Water Data Utilization and Capacity Building in the Mekong Region: Improved Hydrologic Decision Support for the Mekong Basin

Ibrahim Mohammed[1], John Bolten[2], Venkataraman (Venkat) Lakshmi[3], Githika Tondapu[4], Manh-Hung Le[3], Pinida Kamphaengthong[5], and Winai Wangpimool[6]

[1]NASA Goddard Space Flight Center
[2]NASA GSFC
[3]University of Virginia
[4]NASA SERVIR - USRA
[5]Pact
[6]Mekong River Commission Secretariat

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Abstract

This contribution highlights part of training events designed to collect, analyze, and manage water and water-related data (e.g., climate, weather, land, soils) and information products for the purposes of reducing water-related risks, and improving regional responses to environmental emergencies in the Mekong region. In this work, we discuss multiple tools and applications developed by National Aeronautics and Space Administration (NASA) scientists to lower technical barriers through current web technologies and leveraging data sharing capabilities among existing programs and institutions within different parts of the Mekong region. The aim of this training contribution is to leverage a well-established suite of tools that include but are not limited to remote sensing precipitation data adjustment techniques, i.e., the SWATOnline visualization and modeling system, and the NASAaccess data toolkit. The collaborative training events, which this contribution is part of, are administered by the United States Department of State (DOS) and the Ministry of Foreign Affairs - Republic of Korea under the Mekong-US Partnership and its Mekong Water Data Initiative facilitated by Sustainable Infrastructure Partnership (SIP) program. The Mekong Water Data is a DOS Initiative consists of multiple efforts and programs with an overarching objective of building the capacity of Mekong riparian countries and the Mekong River Commission Secretariat (MRCS), National Mekong Committees and line agencies in the Lower Mekong countries to improve the management of the Mekong River.

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[1]NASA GSFC, [2]University of Virginia, [3]NASA SERVIR – USRA, [4]PACT SIP, [5]Mekong River Commission Secretariat

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*Ibrahim.mohammed@nasa.gov

Objectives

Introduction of multiple hydroclimatic applications designed to collect, analyze, and manage water and water-related data (e.g., climate, weather, land cover, soils) for the purpose of reducing water-related risks, and improving regional responses to environmental emergences.

This animation shows rain data collected by the GPM Core Observatory and the partner satellites currently in orbit on March 17, 2014. The end of the animation focuses in on a storm system that moved over the eastern United States, showing GPM Microwave Imager data of rain and snow rates. This is the first time a single satellite has collected simultaneous data on rain and snow for a single storm.

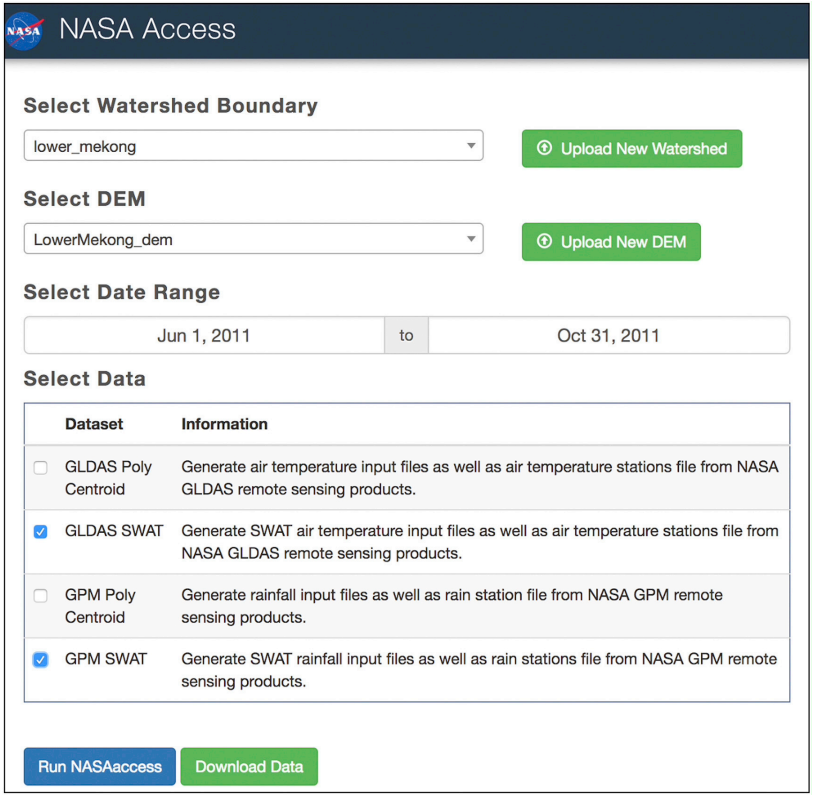
Animation Credit:

NASA's Scientific Visualization Studio
Data provided by the joint NASA/JAXA GPM mission

