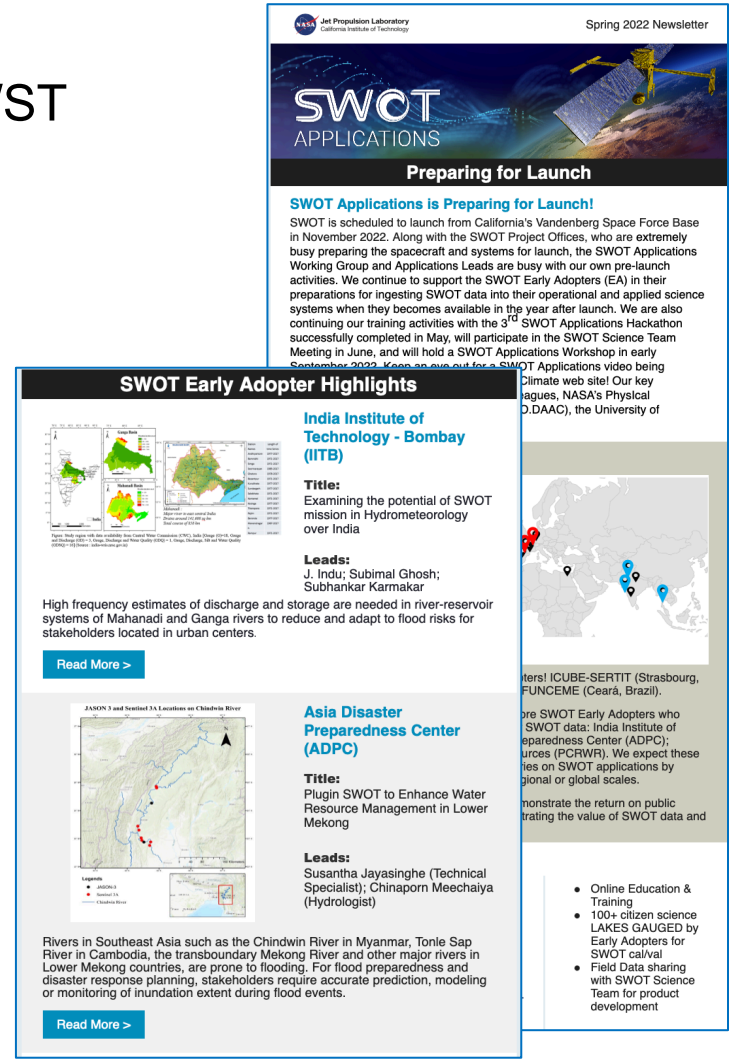
Rev. 20200619

This document has been reviewed and determined not to contain export controlled technical data.

swot.jpl.nasa.gov/applications

SWOT Applications Activities 2013-2022

- **SWOT Applications Working Group (SAWG)**
- **Applications Mission Studies –** Demo of value for SWOT Project/ST
- **25 SWOT Early Adopters - program launched in 2018**
- **Training** (reports published/available online)
  - **8** Application Workshops 2015-2022
  - **3** Virtual Hackathons
- **Communications**
  - Applications web sites – JPL & UW
  - Conference/ST participation
  - Launch – Media (video, article) & Outreach support
- **Publications**
  - **10** wide-audience dissemination (BAMS, ASCE, EOS, AWRA, SERVIR)
  - **14** peer-reviewed research pubs by EA lead authors-*8 directly related to EA Projects*
  - **2 Quarterly** SWOT Applications Newsletters


Jet Propulsion Laboratory
California Institute of Technology

Spring 2022 Newsletter

SWOT APPLICATIONS

Preparing for Launch

SWOT Applications is Preparing for Launch!

SWOT is scheduled to launch from California's Vandenberg Space Force Base in November 2022. Along with the SWOT Project Offices, who are extremely busy preparing the spacecraft and systems for launch, the SWOT Applications Working Group and Applications Leads are busy with our own pre-launch activities. We continue to support the SWOT Early Adopters (EA) in their preparations for ingesting SWOT data into their operational and applied science systems when they becomes available in the year after launch. We are also continuing our training activities with the 3rd SWOT Applications Hackathon successfully completed in May, will participate in the SWOT Science Team Meeting in June, and will hold a SWOT Applications Workshop in early

SWOT Early Adopter Highlights

India Institute of Technology - Bombay (IITB)

Title:
Examining the potential of SWOT mission in Hydrometeorology over India

Leads:
J. Indu; Subimal Ghosh; Subhankar Karmakar

High frequency estimates of discharge and storage are needed in river-reservoir systems of Mahanadi and Ganga rivers to reduce and adapt to flood risks for stakeholders located in urban centers.

Read More >

Asia Disaster Preparedness Center (ADPC)

Title:
Plugin SWOT to Enhance Water Resource Management in Lower Mekong

Leads:
Susantha Jayasinghe (Technical Specialist); Chinaporn Meechaiya (Hydrologist)

Rivers in Southeast Asia such as the Chindwin River in Myanmar, Tonle Sap River in Cambodia, the transboundary Mekong River and other major rivers in Lower Mekong countries, are prone to flooding. For flood preparedness and disaster response planning, stakeholders require accurate prediction, modeling or monitoring of inundation extent during flood events.

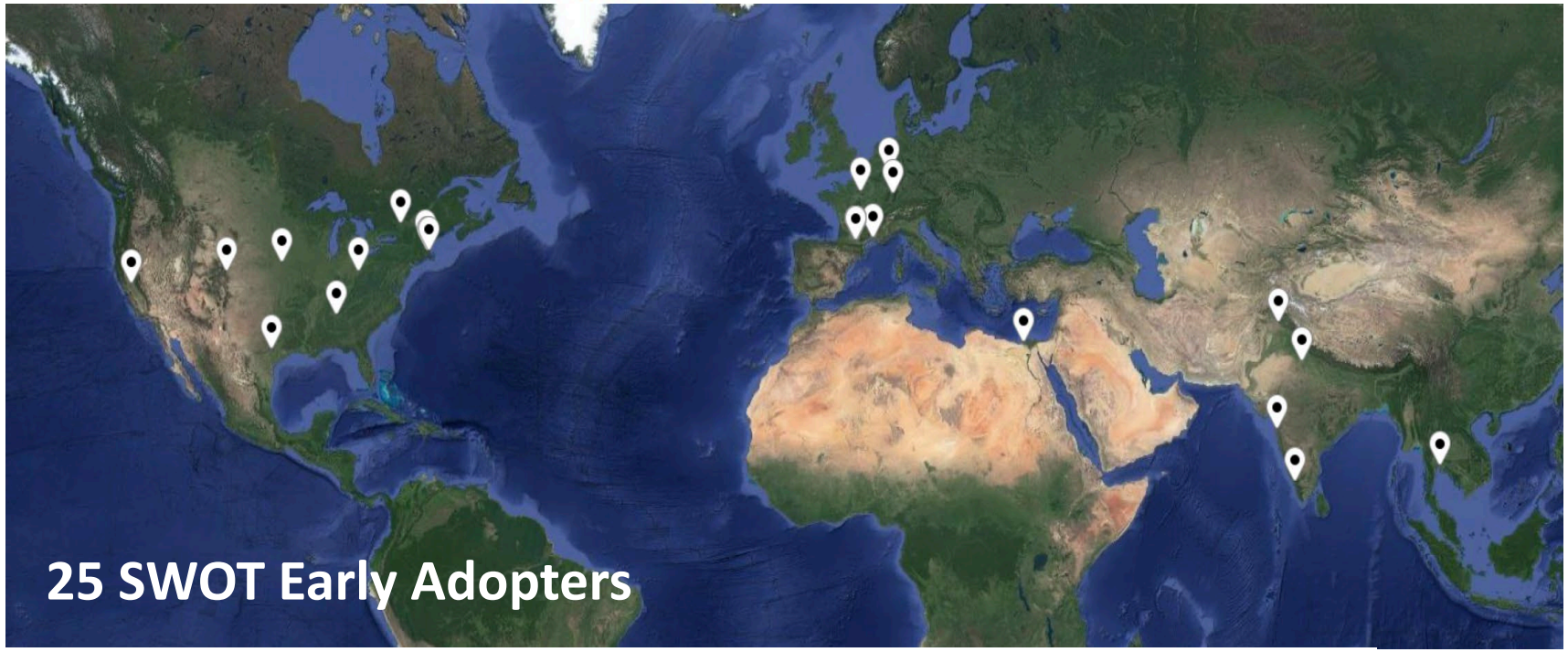
Read More >

- Online Education & Training
- 100+ citizen science LAKES GAUGED by Early Adopters for SWOT cal/val
- Field Data sharing with SWOT Science Team for product development

SWOT Early Adopters

Where are SWOT Early Adopters?

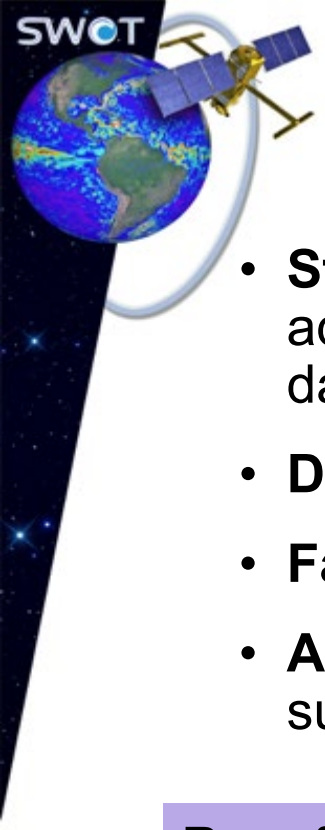
Learn about this growing community working to incorporate future SWOT data into their activities. The locations of Early Adopters are shown in the map and their summaries are included below. View the SWOT Early Adopters Guide.



https://swot.jpl.nasa.gov/applications_ea.htm

Early Adopters

- Alexandria University, Egypt
- Asian Disaster Preparedness Center (ADPC)/SERVIR-Mekong
- BRL Ingénierie (BRLi)
- Centre for Water Resources Development and Management (CWRDM), Kerala, India
- CLS
- Compagnie Nationale du Rhône (CNR)
- Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI)
- Environment and Climate Change Canada (ECCC)
- FM Global
- ICUBE SERTIT
- Indian Institute of Technology Bombay
- Indian Institute of Technology Delhi
- Magellium
- Mercator Ocean
- NASA Short-term Prediction Research and Transition (SPoRT) Center, Univ. Alabama
- NOAA/CIRES University of Colorado Boulder
- Ohio State University
- Pakistan Council of Research in Water Resources (PCRWR)
- Stantec Consulting Services Inc. (Stantec)
- Texas Water Development Board (TWDB), Austin, TX
- U.S. Air Force Weather's Land Information System (LIS), Offutt AFB, NE
- US Geological Survey (USGS)
- University of Bonn and Helmholz-Zentrum Geesthacht
- vorteX.io



