

INFORMATION ITEM

Highlighting the State of Bay-Delta Science 2025 “Extreme Events” Edition

Summary

Staff will present highlights from the newest edition of the State of Bay-Delta Science (SBDS), a major scientific synthesis initiative coordinated by the Delta Science Program. The 2025 edition of SBDS focuses on extreme climate and weather events and their effects on the Bay-Delta’s ecosystems and people. Articles in the edition summarize progress made to date on key research questions related to extreme events and identify important knowledge gaps deserving future scientific study. SBDS is one component of the Delta Science Program’s Delta Science Strategy, a three-part planning, implementing, and reporting strategy aimed at building a common body of scientific knowledge in the Delta. Knowledge communicated through the 2025 edition will be used to inform updates to the Delta Science Plan and Science Action Agenda, guide future science activities, and support science-informed decision-making in the Bay-Delta.

Background

Scientific synthesis refers to putting together existing information or data to generate new analyses and scientific insights. Instead of collecting new data from the field or laboratory, synthesis draws on the wealth of information that already exists to uncover new findings. The Delta Reform Act identifies synthesis as one of the Delta Science Program’s core functions in carrying out its mission to provide the best possible science to support water and environmental decision-making in the Delta. The Delta Science Program advances synthesis through a variety of approaches, including:

1. combining data collected by multiple individual studies or monitoring efforts into a single integrated dataset;

2. performing new statistical analyses on data collected in different ways or by different research efforts; and
3. conducting literature reviews to distill major takeaways from several independent reports or publications.

Examples of the first two of these approaches were shared at the June 2025 Council meeting in a presentation featuring the Delta Science Program's partnership with the National Center for Ecological Analysis and Synthesis (NCEAS) to convene regular Delta Synthesis Working Groups. The third approach is exemplified by another project coordinated by the Delta Science Program called the State of Bay-Delta Science (SBDS).

SBDS: Exploring our current understanding of the Bay-Delta

SBDS is an ongoing synthesis and communication project that seeks to summarize the scientific understanding, or "state of the science," of critical topics for Bay-Delta management. Editions of SBDS are published as collections of articles exploring what is known, what we need to know, and what we might need to do next to inform science and policy audiences. Publications serve as definitive sources of information for anyone looking to understand a topic and where we are heading with science and management. While the first two editions, published in 2008 and 2016, covered a broad set of topics, recent editions take a more focused, themed approach.

SBDS is a key component of the Delta Science Program's Delta Science Strategy, a three-part planning, implementation, and reporting strategy. This strategy establishes a foundation for the vision of "One Delta, One Science" - an open Delta science community that works together to build a common body of scientific knowledge. SBDS articles summarize progress made following each iteration of the Delta Science Plan and Science Action Agenda and inform future updates of those guidance documents by highlighting remaining knowledge gaps and needs.

SBDS is developed under the direction and guidance of an interdisciplinary editorial board that includes the Delta Lead Scientist, Delta Science Program staff, and distinguished scientists. The editorial board identifies themes, topics, and authors for each edition. Articles within each edition undergo peer-review and are

published in the open-access [San Francisco Estuary and Watershed Science journal](https://escholarship.org/uc/jmie_sfews/) (https://escholarship.org/uc/jmie_sfews/). Following publication of articles, Delta Science Program staff coordinate additional communications and outreach to support broad dissemination of findings to science and policy audiences.

SBDS 2025: Extreme events edition

SBDS 2025 explores extreme climate and weather events and their effects on the Bay-Delta's ecosystems and people living in or relying on the region. Individual articles explore our current understanding of and future science needs for governance and climate adaptation; droughts and water availability; temperature patterns and heatwaves; wildfires and water quality; and atmospheric rivers and floods. In the final article, the editorial board provides five perspectives on how science and management can meet the needs of a changing Delta that faces increasingly frequent climate and weather extremes.