- **NASAaccess & SWAT-online software programs were developed for hydroclimatic applications.**
- **The web apps and software packages presented are modular and can be hosted anywhere (public or private servers).**
- **The NASAaccess tools presented give easy access and retrieval capabilities to weather and climate data for any watershed.**
- **The tools presented provide formatted data that can be seamlessly ingested into any hydrological model.**

NASAaccess (Tethys Web Tool & R Package)

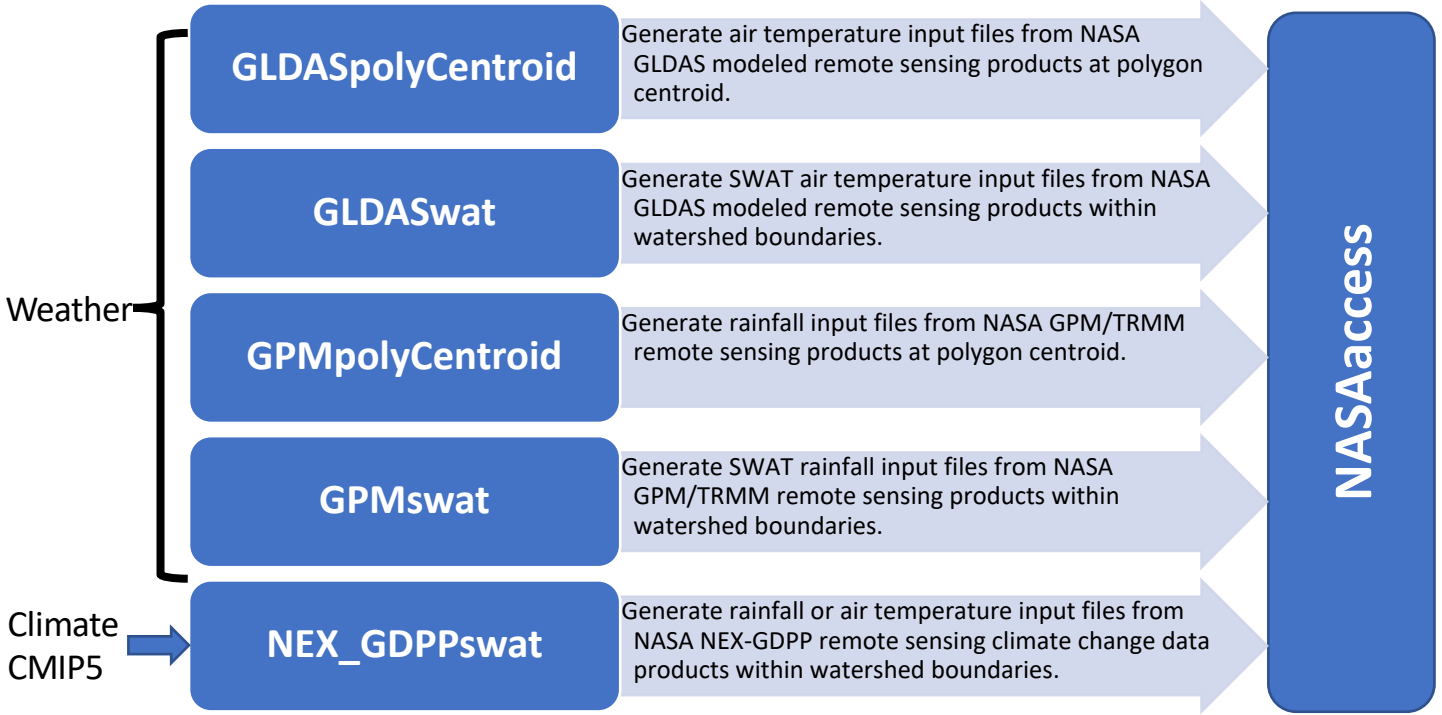
NASAaccess is a software tool built in R software program that streamlines the retrieval and processing of the global National Aeronautics and Space Administration (NASA) earth observation data products for use in hydrological models such as SWAT , VIC, RHESSys, …etc.
(https://imohamme.github.io/NASAaccess/index.html)