Early Adopter Program Goals

- **Stakeholder engagement**; engage innovators in new and existing partner organizations; advocates with tangible and potential applications that would benefit from the use of SWOT data
- **Demonstrate utility** and societal value of SWOT data through applied research
- **Facilitate feedback** on mission products *pre-launch*
- **Accelerate the use of mission products** *post-launch* by providing specific and continuous support to Early Adopters

Benefit to user community;
- Accurate measurements
- Broad (local to global) spatial coverage
- Reliable time series
- Ease of use
- Societal benefit from their applications

Benefit to the Projects;
- Demo of value-added for NASA mission
- Promote applied uses of mission data
- Expand user communities for data
- Enhance international collaborations
- Expand capabilities for technologies

→ ***Build Capacity and benefit society***

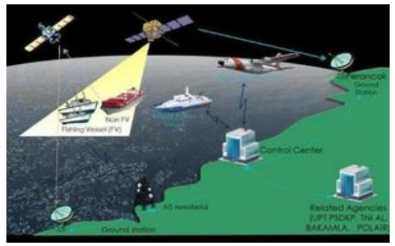
Applications End-Game…

- Establish a **self-sustaining mechanism for generation of SWOT success stories** that show SWOT value for issues of societal relevance
- Create **news headlines and press releases** on successful application of SWOT data serving societal needs

SWOT REVOLUTIONALIZES SUSTAINABLE FISHERIES

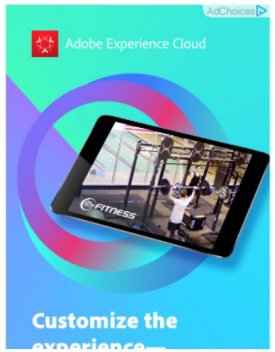
Smart satellite technology for inclusive & sustainable fishing practices in Indonesia

Published 26 January 2017
From: UK Space Agency



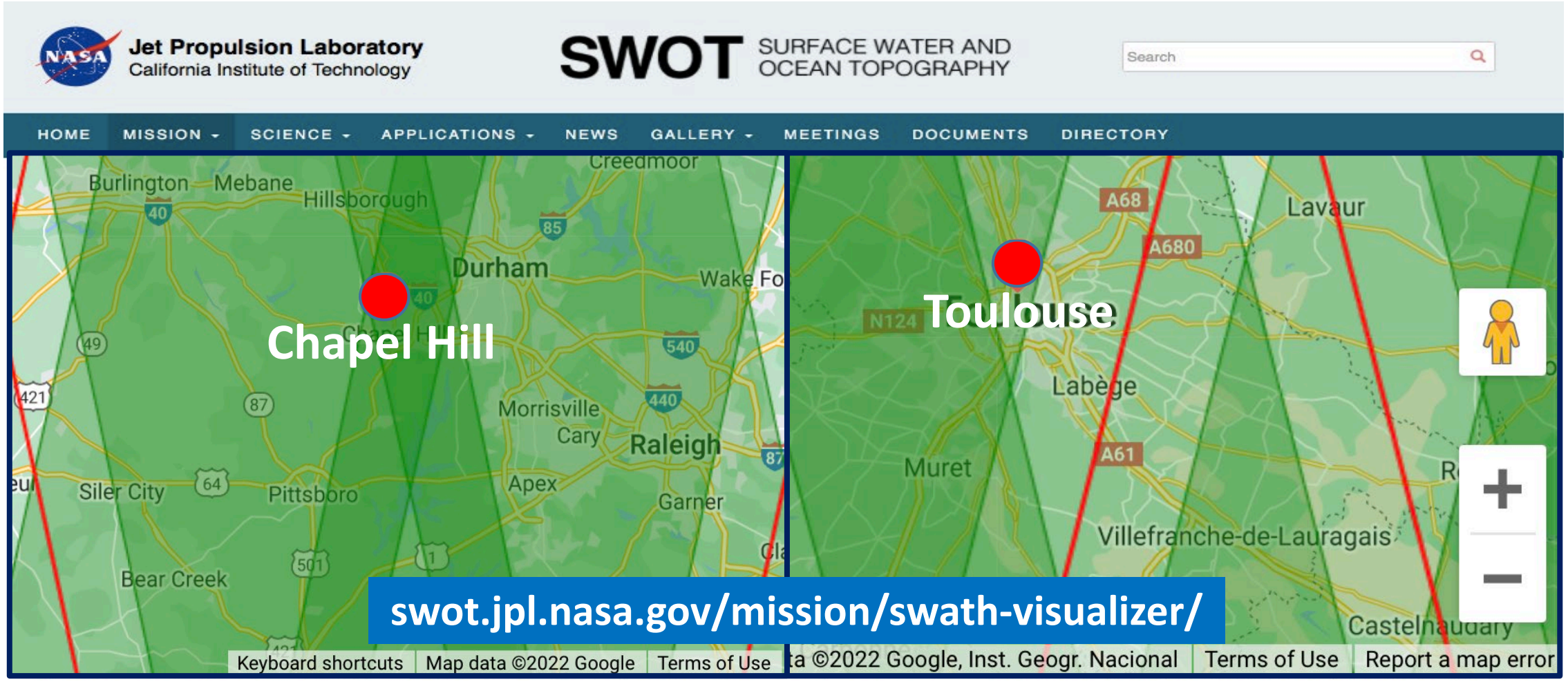
Credit: Inmarsat

SWOT IMPROVES LIVELIHOODS IN COASTAL FORESTS



SWOT Swath Coverage

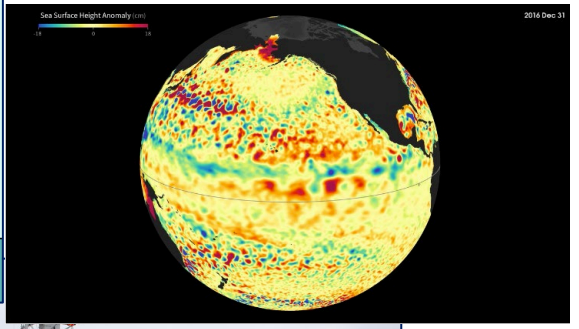
Will your region be covered?



Measuring water surface topography enables…

- Planning for coastal impacts of sea level rise
- Improved flood modeling
- Operational oceanography
- Weather & climate forecasting
- Water resources management – lakes, reservoirs, rivers
- Transboundary water information sharing
- Decision support



3rd SWOT Early Adopter Hackathon

Virtual Hackathon provided intense 1-1 hands-on experience for EAs by a team of **volunteer** hacker helpers.

- Focus on EA-specific needs
- Focus on EAs with ”last mile” work to finish by 2023
- Build automation, scripts/tools for backend and front-end interfaces

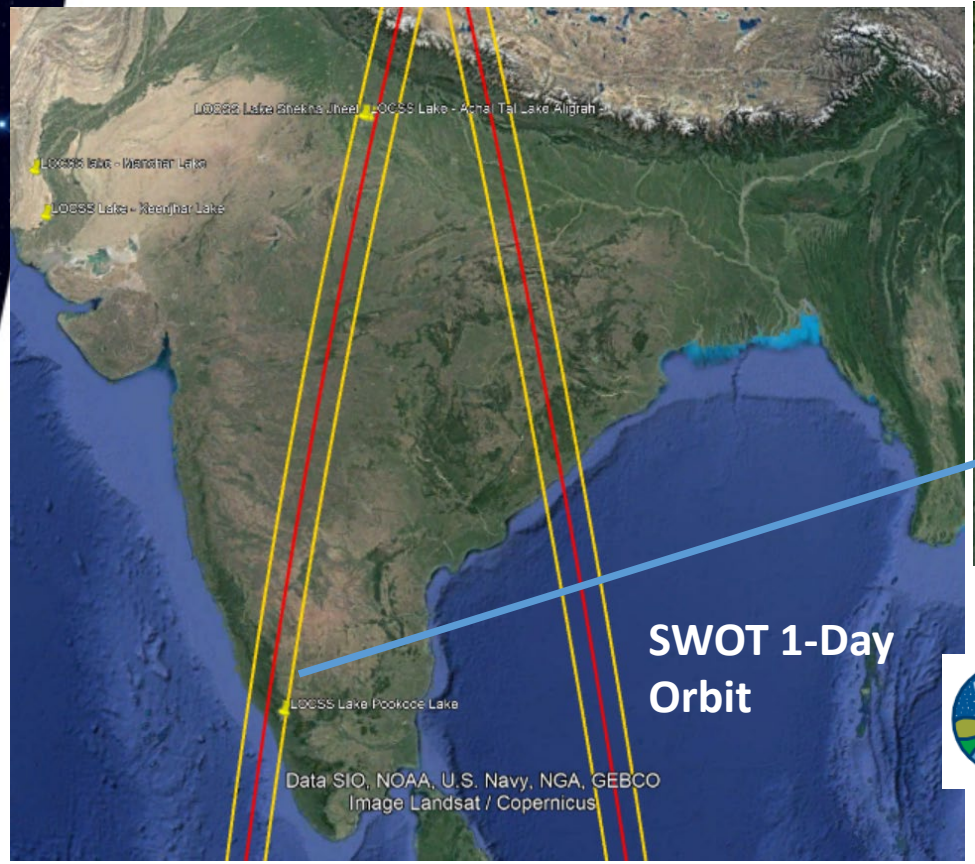
- Report; DOI: 10.1175/BAMS-D-22-0107.1

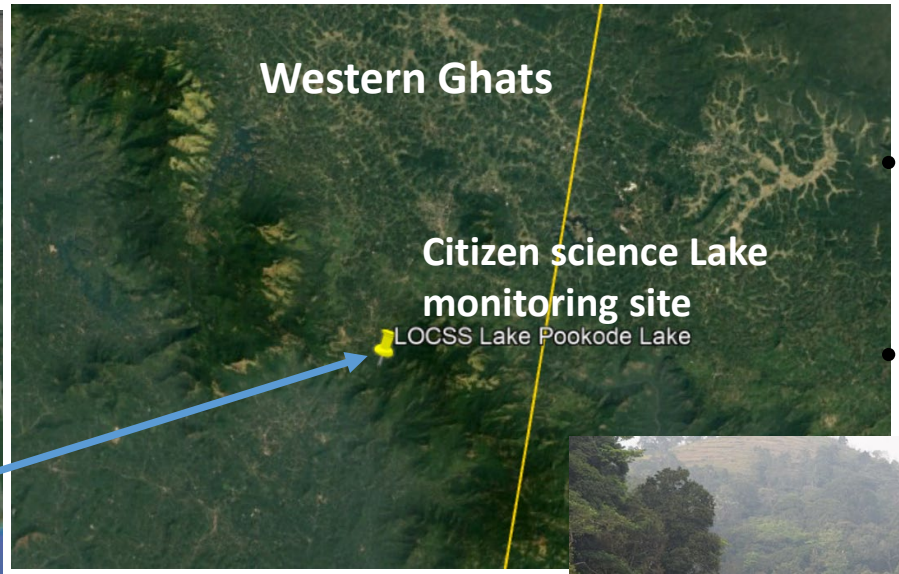
http://depts.washington.edu/saswe/swot/hackathon.html

Exciting Developments for SWOT Contributed by the EA Program

Three SWOT EAs helped set up 4 lake gauges in South Asia – CWRDM, IIT-B, PCRWR

- Early Adopters to help assess SWOT for lake storage monitoring
- SWOT Science team may be able to assess lake product cal/val (1-day orbit)
- Western Ghats is unique!





