

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

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## 2022 Third SWOT Early Adopter Virtual Hackathon

**What:** For a third year in a row, a virtual hackathon was organized for early adopters of the Surface Water and Ocean Topography (SWOT) mission that is planned for launch in late 2022. Two dozen participants representing various sectors of the user community and support staff collaborated intensively to resolve bottlenecks and software hurdles associated with building skills to use anticipated SWOT data. A unique training feature called "*Hacktion* plan" (Hackathon action plan) was introduced for each early adopter to maximize collaboration in solving hurdles in the year of launch.

**When:** 25–28 April 2022

**Where:** Online (organized by the University of Washington)

**KEYWORDS:** Education; Societal impacts

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The Surface Water and Ocean Topography (SWOT) mission (Biancamaria et al. 2016), jointly developed by NASA and French Space Agency (CNES) with contributions from the Canadian and U.K. space agencies, is designed to provide a spatially distributed and high-frequency measurement of water elevation data for the hydrology and oceanography communities for the first time (Morrow et al. 2019). By virtue of its stated scientific goals, SWOT satellite data are expected to have tremendous societal impact in various sectors that involve water, such as, but not limited to, disaster management, reservoir operations, water management, ecosystem services planning, hydropower and navigation, fisheries (freshwater and marine), and marine shipping.

For over four years prior to scheduled launch of SWOT Mission in November 2022, there has been an Early Adopter Program (EAP) in place (Hossain et al. 2017). The EAP is a prelaunch protocol developed by NASA Applied Sciences Program (ASP) for engaging with the broader user community to maximize and accelerate the use and societal impact of a planned mission once data become publicly available (Brown and Escobar 2019). The EAP is composed of selected early adopters (EA), which are entities with a potential need for the data from the mission. Each EA proposes an activity for the use of satellite mission data, using either proxy datasets, or simulated data that mimic the anticipated mission during the postlaunch era. The key objectives of the SWOT EAP are to disseminate awareness for the user community on 1) what and how will SWOT measure; 2) format, data structure, and accessibility of SWOT data; 3) ancillary services and supporting resources to facilitate handling of SWOT data; and 4) potential examples of societal application of SWOT data. These objectives have been specifically designed to sustain and nurture a growing community of potential users so that real-world and honestly brokered societal applications based on SWOT data and science are accelerated around the world. If there is one overarching objective of the SWOT EAP, it is to accelerate and maximize societal applications after launch that would have otherwise taken much longer to materialize and become self-sustaining.

For SWOT, there are currently more than two dozen EAs that have reached varying levels of literacy in building user readiness for the data through repeated training workshops called SWOT Virtual Hackathon since 2020 (Hossain et al. 2020a). In the third such training workshop and the last one before mission launch—2022 *Third SWOT Early Adopter Virtual Hackathon*—we summarize the unique features of EA training that were implemented by the University of Washington.

### **The Third SWOT Early Adopter Virtual Hackathon**

Like previous SWOT hackathons, the third hackathon was designed as a 4 day, completely virtual hackathon with one session per day lasting up to three hours. The limit on each day is to minimize fatigue from online connectivity and to accommodate diverse time zones for a more global audience. The first day was allocated for building SWOT data literacy, awareness of tools, and “prepare” the EAs and the broader user community to dive into the intense one-on-one

hack sessions during the following two days of hacking user challenges. Like previous years, the third virtual hackathon provided prerecorded audio–visual content, which is basically an online repository of videos on tutorials and hands-on activities by domain experts and the SWOT support team. The hackathon is premised on the assumption that making training contents available for EAs to peruse beforehand can make interactions during the live sessions more interactive and EAs will know what specifically to seek help on for their EA projects. This premise is well supported by user survey data from the past two hackathons (Hossain et al. 2020a,b). For more details on the 2022 SWOT hackathon, readers are encouraged to visit the hackathon website at <http://depts.washington.edu/saswe/swot/hackathon2022.html>.

With support from the SWOT science community, successive SWOT hackathons have been able to build a formidable archive of freely available multimedia tutorials, education materials, and self-help resources for any user interested in exploring SWOT applications, akin to the Khan Academy or Coursera on SWOT (readers can access the resources from <http://depts.washington.edu/saswe/swot>). With the execution of the third hackathon, this multimedia archive has now grown to about 50 h of training video. This online repository continues to grow because of the community spirit of the EA program where fellow EAs, SWOT scientists, and data support staff help each other to overcome their respective project hurdles in a “hack” manner and make the lessons learned public (Hossain et al. 2020a).