GitHub

McDonald, S., Mohammed, I.N., et al., 2019. *Environ. Modell. Softw.* 120:104499

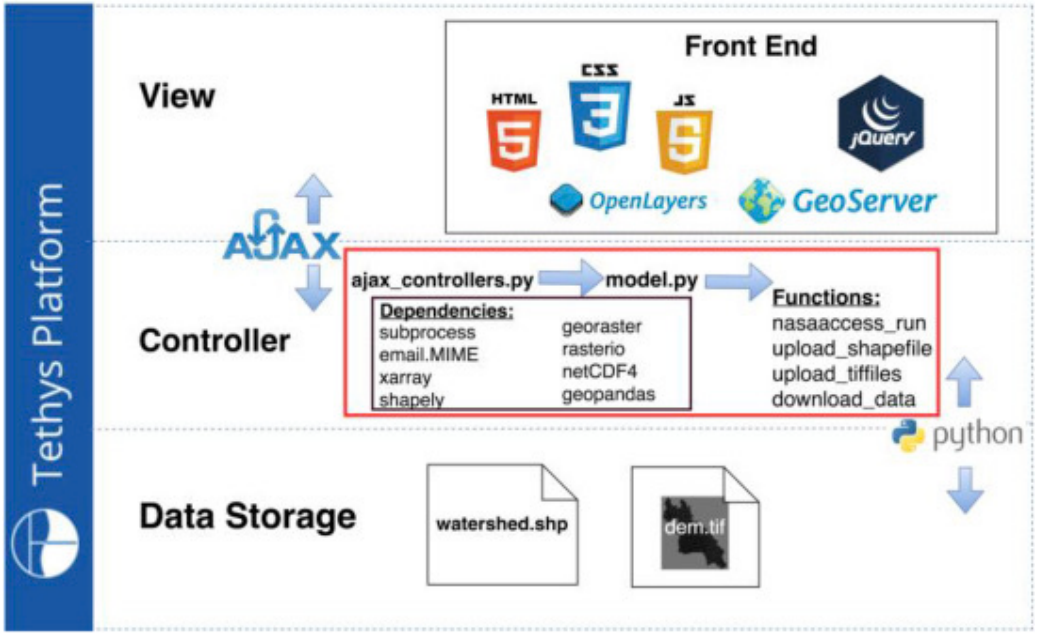
NASAaccess ...



https://github.com/nasa/NASAaccess

NASAaccess Tethys Organization

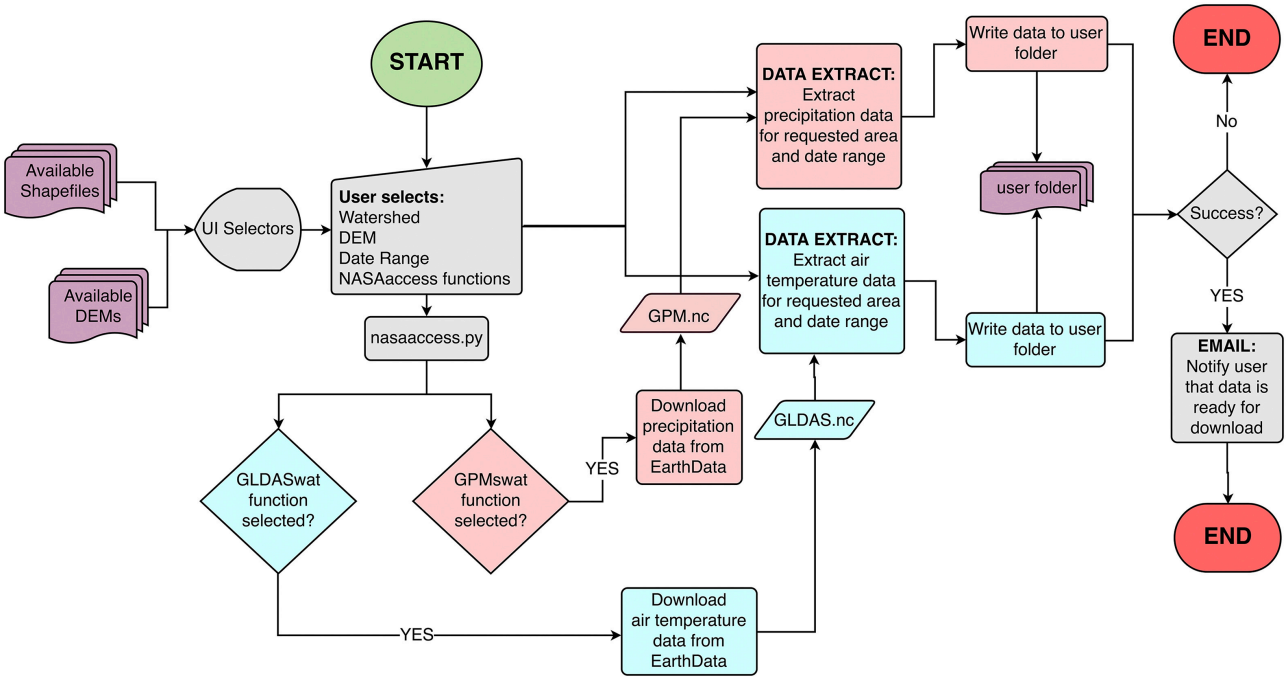
- Scientists can leverage the wealth of already developed Python packages along with their own customized scripts to control the data retrieval, processing, and analysis functions.