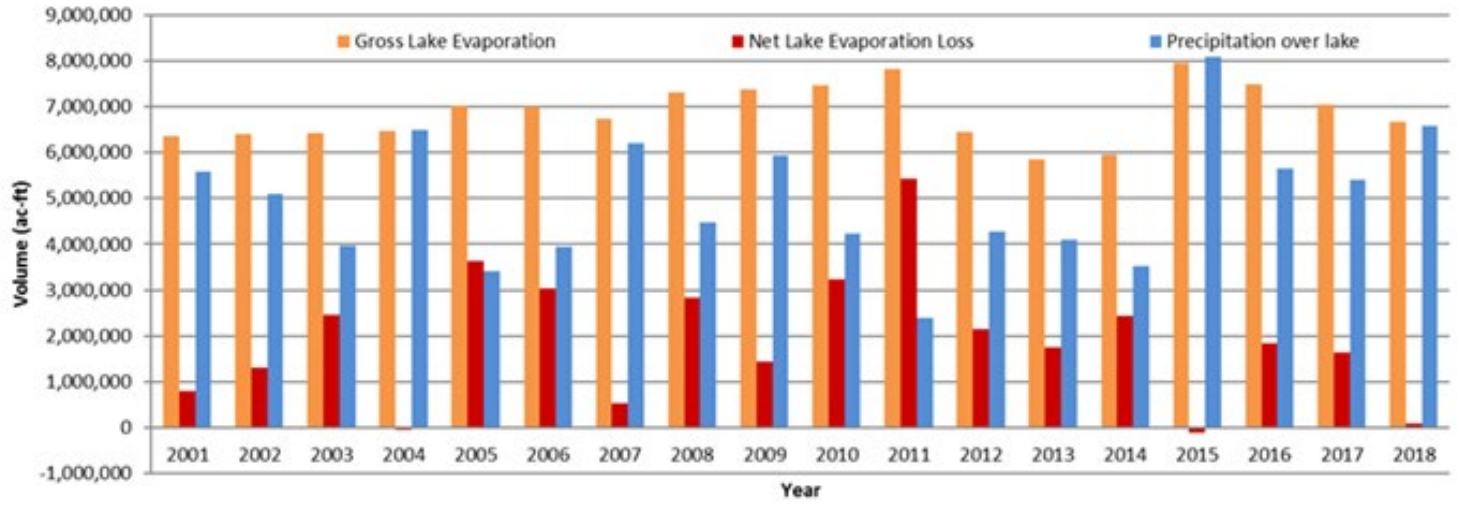
LAKE OBSERVATIONS
BY CITIZEN SCIENTISTS & SATELLITES

PI – Tamlin Pavelsky

Source: CWRDM

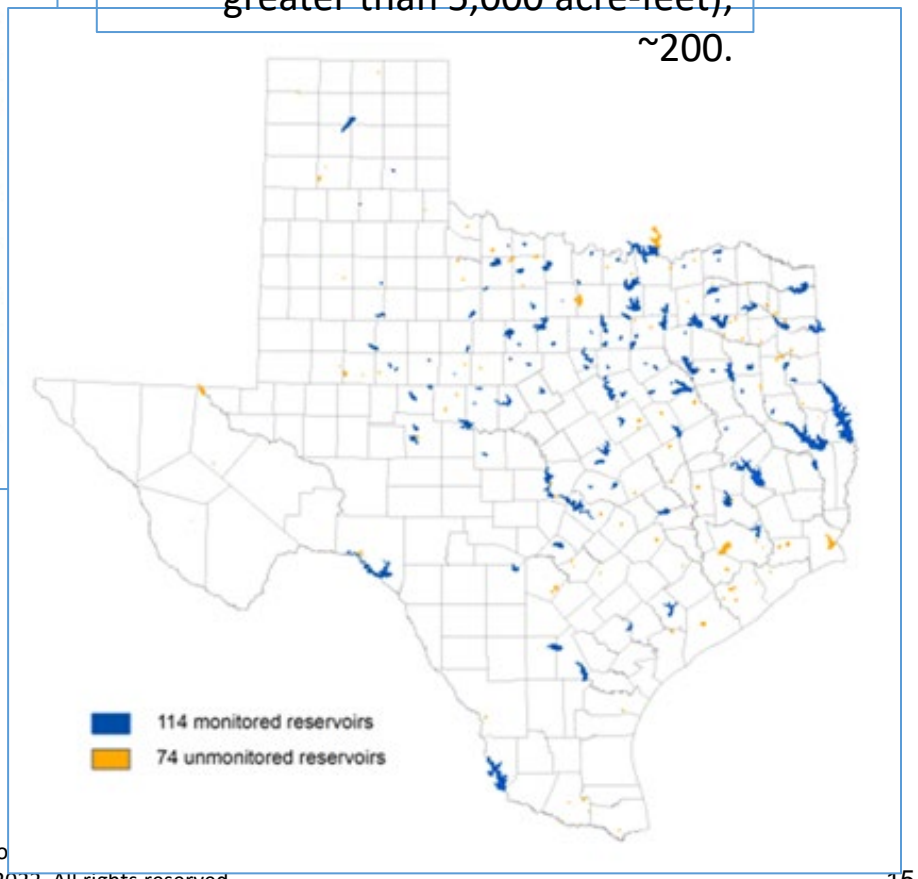
Texas Water Development Board (TWDB), Austin, TX

- **Title:** Estimation of Volumetric Evaporative Water Loss from Unmonitored Reservoirs in Texas
- **Leads:** Nelun Fernando, PhD, Manager; John Zhu, PhD, PG, Hydrologist



Annual net reservoir evaporation loss (dark-red) from 114 monitored reservoirs in Texas. The net evaporation loss is a result of gross evaporation (orange) minus precipitation (blue). When SWOT provides surface area for unmonitored reservoirs, TWDB will be able to compute “statewide” losses.

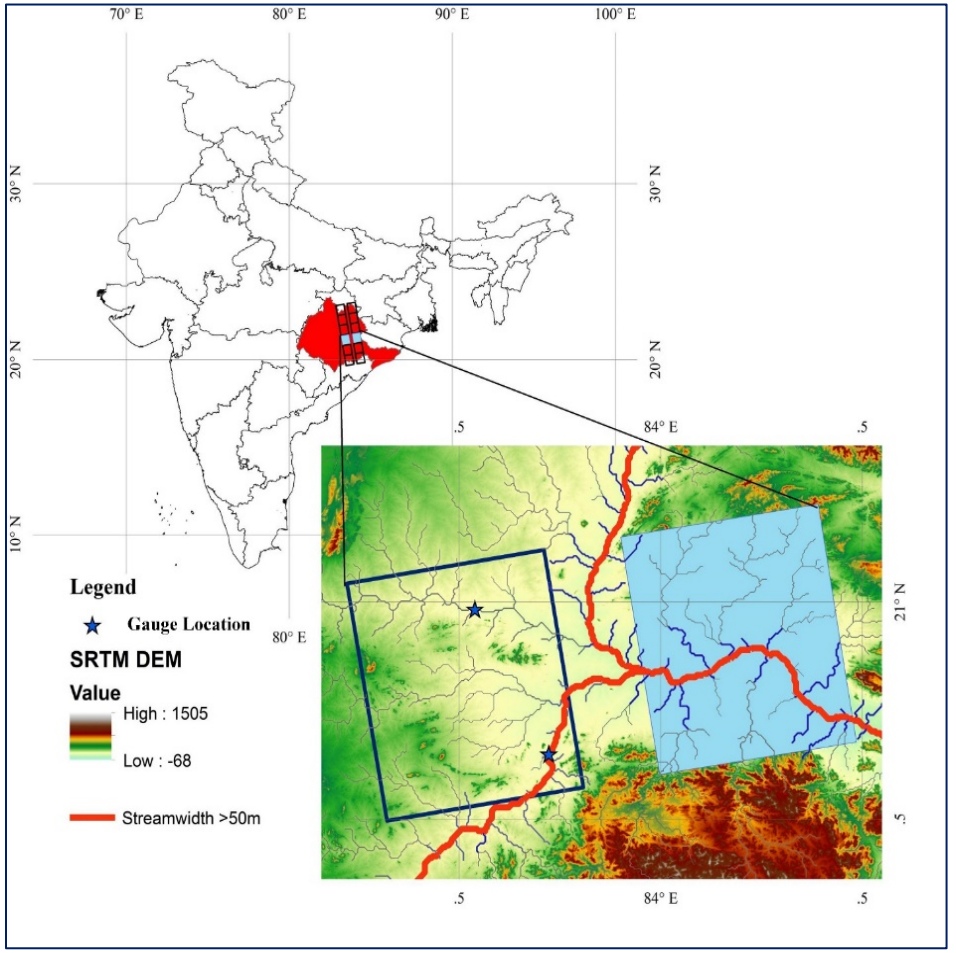
Major Texas reservoirs (capacity is greater than 5,000 acre-feet); ~200.



India Institute of Technology, Bombay

- **Title:** Examining the potential of SWOT mission in Hydrometeorology over India
- **Leads:** J. Indu; Subimal Ghosh; Subhankar Karmakar

The Societal Need: High frequency estimates of discharge and storage are needed in river-reservoir systems of Mahanadi and Ganga rivers to reduce and adapt to flood risks in urban centers.
The Challenge: A seamless information system which can provide high frequency estimates of discharge, reservoir storage and inundation without gaps is not possible with current models, in-situ gauges, and satellite sensors.
SWOT Value: SWOT river and reservoir data products, with its unique and simultaneous elevation and water extent mapping capability, can be assimilated operationally in hydrologic-hydrodynamic modeling systems with in-situ gauges and other satellite sensors to build a seamless high-frequency predictive and forecasting tool for stakeholder agencies of urban centers of Mahanadi and Ganga river basins.



Jet Propulsion Laboratory, California Institute of Technology, Copyright 2021. All rights reserved.