### The *Hacktion* plan for the Third SWOT Early Adopter Hackathon

Etymologically, the word hackathon is a marriage of two words—“hack” and “marathon,” where hack here refers to exploratory computer programming and not computer security breach (Trainer et al. 2016). For the third hackathon, we extended the etymological to hackathon and action and created a *Hacktion* plan. A *Hacktion* plan was developed for each EA prior to the delivery of the hackathon through multiple discussions with the EA and organizers to understand with sufficient granularity the objectives and tasks for the hackathon sessions. Such a list of objectives and tasks provided specificity during the hack session within a loosely defined boundary for both the organizers and the EA. We recommend that all future hackathons develop such a *Hacktion* plan for each EA as it provides clarity to EAs and support staff (hackers/helpers) on important action items that are aligned to the overall objective of the applications program of a planned satellite mission. Table 1 below provides an example of a *Hacktion* plan for one such SWOT EA—the Texas Water Development Board.

**Table 1. Example of a *Hacktion* plan for a SWOT EA—Texas Water Development Board.**

Hackathon objectives
(i) Learn to set up CNES SWOT simulator over 1–2 TWDB lakes/reservoirs.
(ii) Understand the potential improvement due to SWOT in estimating lake area in the context of current pre-SWOT multisensor area estimation tool for TWDB.
(iii) Understand the codes/scripts and processing chain required to get the multisensor area estimation tool ready to operationally ingest SWOT L2 lake area data product and improve TWDB’s evaporation estimation. Specifically, L2_HR_LakeSP, L2_HR_LakeAvg, L2_HR_Raster.
Tasks
1) Select 1 or 2 TWDB lakes/reservoirs (that are also modeled in Multi-sensor Texas Reservoir Area Estimation for TWDB). TWDB suggests Lake Buchanan as one of the lakes.
2) Use a 1 yr time series of reference/in situ elevation data measured by TWDB to generate reference water level shapefiles, using the area-elevation/bathymetry relationships.
3) Feed the time series of lake area shapefiles into CNES SWOT simulator to generate SWOT simulated lake area.
4) Compare that time series of area by plotting it with the non-SWOT generated lake area estimated from the multisensor tool with the range of uncertainty (based on Sentinel-1, Sentinel-2, and Landsat).
5) Quantify improvement due to SWOT for area (and evaporation estimation) in the context of non-SWOT (pre-SWOT) area estimation uncertainty.

Further details on Hacktion plan for EAs can be found on the SWOT hackathon web page (<https://depts.washington.edu/saswe/swot/Hacktionplan.pdf>).

### **Implementing the Hacktion plan**

Availability of the Hacktion plan for EAs participating in the hackathon made the hack sessions more focused with both EA and the support team of hackers keenly aware of what exactly needed to be “hacked.” Examples of hacks as specific tasks included, but not limited to, debugging codes, building or enhancing existing EA codes/tools for processing SWOT data, developing cron jobs for future operational and repeat use of SWOT data, building web interfaces for visualization, understanding how SWOT data/algorithms work.

Compared to previous two hackathons of 2020 and 2021, the Hacktion plan was found to be a differentiating factor that made hack sessions more productive and oftentimes exceeding expectations of progress for EAs. This was evident in the posthackathon survey of EAs that we carried out after the completion of the hackathon. In general, 100% of EAs found all or some of the virtual hackathon content useful with 70% indicating that they feel confident about being able to successfully use SWOT data within six months of it becoming publicly available (online supplemental material; <https://doi.org/10.1175/BAMS-D-22-0107.2>). In particular, when EAs were asked about the impact of the Hacktion plan compared to previous hackathons, 100% of EAs found that it made a major difference in achieving the goals of building literacy and skill for application of SWOT data. Similar to previous hackathons, many EAs demonstrated significant increase in SWOT mission data literacy by suggesting new technical challenges to address for a future hackathon after the launch of the SWOT mission (see supplemental material).

### **Conclusions**

In this paper, we described the third virtual hackathon for early adopters of the planned SWOT mission in the year of launch. An innovative feature of hackathon called *Hacktion* (Hackathon action) plan was implemented during the Third SWOT Virtual EA Hackathon. We found that predesigned Hacktion plan in close consultation with the EAs prior to the hackathon can make a significant impact on improving the effectiveness of hackathons in building user readiness for the SWOT mission. We recommend that future hackathons of other planned satellite missions explore the use of this protocol of Hacktion plan as a best management practice for the Early Adopter Program.

Planned satellite Earth missions, such as the SWOT mission, today require proactive engagement with the broader user community that spans the spectrum of scientific research and practitioner end-user needs if the mission is to hit the ground running when data become publicly available. Proactive engagement allows us to realize the user potential of planned satellite data more fully in the longer term. Hackathons and Hacktion plans can be critical to the success of such proactive engagement, particularly during the year of launch, as demonstrated for the SWOT mission for the past three years.

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