Model-View-Controller (MVC)

McDonald, S., Mohammed, I.N., et al., 2019. *Environ. Modell. Softw.* 120:104499

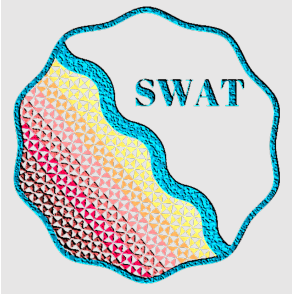
NASAaccess Tethys Web App Flowchart



McDonald, S., Mohammed, I.N., et al., 2019. *Environ. Modell. Softw.* 120:104499

What is SWAT-Online Framework?

- SWAT-online represents an effort to lower technical barriers for the SWAT model through using open-source web development, web services, and cloud storage technologies.
- SWAT-online is a Tethys App for visualizing and sharing inputs/outputs of any SWAT Model project.



https://www.tethysplatform.org/

SWAT-Online Lower Mekong

McDonald, S., Mohammed, I.N., et al., 2019. *Environ. Modell. Softw.* 120:104499

Select Watershed

Lower Mekong

Toggle Layers

Basins

On

Stations

On

Watersheds

On

Supplementary Layers

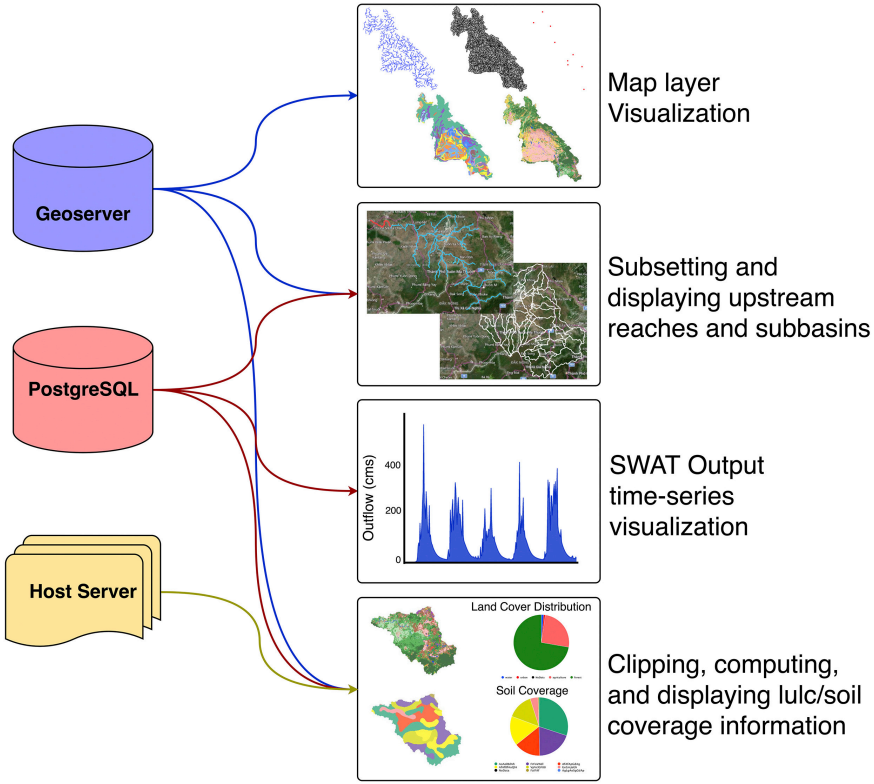
Land Use/Land Cover | Soil | None

Station Name	Kratie
Station Code	14901
River	Mekong
Lmb ID	SUB-BASIN 6 OUTLET
Point X	106.017198536
Point Y	12.4468270153
URL	https://monitoring.mrcmekong.org/station/014901

A Tethys web app to visualize and share inputs/outputs from Lower Mekong River Basin

Lower Mekong Watershed modeled data from Mohammed et al., 2018. *Remote Sens.* 10(6):885