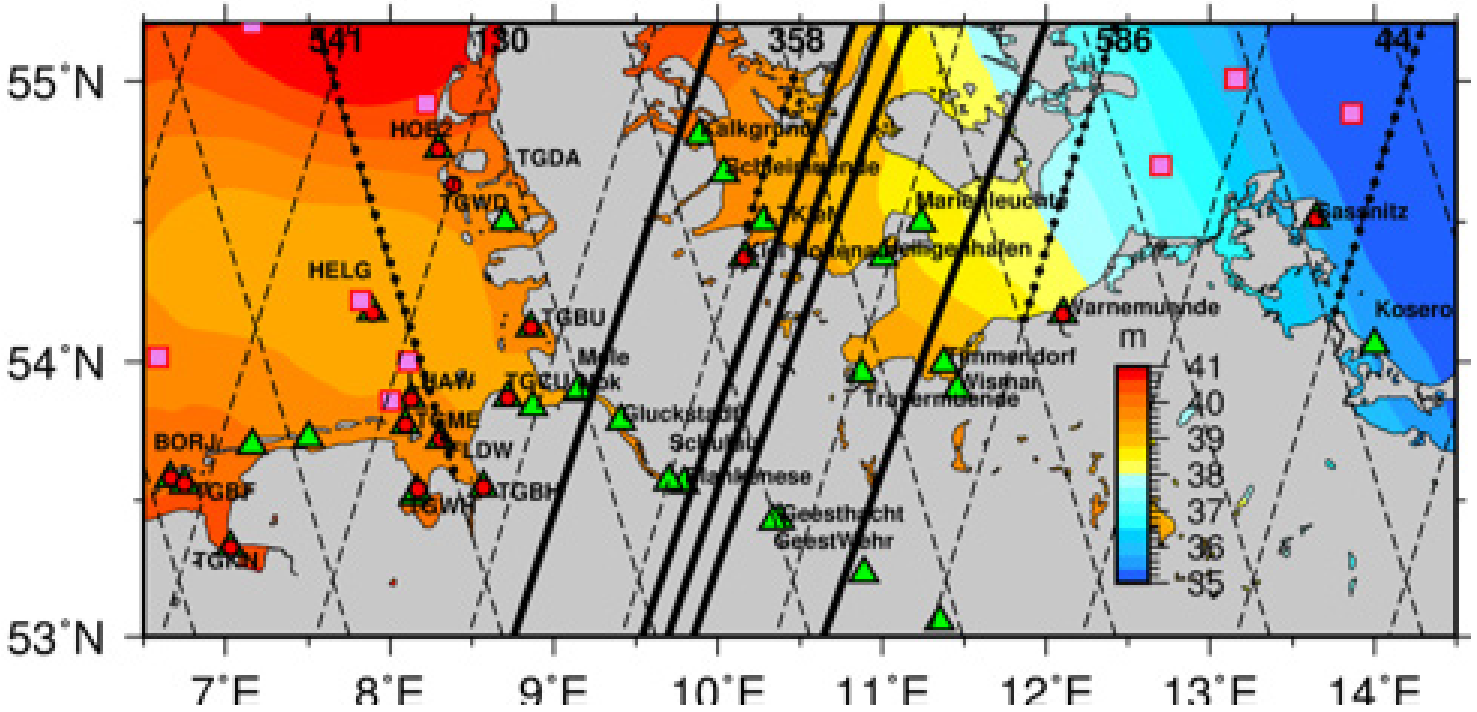
University of Bonn and Helmholz-Zentrum Geesthacht

- **Title:** Monitoring estuaries and coastal zone with SWOT
- **Leads:** Dr.-Ing. habil Luciana Fenoglio (University of Bonn, Institute of Geodesy and Geoinformation); Dr. Joanna Staneva (Head of Department Hydrodynamics and Data Assimilation, Institute for Coastal Research)

Operational Applications

Objectives:

1. Coastal ocean dynamics
2. Coastal tides and internal tides
3. Extremes
4. Track coastal evolution



Ground tracks of Sentinel-3A (dash) and SWOT (line), tide gauge (green), GPS (circle), buoys (square). Local geoid color bar.

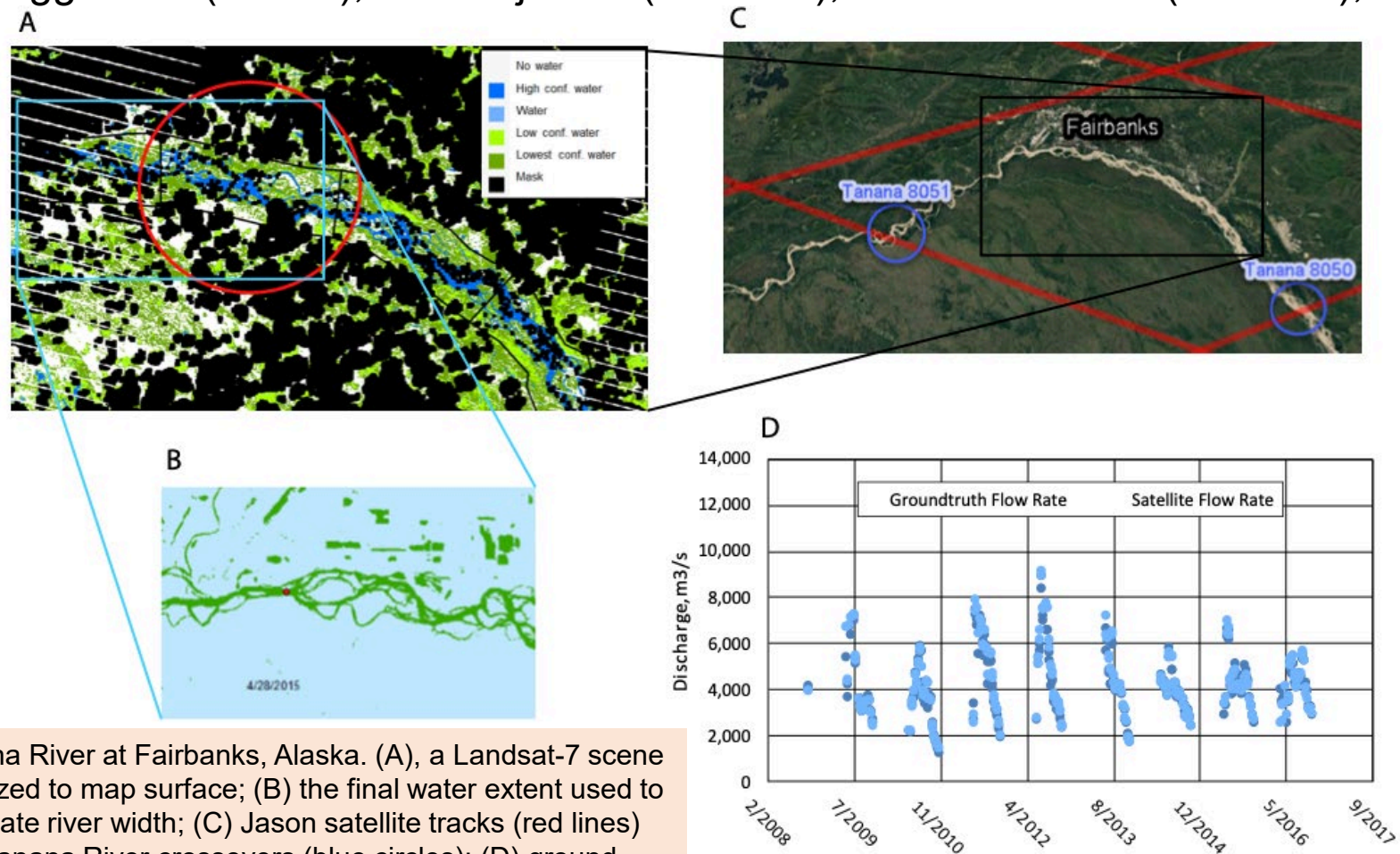
Credit: U. Bonn, L. Fenoglio

U.S. Geological Survey

- **Title:** USGS Satellite-based Remote Sensing of Discharge
- **Leads:** Rob Dudley (USGS); Jack Eggleston (USGS); Dave Bjerklie (NEWSC); Luke Sturtevant (NEWSC); John Jones (Leetown Science Center)

Project Highlights

- Measure water levels & flows in Alaskan rivers
- Improve flood response and forecasting, and management of transportation, fisheries, and ecosystems w/satellite observations
- Enable increases in the number of river monitoring sites and remote river monitoring
- Operationalize and streamline data production and improve accuracy of satellite river monitoring data



Tanana River at Fairbanks, Alaska. (A), a Landsat-7 scene analyzed to map surface; (B) the final water extent used to calculate river width; (C) Jason satellite tracks (red lines) and Tanana River crossovers (blue circles); (D) ground-measured and satellite-measured river flows.

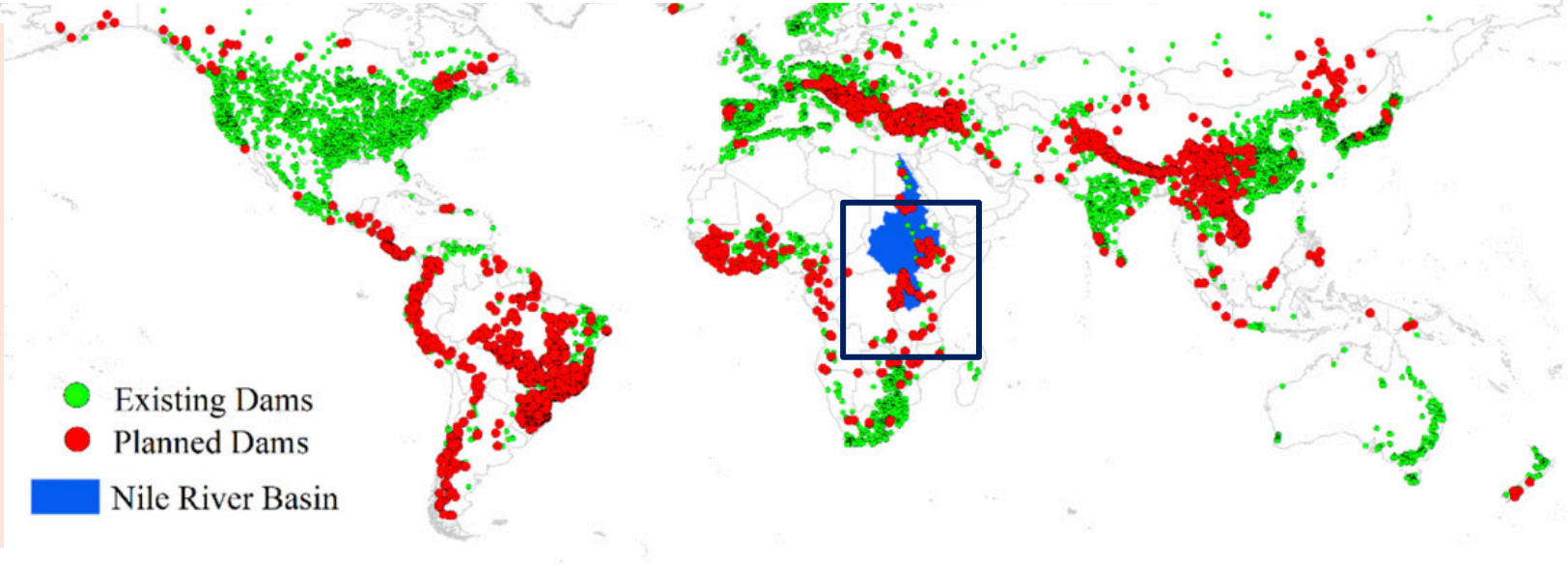
Credit: USGS

Alexandria University, Egypt

- **Title:** Integrating SWOT Mission into the Operational Nile Basin Reservoir Advisory System (NiBRAS)
- **Leads:** Dr. Hisham Eldardiry, Dr. Mohamed Elkholy, Dr. Ahmed Abdelrazek

