Delta Stewardship Council
A CALIFORNIA STATE AGENCY

INFORMATION ITEM

Lead Scientist Report

Summary

In their paper "SWOT Water Surface Elevation in Herbaceous Wetlands of Florida's Everglades," Kica et al. (2025) show how data from the recently launched Surface Water and Ocean Topography (SWOT) satellite can be used to measure water levels in wetlands. This is important because water levels in wetlands control numerous ecological processes, are difficult to detect through vegetation, and can be used to calculate water flow rates and storage. Here in the Delta, such water elevation data can be used to inform water resource management under flood or drought conditions, track evolution of large-scale wetland restoration projects, monitor impacts of invasive vegetation on water levels, and understand hydrology of ungauged waterbodies within the Delta watershed.

Measuring water levels in wetlands using new satellite data

Kica, S., Pavelsky, T. M., Fayne, J. V., & Williams, B. A. (2025). SWOT Water Surface Elevation in Herbaceous Wetlands of Florida's Everglades. *Geophysical Research Letters*, *52*(9), e2025GL114956. https://doi.org/10.1029/2025GL114956

A key piece of information for managing wetlands involves understanding the elevation and the extent of surface water—in other words, what is covered by water and how deep that water is. This is important because the magnitude and timing of water level fluctuation affects many vital ecological processes. These include how nutrients move through the system, the health and reproductive success of species that rely on certain water levels at certain times, and when and how greenhouse gases are released or stored. It is also particularly important for water management in systems with many competing environmental and human water demands.

Typically, water levels are measured by a network of physical sensors set in place. However, scientists are increasingly using different types of imagery from satellites (a type of remote sensing) to do things like calculate river flow and track ground subsidence, groundwater loss, and relative changes in water levels. In this article, Kica et al. (2025) investigate potential uses for data from the Surface Water and Ocean Topography (SWOT) satellite. This satellite mission was developed by NASA and the Centre National D'Etudes Spatiales (CNES, the French national space agency) in collaboration with the Canadian and UK space agencies. The mission was launched in 2022 with the aim of measuring Earth's surface waters using a special type of radar instrumentation.

The researchers show that SWOT can successfully and accurately map water levels and the extent of water inundation in certain Florida wetlands. Like the San Francisco Bay-Delta system, the Florida Everglades were historically expansive wetlands that have been substantially altered for agricultural use and other development. Both ecosystems have also been highly modified to facilitate water supply. As such, SWOT's demonstrated utility in the Everglades is relevant to wetlands in the Bay-Delta, especially in terms of restoration and hydrological monitoring.

The four most important takeaways we can draw from Kica et al. (2025) are:

1. Unlike many remote sensing techniques that must infer hydrological information from land movement, SWOT measures water surface elevation directly. Furthermore, because its radar can penetrate some kinds of vegetation, SWOT can measure water surfaces in wetlands and beneath some types of invasive aquatic vegetation—both of which are important to managing the Delta.
2. In addition, many remote sensing techniques can only monitor how water levels have changed over time—e.g., an increase of half a meter between two dates—and require other data to calculate the actual water levels. However, SWOT allows for accurate measurement of the actual water level with no other data or calculations needed—e.g., measuring that the water level is 4 meters above sea level.
3. SWOT does not require on-the-ground sensors, and can track water level fluctuations, storage changes, and inundation patterns over large areas. This

could facilitate monitoring much more of the Delta watershed—not just areas with no sensors, but also areas where there are insufficient sensors to capture local variability in conditions.

4. This extensive spatial coverage allows SWOT to inform large-scale wetland restoration projects, including monitoring how any changes in water behavior affect wetland habitat and species.

An ongoing challenge facing the Bay-Delta system is the need to collect, process, and analyze large amounts of environmental data to help deliver the best possible science to inform management decisions. This need will only increase as climate stressors intensify and new management plans are developed that rely heavily on—and respond to—reliable real-time data streams (e.g., the Healthy Rivers and Landscapes proposal currently being considered by the State Water Resources Control Board). As such, there is much work underway to assess how new data methodologies can make it easier, cheaper, and more effective to collect such data across wide geographic areas and over long periods of time. The SWOT mission is a promising tool, especially for assessing and managing water levels in wetlands.

Delta Science Program Activities

How to interweave Traditional Knowledge into Delta management systems

Scientists, policymakers, and Tribes are recognizing the insights that diverse knowledge systems can provide for both the global ecocultural landscape and the Delta specifically. Traditional Knowledge (TK) is the deep place-based knowledge, practices, and ethical beliefs of Indigenous peoples. TK has historically been under-represented in decision-making, and many managers, policymakers, and scientists struggle to understand how to interweave knowledge systems together in a meaningful way.