SWAT-Online Visualization Methods



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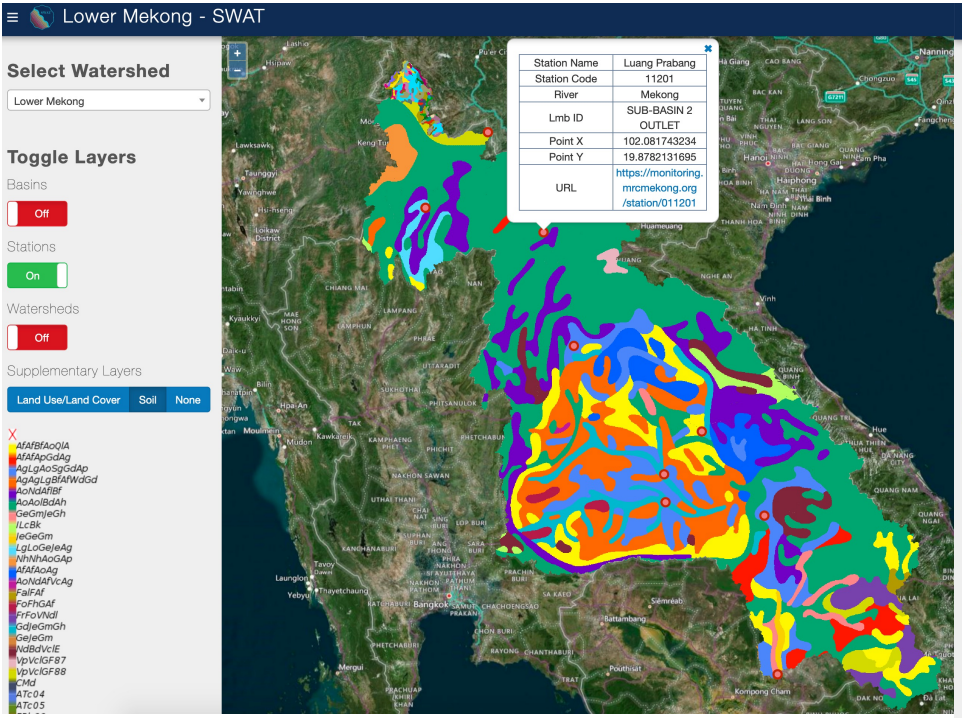
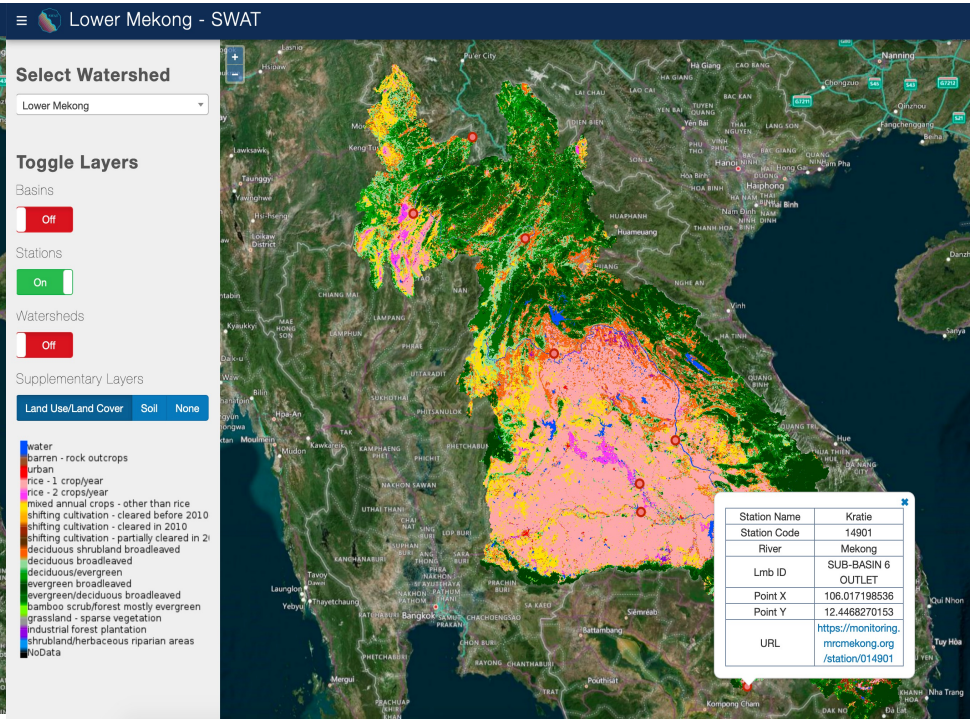
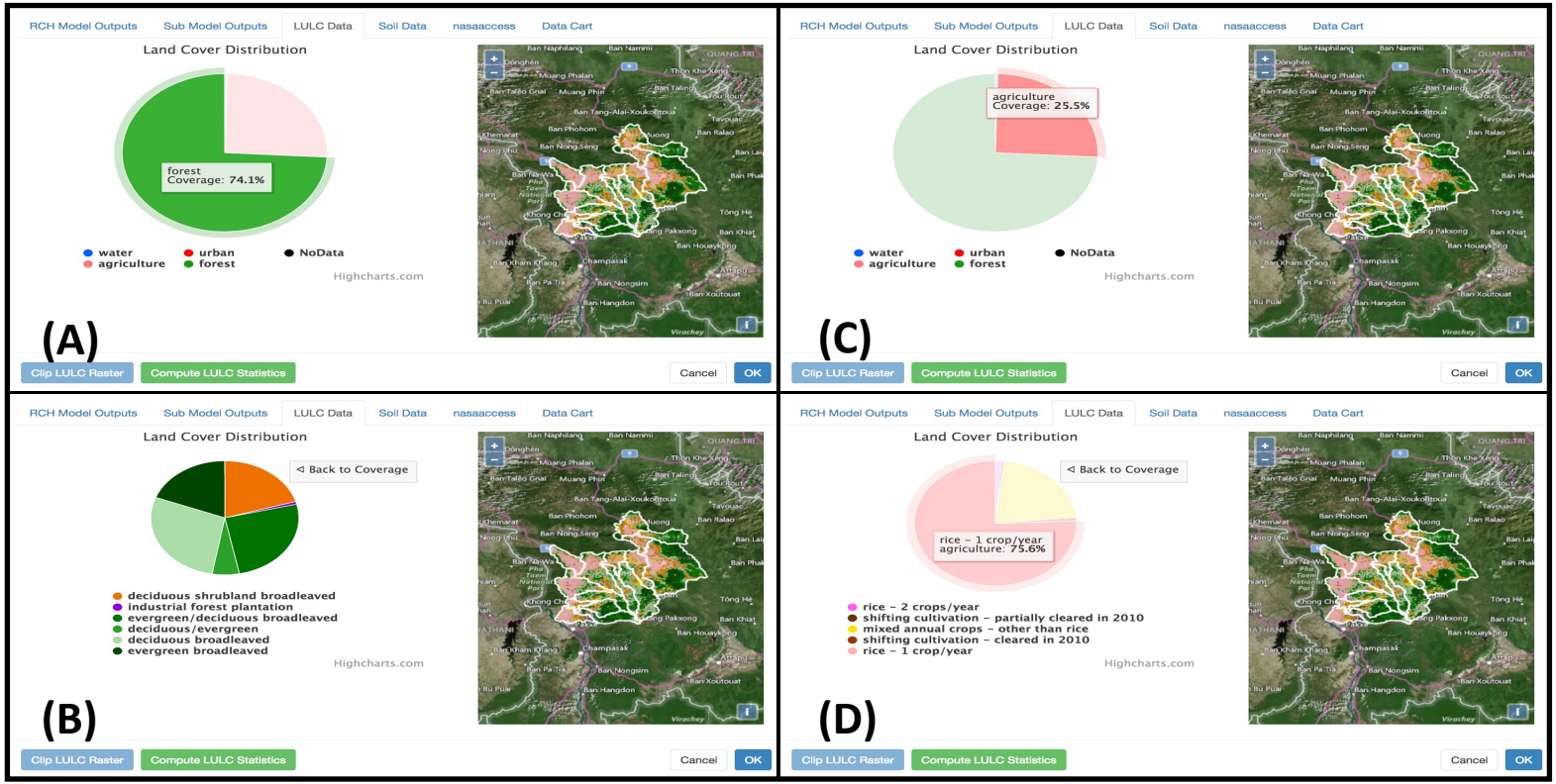