The Societal Need: Because newer dams are being built in Sudan and Ethiopia, Egypt now must monitor reservoir operations by upstream nations and forecast inflow for better planning and adaptation.
The Challenge: Monitoring of the Nile river system within Egypt doesn't provide information about reservoir impoundments or operations upstream in Sudan and Ethiopia.
SWOT Value: With SWOT, this project may be able to infer dam operations over the Nile river basin with focus on High Aswan dam (in Egypt). The project will also test the integration of SWOT into the operational Nile Basin Reservoir Advisory System (the NiBRAS system)

Key Elements:
1) Test/apply SWOT synthetic data for lake water balance analysis and modeling with focus on Lake Nasser (HAD reservoir)
2) Test the integration of SWOT data/products into the operational Nile Basin Reservoir Advisory System or (NiBRAS).



Credit: Alexandria Univ.

SUMMARY OF KEY ACTIVITIES BY SAWG

MAJOR ACCOMPLISHMENTS AND HIGHLIGHTS (CUMULATIVE SUMMARY SINCE 2016)

Jet Propulsion Laboratory
California Institute of Technology

Education

Dam Deduction: A 'Pi in the Sky' Math Challenge

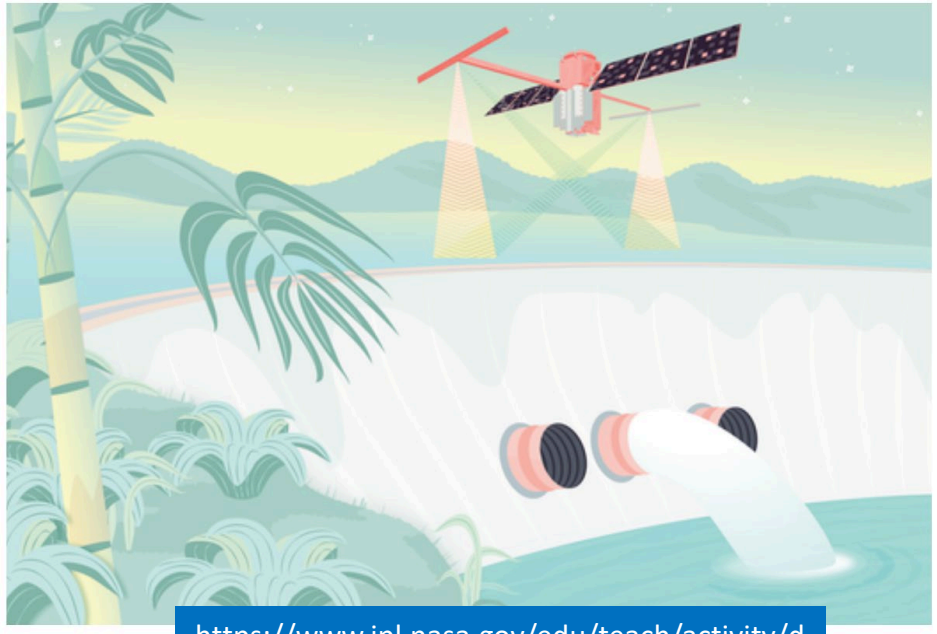


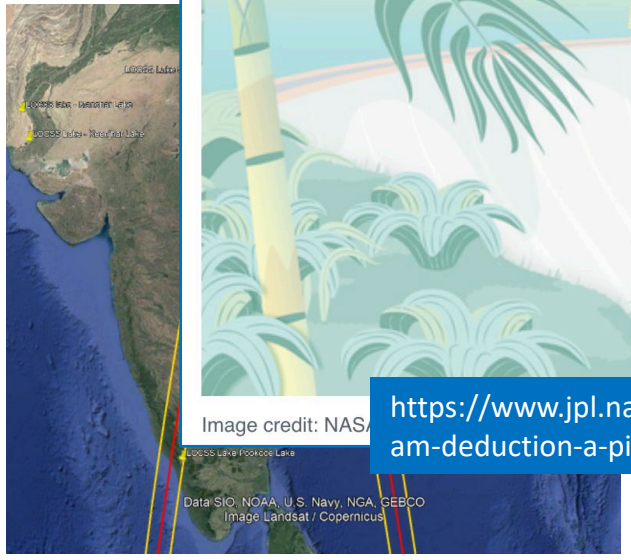
Image credit: NASA

https://www.jpl.nasa.gov/edu/teach/activity/dam-deduction-a-pi-in-the-sky-math-challenge/

Eos NEWS OPINIONS

Putting
Practic

2nd SWOT
for Advanci
Topography



BAMS
Meeting Summary

r the Surface
ellite Mission
uring the Prelaunch Era

d Beighley, Alice Andral,
Yasir Kaheil, Bareerah Fatima,
efevre, Sébastien Legrand,

BAMS
Meeting Summary

Accelerating Applications for Planned NASA Satellite Missions

A New Paradigm of Virtual Hackathons during a Pandemic and in the Post-Pandemic Era

Faisal Hossain, Nicholas Elmer, Margaret Srinivasan, and Alice Andral

2020 SWOT Virtual Early Adopter Hackathon

What: A virtual hackathon was organized using Zoom web conferencing for early adopters of the Surface Water and Ocean Topography (SWOT) mission that is planned for launch in 2022. Thirty-eight participants representing early adopters and support staff

GUEST ARTICLE

Article Type: Research Article

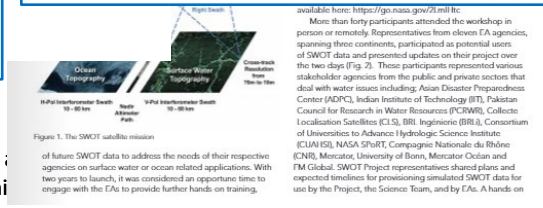
Engaging Potential Users of the Planned Surface Water And Ocean Topography Mission (SWOT) Mission in the Year of Launch

Faisal Hossain[1], Margaret Srinivasan[2], Nicolas Picot[3], Santiago P...

View More +

Published-online: 14 Jun 2022

DOI: https://doi.org/10.1175/BAMS-D-22-0107.1



Read the full text >

PDF TOOLS SHARE

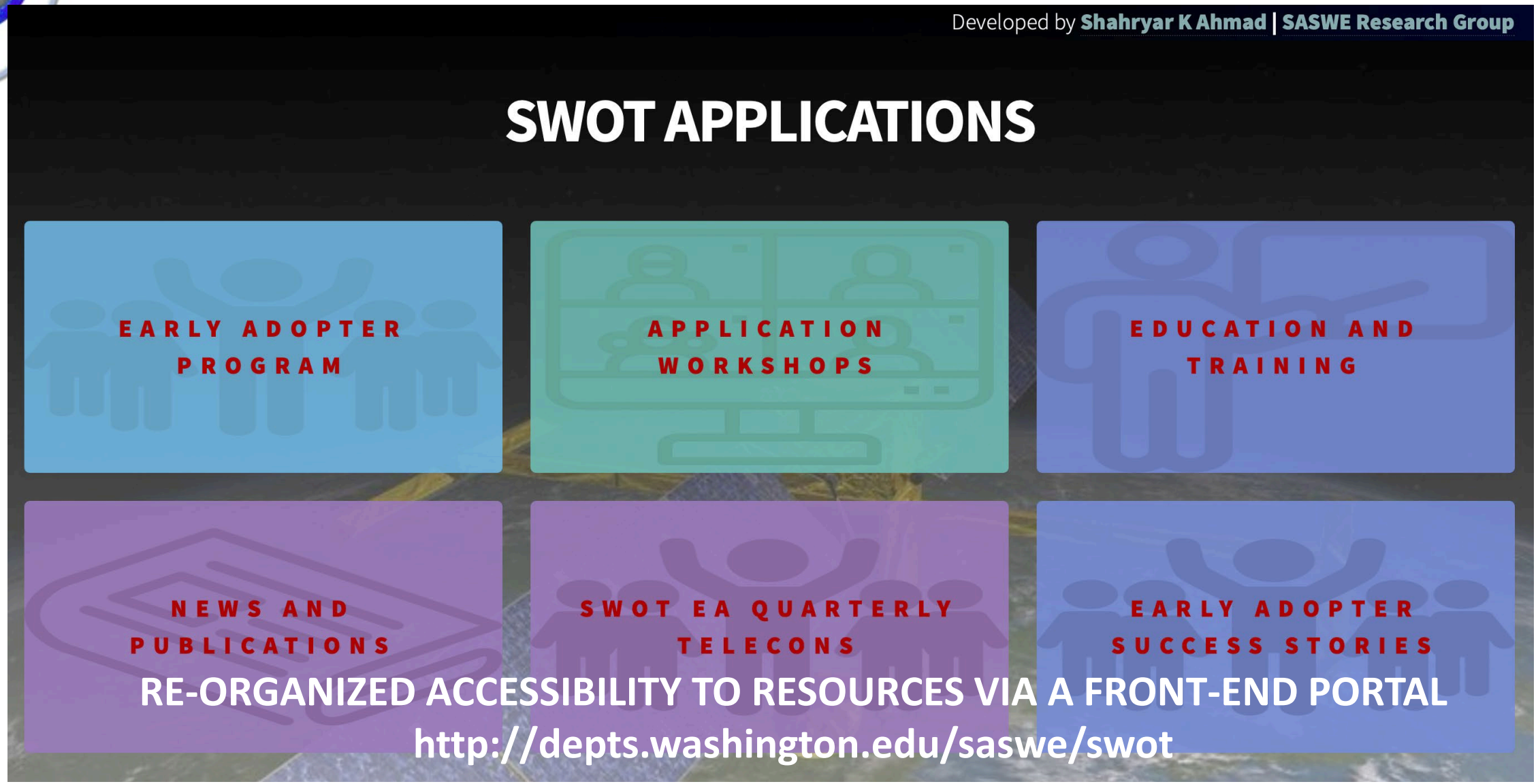
Abstract

The Surface Water Ocean Topography (SWOT) mission will launch in early 2022 to provide the first global inventory of terrestrial surface water. Although SWOT is primarily a research mission with key science objectives in both the oceanography and hydrology