In the article "Changing Paradigms of Knowledge Production: Interweaving Traditional Knowledge and Predominant Science in the Delta," published in the new issue of [San Francisco Estuary & Watershed Science](https://escholarship.org/uc/jmie_sfews) (https://escholarship.org/uc/jmie_sfews), Dr. Xoco Shinbrot and colleagues within and outside the Council explore approaches to interweaving knowledge systems, where to find interweaving opportunities, and the governance structures that may support this. Collaborative knowledge production is illustrated through three examples in the Delta: (1) cultural burning practices, (2) ecological restoration, and (3) species management, some of which are already being implemented in places like Webb Tract. The authors also acknowledge ongoing barriers and solutions to interweaving TK and challenging misperceptions of TK, and highlight the need to protect Indigenous data while ensuring that funding mechanisms are accessible and appropriate to TK practitioners.

Delta Research Awards announced

The Delta Stewardship Council's Delta Science Program recently announced $5.9 million in awards to fund eight critical scientific studies in the Sacramento-San Joaquin Delta and Suisun Marsh. In addition to the eight projects selected for Delta Science Program funding, the State Water Contractors will fund two studies that support recovery efforts for endangered fish in the Delta, bringing the total awards to more than $7.8 million. The awarded projects address high-priority science actions identified in the 2022–2026 Science Action Agenda, a collaboratively produced plan that prioritizes and aligns science actions to inform management decisions in the Delta. The projects cover a range of important research topics, including harmful algal blooms, eco-cultural restoration, Tribal knowledge, subsidence, hydrology, acoustic telemetry, endangered species, and more. This solicitation incentivized social science proposals and encouraged co-produced research, where information is produced by both the researchers and the communities affected by the research. A total of 66 proposals were submitted to the solicitation, which was facilitated by California Sea Grant and reviewed by nationally and internationally renowned subject matter experts. The Delta Science Program's research awards web page (https://deltacouncil.ca.gov/delta-science-program/research-awards) has more information and project details.

On Your Radar

Emerging research climate symposium, September 16–17

As global climate change intensifies, human-altered and engineered landscapes around the world are facing increasing stressors and shocks that threaten their stability and functionality. California, a state that already experiences significant climate variability, could face increasing risks of extreme droughts, less snow, mega-floods (due to atmospheric rivers), and warmer ocean temperatures. The Delta Independent Science Board (Delta ISB), which provides scientific oversight of programs supporting adaptive management, seeks to stay informed on pressing and important topics affecting the Delta system. To help achieve this, the Delta ISB is planning to host a symposium on September 16–17, 2025, at UC Davis. The symposium will explore: 1) current climate projections for California's Sacramento-San Joaquin Delta and related uncertainties; and 2) how organizations in the region are incorporating climate change into their decision-making. As an outcome of the symposium, the Delta ISB plans to prepare a memo on key takeaways from the symposium, including any research gaps and how current management approaches align with the latest research in the field.

Release of final 2025 State of Bay-Delta Science articles

The September 2025 issue of the online, open-access journal San Francisco Estuary & Watershed Science (SFEWS) will include the remaining three chapters of the 2025 edition of the State of Bay-Delta Science (SBDS). This edition explores extreme events affecting the Bay-Delta—heatwaves, droughts, atmospheric rivers, and wildfires—and how science and governance systems can adapt to the increasingly complex management challenges posed by climate change. The first four articles were released in SFEWS in March 2025: an introduction to the edition and three review articles covering climate governance, heatwaves, and droughts. The final three chapters consist of: a review article addressing the significance of wildfires and their impacts on water quality; a review of the science of atmospheric rivers and their effects on the Bay-Delta system; and a concluding article with perspectives from the SBDS Editorial Board on how science and management can adapt to rapidly changing conditions in the system. The State of Bay-Delta Science (https://sbds.deltacouncil.ca.gov/) is an ongoing Delta Science Program synthesis and communication effort intended to inform science and policy audiences about the "state of the science" for topics relevant to managing the Bay-Delta system.

Delta topographic data updated using LiDAR

A key data type used to inform resource management across the whole of the Bay-Delta is accurate topographic data. At the end of June, during the lowest daytime low tide of the year, a plane flew over the Bay-Delta collecting detailed surface elevation information using Light Detection and Ranging—more commonly known by its acronym, LiDAR. This technique bounces specialized laser pulses off the Earth's surface and measures how long they take to come back, which is used to calculate elevation. When you combine many millions of these surface elevation data points, you can ultimately build up a detailed 3D picture of the terrain, vegetation, and even buildings on the Earth's surface. This LiDAR mapping effort was led by the Delta Stewardship Council in partnership with the Department of Water Resources and the San Francisco Estuary Institute. Here in the Delta the data will be used to construct and update digital elevation models. Essentially, these are topographic maps accurate down to the centimeter that can be used to monitor and manage things like subsidence or flood risk to levees and to help plan restoration projects.

By the Numbers

Science Program staff will summarize current numbers related to Delta water and environmental management. The summary (Attachment 2) will inform the Council of recent counts, measurements, and monitoring figures driving water and environmental management issues.

List of Attachments

Attachment 1: Visual Summary of Article

Attachment 2: By the Numbers

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