Easy access to various input raster data such as Soils and Land Use Land Cover

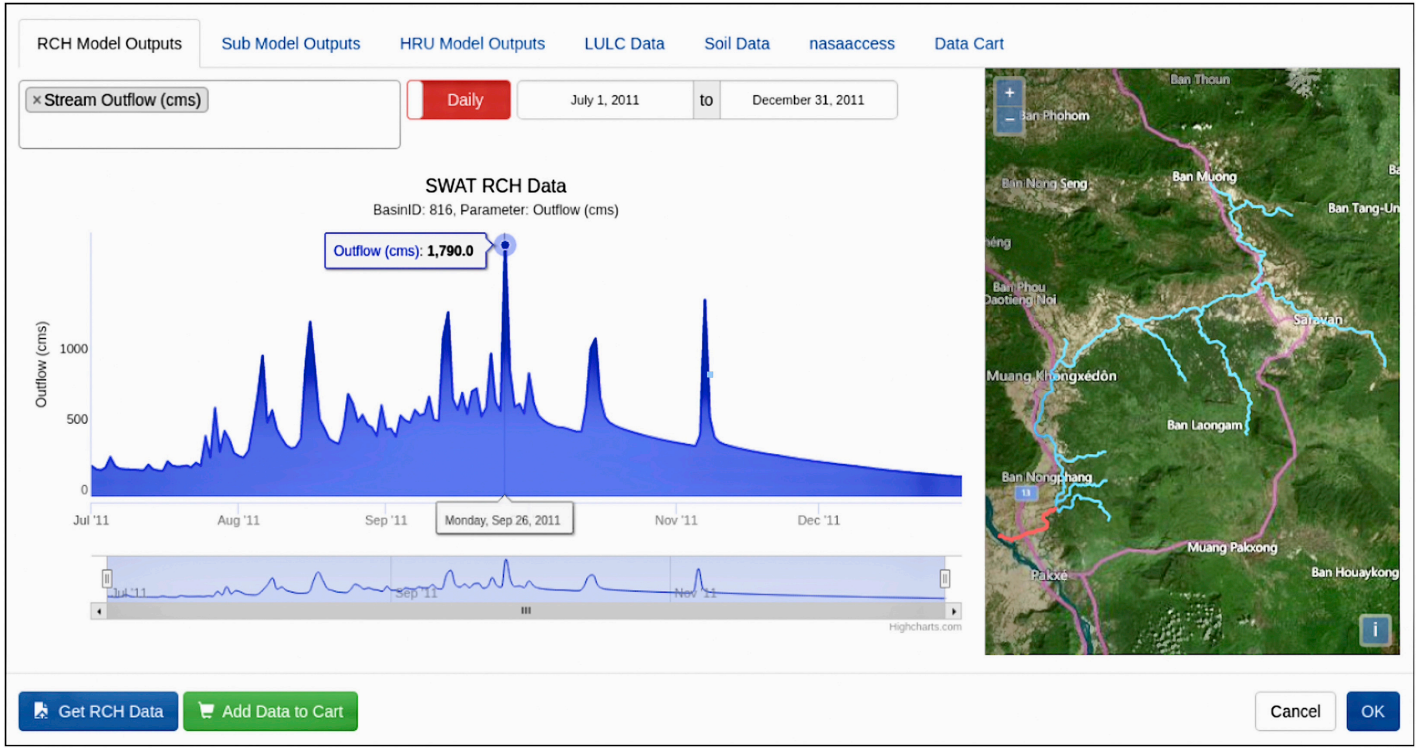
McDonald, S., Mohammed, I.N., et al., 2019. *Environ. Modell. Softw.* 120:104499