This document has been reviewed
Jet Propulsion Laboratory, Californi

I data
erve

Sustainable & Self-Help Architecture for Training & Resources



Immersive & Visual EA Stories Pages

Asian Disaster Preparedness Center (ADPC)/SERVIR-Mekong

BRL Ingénierie (BRLi)

Centre for Water Resources Development and Management (CWRDM), Kerala, India

CLS

Compagnie Nationale du Rhône (CNR)

Consortium of Universities for the Advancement of Hydrulogic Science, Inc. (CUAHSI)

Environment and Climate Change Canada (ECCC)

FM Global

Indian I

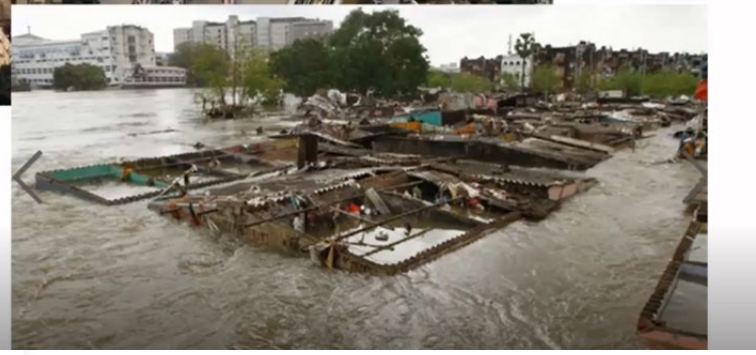
Indian Institute of Technology Bombay

Title: Examining the potential of SWOT mission in Hydrometeorology over India
Organization: Indian Institute of Technology Bombay
Leads: J. Indu; Subimal Ghosh; Subhankar Karmakar

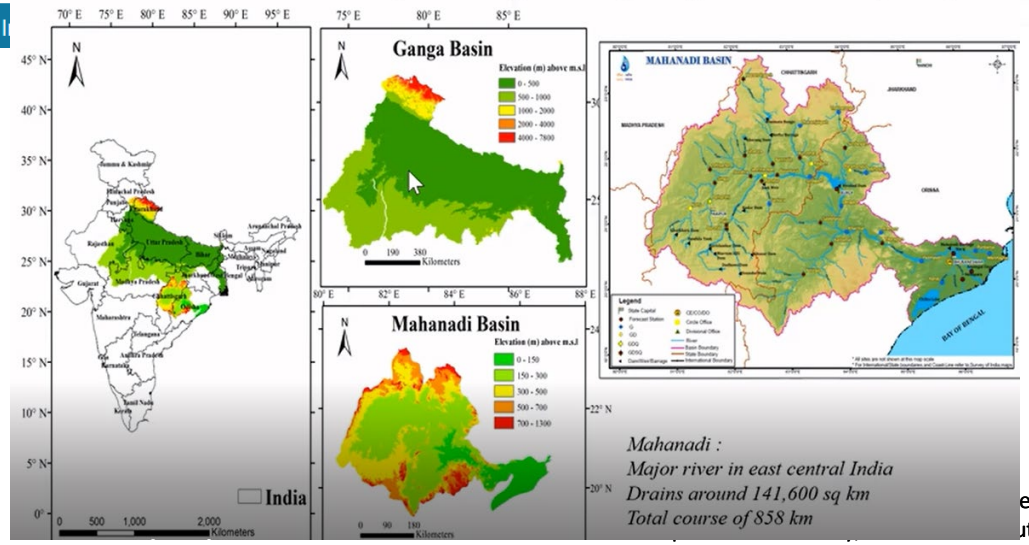
Summary

In order to derive weekly/monthly estimates of river discharge, this project will use data assir to generate continuous fields of SWOT-relevant observables by merging them with model predictions. This will provide hydrologic information in areas where SWOT data gaps will prev direct observation. The research objectives of this project are: Evaluate various data assimilati techniques on synthetic SWOT measurements to generate improved SWOT observables Unc quantification of SWOT orbital data products Using SWOT measurements for the creation of a inventory towards flood forecasting for different hydro-climatic scenarios

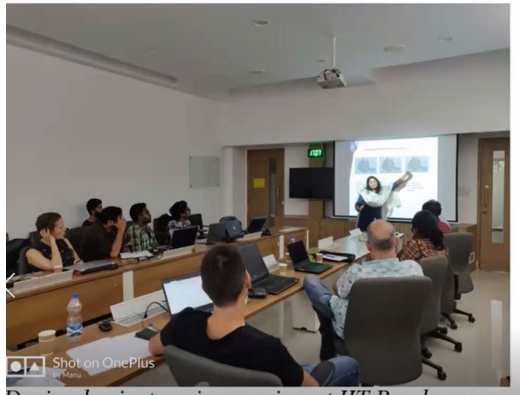
Current Progress and Future Steps



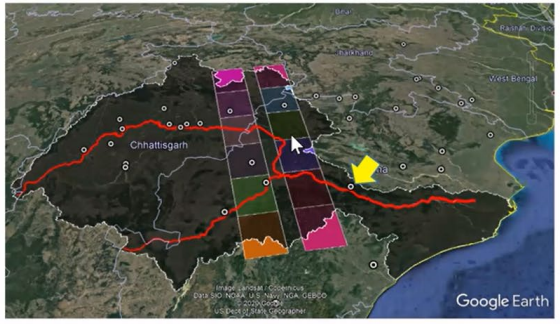
https://swot.jpl.nasa.gov/applications/early-adopters/



Mahanadi :
Major river in east central India
Drains around 141,600 sq km
Total course of 858 km



During brainstorming session at IIT Bombay on Application of SWOT over Mahanadi basin



Mahanadi River ⦿ CWC Gauging stations

Day2 SWOT_Hackathon_2021_J.INDU_IITBOMBAY

SAWG STRATEGIC PLAN [By end of 2024]

2021-2022 (PRE LAUNCH)

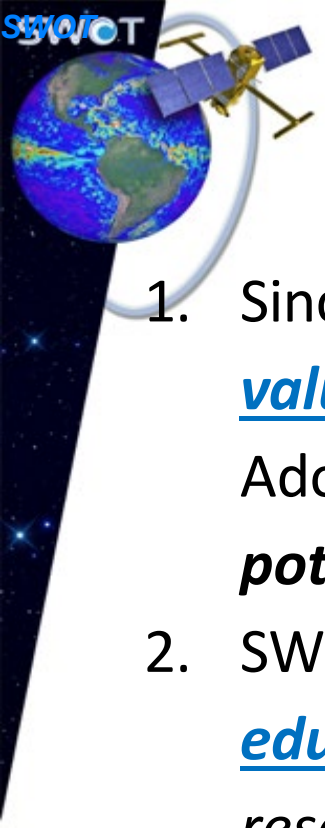
- Create the ***online infrastructure and self-help community*** where applications of SWOT data and success stories are ***easier*** to create, accelerate and scale globally by any entity addressing water issues

2023-2024 (POST LAUNCH)

- Generate **high profile success stories and NASA Hyperwall** on how the SWOT mission adds value to stewardship of water resources and ocean applications.
- Train a new generation of **diverse (BIPOC) leadership** ready to lead SWOT application activities.

2024- (SUSTAINABILITY)

- Formalize a **self-sustaining mechanism for generation of training materials**, multi-media tutorials, education activities with AWRA, CUAHSI, NASA ARSET
- Establish **operational synergy between SWOT and national/global discharge assimilation activities** (NOAA/ECMWF) and other missions (NISAR, Sentinel series)



What is the value of SWOT Applications Activities?

1. Since 2016 SWOT Applications program has ***expanded awareness of SWOT's societal value*** & ***generated anticipation for SWOT data*** among potential users (e.g 4 Early Adopters already confirmed operational uptake of SWOT L2 data after 2023 = ***4 potential success stories expected for NASA after 2024***)
2. SWOT Applications program ***pioneered*** infrastructure for ***24/7 community-driven online education/training*** for building technical literacy on SWOT. (*Science Team can use the resources too!*)
3. Many SWOT Early Adopters are doing application-critical science; providing ***cal/val infrastructure for lake data product at no additional cost*** (*current total > 100 Asian sites with 3 under SWOT 1-day orbit*)
4. SWOT Early Adopter Program ***growing since 2018*** *(current total 25 spanning Americas, Europe, Asia & Africa, private/public and research sectors)*

Applications Publications

•Nair, A., V. Kaushlendra, S. Karmakar, S Ghose, J. Indu (2022), Exploring the potential of SWOT mission for reservoir monitoring in Mahanadi basin, *Advances in Space Research*https://doi.org/10.1016/j.asr.2021.11.019.

•Nair, A, N. Kumar, I, Jayaluxmi, Vivek B. (2021), Monitoring Lake Levels from Space: Preliminary Analysis with SWOT, *Frontiers in Water: Rising Stars 2021*, https://doi.org/10.3389/frwa.2021.717852

•Elmer, N. J., J. McCreight, and C. Hain (2021), Hydrologic Model Parameter Estimation in Ungauged Basins using Simulated SWOT Discharge Observations, *Water Resources Research*, https://doi.org/10.1029/2021WR029655 .

•Eldardiry, H., Hossain, F., Srinivasan, M., and Tsontos, V. (2022). Success Stories of Satellite Radar Altimeter Applications. Bulletin of the American Meteorological Society. 1-49. https://journals.ametsoc.org/view/journals/bams/103/1/BAMS-D-21-0065.1.xml.

•Hossain, F., Elmer, N., Srinivasan, M., and Andral, A. (2020). Accelerating Applications for Planned NASA Satellite Missions: A New Paradigm of Virtual Hackathons during a Pandemic and in the Post-Pandemic Era. Bulletin of the American Meteorological Society. preprint. https://doi.org/10.1175/BAMS-D-20-0167.1.

•Hossain, F., et al., (2019). The Early Adopter Program for the Surface Water Ocean Topography Satellite Mission: Lessons Learned in Building User Engagement during the Pre-launch Era. Bulletin of the American Meteorological Society. https://doi.org/10.1175/BAMS-D-19-0235.1.

•Hossain, F., et al., (2017). Engaging the User Community for Advancing Societal Applications of the Surface Water Ocean Topography Mission, *Bulletin of the American Meteorological Society*, 98(11), ES285-ES290. Retrieved Mar 11, 2022, from https://journals.ametsoc.org/view/journals/bams/98/11/bams-d-17-0161.1.xml

•Hossain, F., Andral, A., Srinivasan, M., (2017). Putting Satellite Maps of Surface Water to Practical Use, EOS, 19 Sept 2017, https://doi.org/10.1175/BAMS-D-20-0167.1

•Escobar, V. M., et al., (2016). Improving NASA's Earth Observation Systems and Data Programs Through the Engagement of Mission Early Adopters, (chapter), book, Earth Science Satellite Applications: Current and Future Prospects,2016, Springer, pp. 223-267, doi 10.1007/978-3-319-33438-7_9, http://dx.doi.org/10.1007/978-3-319-33438-7_9

•Srinivasan, M., et al., (2015). Engaging the Applications Community of the future Surface Water and Ocean Topography (SWOT) Mission, IAPRS, 2015, http://www.int-arch-photogramm-remote-sens-spatial-inf-sci.net/XL-7-W3/1497/2015/isprsarchives-XL-7-W3-1497-2015.html.

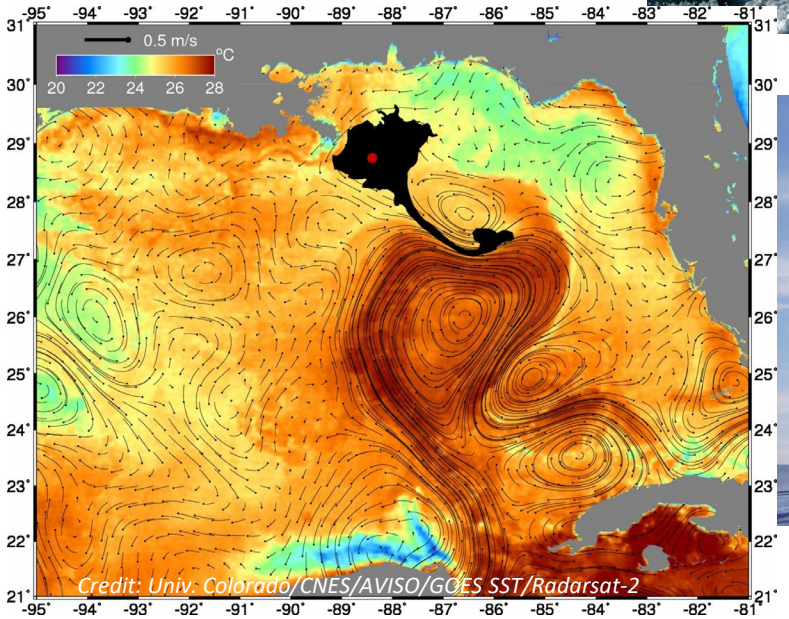
•Srinivasan, M., Peterson, C., Callahan, P., (2012). Mission Applications Support at NASA: SWOT, Proceedings of the Symposium on 20 Years of Progress in Radar Altimetry, Venice, Italy, 24-29 Sep 2012. Noordwijk, The Netherlands, *ESA Publications Division*, European Space Agency, Paper-2494283.

Thank You!

- *sealevel.jpl.nasa.gov/applications*
- *swot.jpl.nasa.gov/applications*
- *depts.washington.edu/saswe/swot/*
- Questions? - *margaret.srinivasan@jpl.nasa.gov*

Operational Oceanography

- Ocean forecasting for ship routing, naval operations
- Safety at sea
- Energy operations
- Tracking oil spills & marine debris
- Assessment of shipping risks



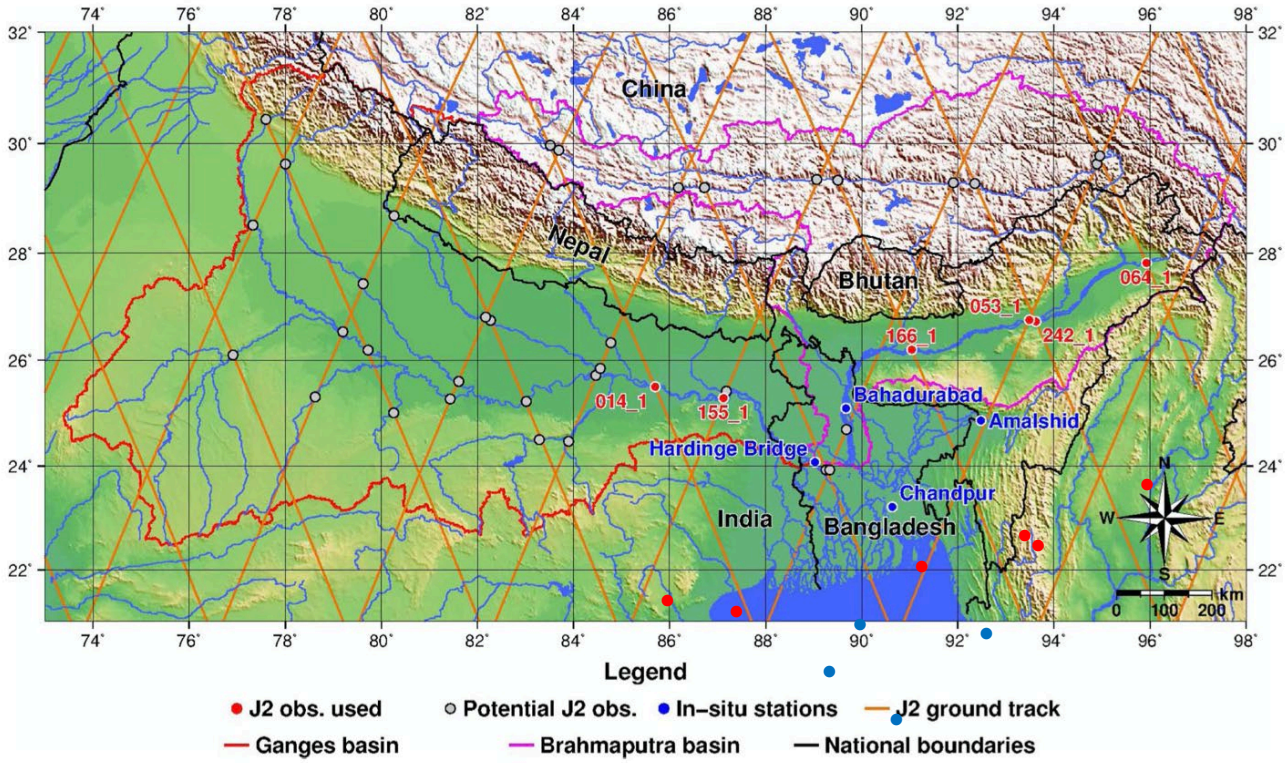
Credit: Univ. Colorado/CNES/AVISO/GOES SST/Radarsat-2

Improved Flood Modeling

Flood prediction;

- Improve measurements of topography on floodplains
- Track floodwater levels on rivers
- Increase public forecast of flooding events
- Improve flood modeling

Virtual gauging stations – Ganges Brahmaputra River basins



Hossain et al. 2014

Coastal Impacts

- Sea level rise
- High tide flooding (nuisance flooding)
- Coastal erosion, ecosystem deterioration (marshes, wetlands)
- Infrastructure risks (e.g. military installations, power plants, roads)

Buxton, NC, 8 Nov. 2021
Credit: facebook.com/altitude12

GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

FEATURE | December 14, 2020

Sea Level Projections Drive San Francisco's Adaptation Planning

The Washington Post
Democracy Dies in Darkness

Capital Weather Gang

Intensifying storm brings coastal flooding to Southeast

Charleston saw its 11th highest water level on record Saturday morning, with flooding reported

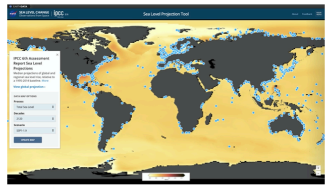
The New York Times

Slow-Moving Storm Brings Heavy Flooding to Mid-Atlantic

A National Weather Service forecaster warned that heavy rain during high tides could lead to "astronomical surges" of ocean water.

SEA LEVEL CHANGE
Observations from Space

IPCC AR6 Sea Level Projection Tool



Under a warming climate, sea levels around the world have been rising and are projected to continue rising in the future. The projections of future sea level rise are critical for coastal planners and policymakers trying to understand and account for sea-level impacts on their communities. Understanding the science, determining which projections to use, and having access to those projections and underlying data are challenges that stakeholders must tackle.

WJCT News

NOAA: 'Sunny Day Flooding' Becoming More Common Across Fla. As Sea Levels Rise

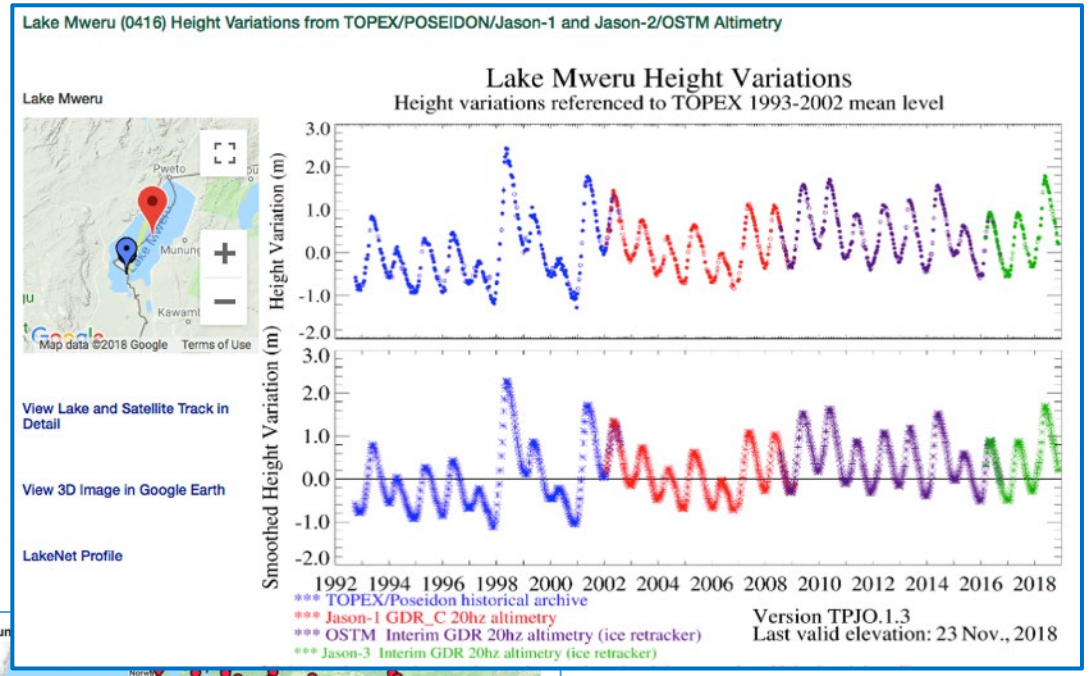
WJCT News | By Brendan Rivers
Published July 15, 2021 at 4:58 PM EDT

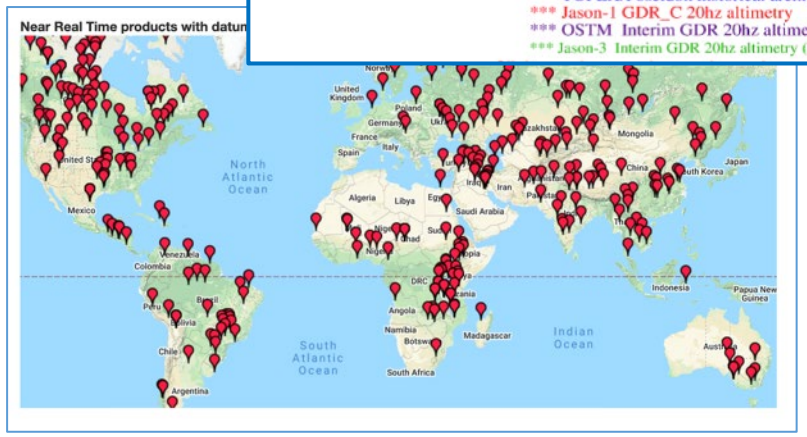
ner for the City and County of San Francisco, David
t access to the latest information about sea level rise
b -- and his city.