SWAT-Online Clipping, Computing and Displaying Raster Information



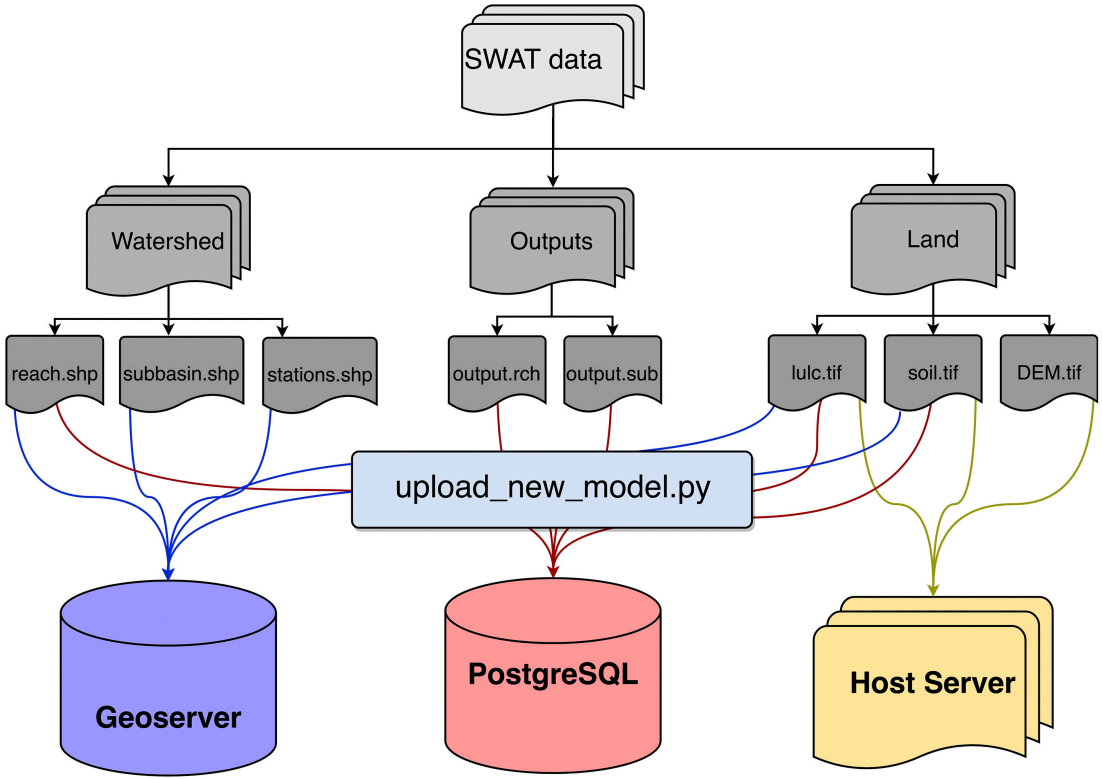
McDonald, S., Mohammed, I.N., et al., 2019. *Environ. Modell. Softw.* 120:104499