Global Lakes & Reservoir Monitoring

Summary: USDA-FAS, with NASA & University of Maryland—routine monitoring of global lake and reservoir height variations.

- Using NASA/CNES/ESA/ISRO radar altimeter data
- Surface elevation products for USDA and public access
- Real-time products from this project have been in operation since December 2003.





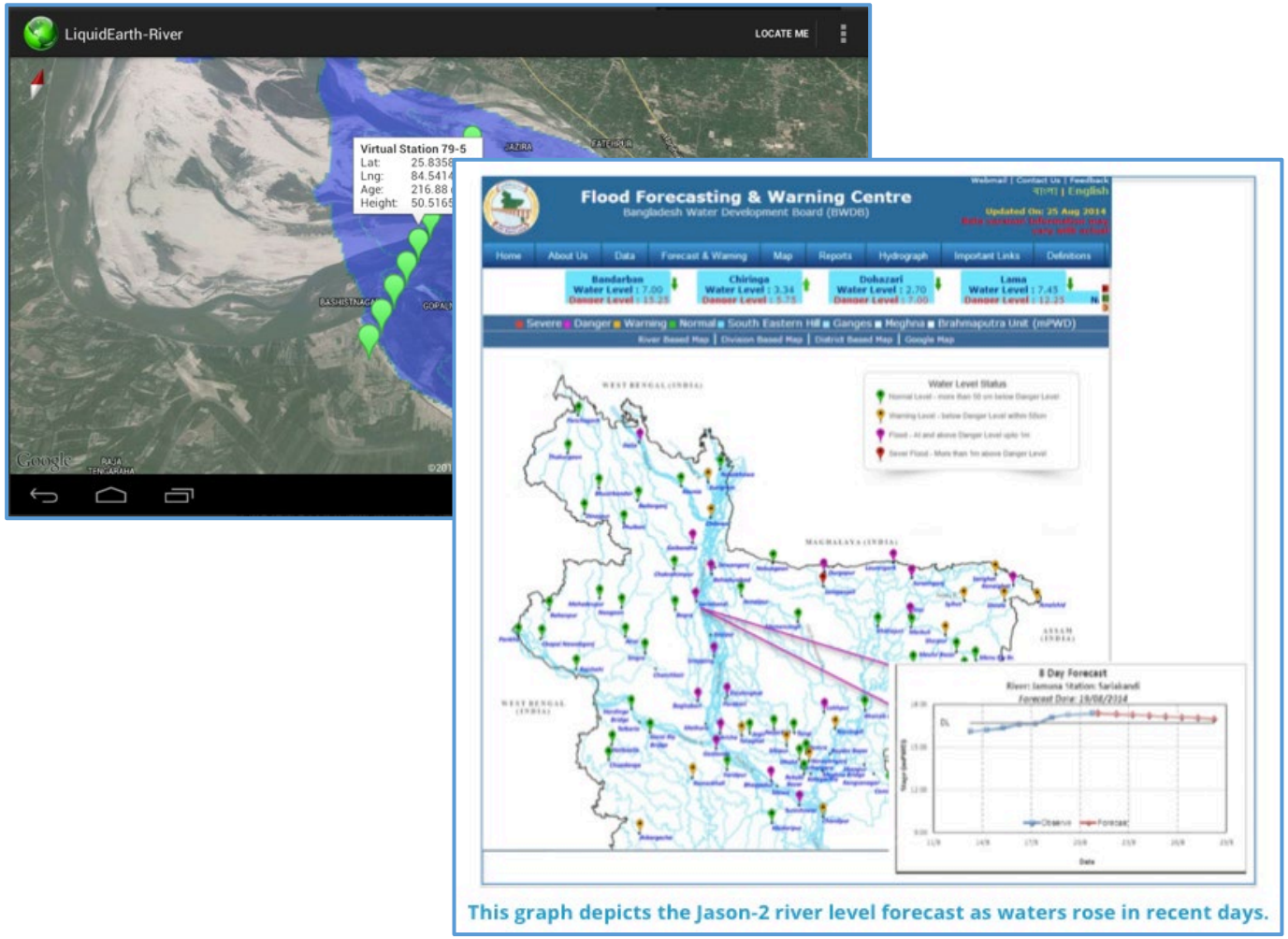
Users:

- USDA FAS, farmers, water managers - quickly locate regional droughts, as well as improve crop production estimates for irrigated regions located downstream from lakes and reservoirs.

Links

- USDA FAS; https://ipad.fas.usda.gov/cropexplorer/global_reservoir/
- C. Birkett research; https://sealevel.jpl.nasa.gov/science/ostscienceteam/scientistlinks/scientificinvestigations2008/birkett/

Flood Risk Assessment



This graph depicts the Jason-2 river level forecast as waters rose in recent days.

Summary: U. Washington developed a mobile platform for the dissemination of flood risk in developing nations.

- Uses multiple altimeter inputs (Jason 2, ICESat-2, Sentinel 3, Cryosat-2).
- River levels used to model downstream virtual stream gauge levels.
- Flood forecast times increased (5 to 8 days)

Users:

- Flood Forecasting and Warning Center (FFWC), Bangladesh Water Development Board
- NASA's SERVIR

Link; NASA's SERVIR Program; https://www.servirglobal.net/Global/Articles/Article/1334/servirs-flood-forecasting-system-proving-itself-in-bangladesh

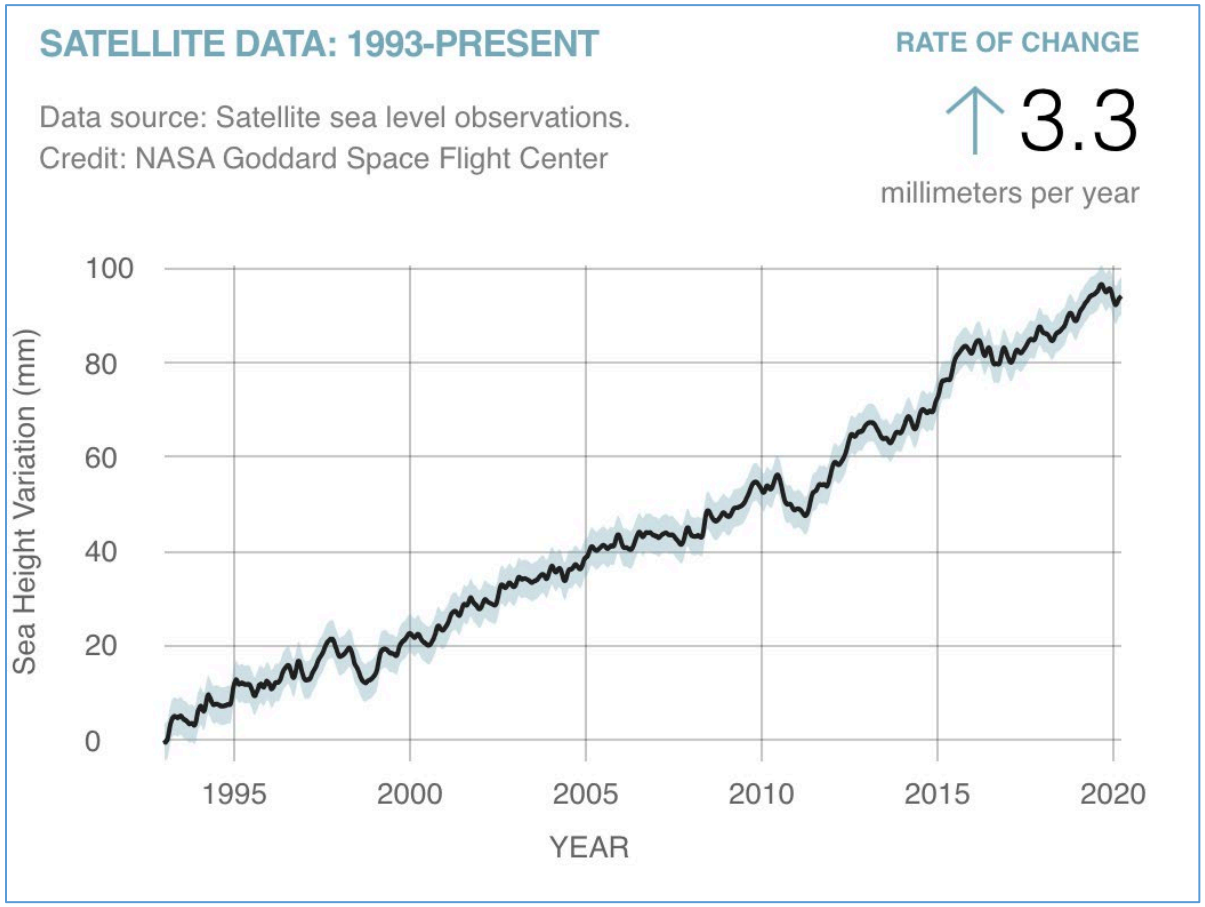
Operational Ocean Forecasting

Summary: Multiple satellite altimeters over 29 years and data merging techniques –> unique capabilities to observe the dynamic oceanography

- NRT high-res global sea level anomaly maps (SSALTO/DUACS system).
- Altimetry + in situ ocean observation systems (Argo) provide measurements of global SLR (~3 mm/yr).
- Ocean analysis and forecasting models are strongly dependent on multiple altimeter data and Argo observations.

Users: Products & services for a wide range of applications:

- Marine environment monitoring – marine debris, oil spills



- Coastal managers, ocean biologists, marine mammal monitoring organizations
- Weather & event forecasting, seasonal and climate prediction; NOAA (CoastWatch, OceanWatch, National Hurricane Center)
- Maritime safety and pollution forecasting, national security, the oil and gas industry, fisheries management and coastal and shelf-sea forecasting.