SWAT-Online Time-series Visualization



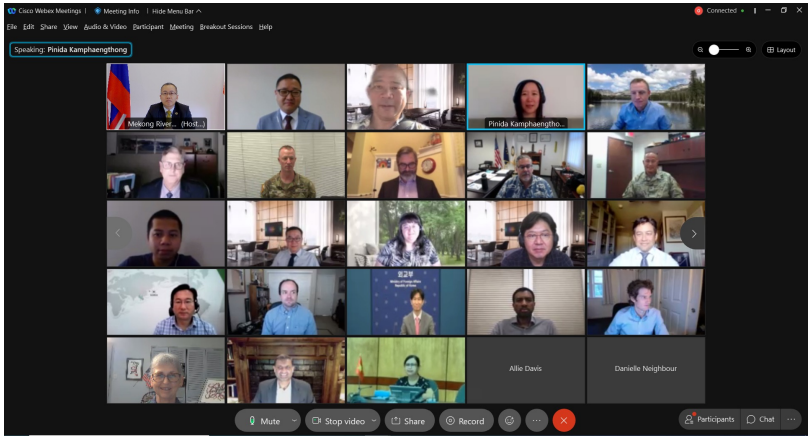
McDonald, S., Mohammed, I.N., et al., 2019. *Environ. Modell. Softw.* 120:104499

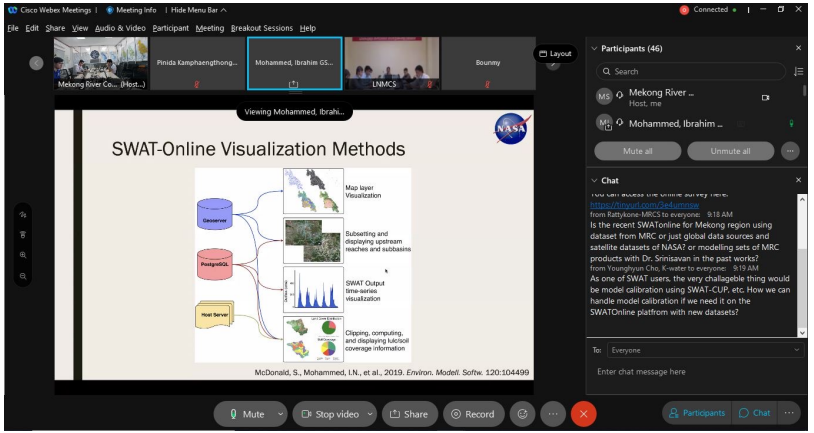
SWAT-Online Upload and Storage Methods



McDonald, S., Mohammed, I.N., et al., 2019. *Environ. Modell. Softw.* 120:104499

Capacity Building Training Program for MRC

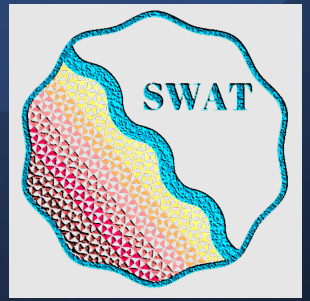




Training on introduction to NASA's satellite data access (NASAaccess), SWAT-Online, and the use of satellite remote sensing in hydrology attended by 65 participants from different agencies and organizations in the Mekong region.

Summary

NASAaccess



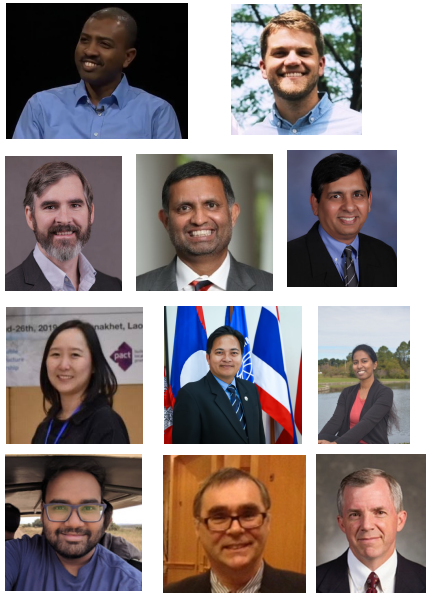
SWAT-Online Lower Mekong

Bridging the gap for non-technically trained stakeholders and decision makers charged with water, climate and environmental management decisions.

Saving time for scientists tasked with analyzing weather and climate data as well as developing hydrological models.

Readiness for addressing the needs of the AGU community.

Thank You!



Ibrahim.mohammed@nasa.gov

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- McDonald, S., **Mohammed, I. N.**, Bolten, J. D., Pulla, S., Meechaiya, C., Markert, A., et al. (2019). Web-based decision support system tools: The Soil And Water Assessment Tool Online visualization and analyses (SWATOnline) and NASA earth observation data downloading and reformatting tool (NASAaccess). *Environmental Modelling & Software, 120*, 104499. https://doi.org/10.1016/j.envsoft.2019.104499
- **Mohammed, I. N.**, Bolten, J., Srinivasan, R., & Lakshmi, V. (2018). Improved hydrological decision support system for the Lower Mekong River Basin using satellite-based earth observations. *Remote Sensing, 10*(6), 885. https://doi.org/10.3390/rs10060885