The theme for this newest SBDS edition is closely aligned with Management Need 6 from the [2022-2026 Science Action Agenda \(SAA\)](https://scienceactionagenda.deltacouncil.ca.gov/pdf/2022-2026-science-action-agenda.pdf) (<https://scienceactionagenda.deltacouncil.ca.gov/pdf/2022-2026-science-action-agenda.pdf>), which identifies the need to assess and anticipate the impacts of climate change and extreme events to support successful adaptation strategies. In 2025, the Delta Science Program is also developing the third iteration of the [Delta Science Plan](https://deltascienceplan.deltacouncil.ca.gov/) (<https://deltascienceplan.deltacouncil.ca.gov/>), which will identify priority actions, tools, and strategies to address the [Grand Challenges to Delta Science](https://deltascienceplan.deltacouncil.ca.gov/sites/default/files/2024-11-20-grand-challenges-in-delta-science-essay.pdf) (<https://deltascienceplan.deltacouncil.ca.gov/sites/default/files/2024-11-20-grand-challenges-in-delta-science-essay.pdf>). SBDS 2025 complements this process by providing perspectives from authors and the editorial board on future science needs to strengthen our capacity to anticipate and respond to a changing climate and to remain relevant to the challenges ahead.

Articles

Seven articles were published across two issues of the online, open-access [San Francisco Estuary and Watershed Science](https://escholarship.org/uc/jmie_sfews/) journal for the 2025 edition. The table below provides a full list of topics explored in individual articles and citations for the corresponding articles.

Part 1 - March 2025 article releases

Topic	Trends and implications	Citation
Introduction to the edition	Extreme events are increasingly affecting the Bay-Delta. This edition covers current and projected changes in heatwaves, droughts, atmospheric rivers, and wildfires; knowledge gaps; and management solutions.	Thompson et al. 2025. http://dx.doi.org/10.15447/sfews.2025v23iss1art1
Climate governance	The Delta governance system involves many institutions, rules, and processes. Responses to climate change and extreme events can become more efficient and equitable by improving opportunities for learning, innovation, and civic participation.	Rudnick et al. 2025. http://dx.doi.org/10.15447/sfews.2025v23iss1art2
Droughts and management approaches	Drought frequency and severity are projected to increase over this century, which is likely to exacerbate long-standing conflict between competing water uses. Management approaches include regulations, infrastructure, restoration, and education.	Hartman et al. 2025. http://dx.doi.org/10.15447/sfews.2025v23iss1art3
Heatwaves and rising temperatures	Air and water temperatures in the Delta are rising, with heatwaves becoming more frequent and severe. Current and projected effects on humans and ecosystems are widespread.	Mahardja et al. 2025. http://dx.doi.org/10.15447/sfews.2025v23iss1art4

Topic	Trends and implications	Citation
Introduction to the edition	Extreme events are increasingly affecting the Bay-Delta. This edition covers current and projected changes in heatwaves, droughts, atmospheric rivers, and wildfires; knowledge gaps; and management solutions.	Thompson et al. 2025. http://dx.doi.org/10.15447/sfews.2025v23iss1art1
Climate governance	The Delta governance system involves many institutions, rules, and processes. Responses to climate change and extreme events can become more efficient and equitable by improving opportunities for learning, innovation, and civic participation.	Rudnick et al. 2025. http://dx.doi.org/10.15447/sfews.2025v23iss1art2
Droughts and management approaches	Drought frequency and severity are projected to increase over this century, which is likely to exacerbate long-standing conflict between competing water uses. Management approaches include regulations, infrastructure, restoration, and education.	Hartman et al. 2025. http://dx.doi.org/10.15447/sfews.2025v23iss1art4
	effects on humans and ecosystems are widespread.	5447/sfews.2025v23iss1art4

Extreme events explored in this edition include droughts, atmospheric rivers, wildfires, and heatwaves. These articles provide novel contributions to Delta science by sharing:

- the first analysis of heatwave occurrences over recent decades in the Bay-Delta region (Mahardja et al. 2025),
- the first synthesis of water quality impacts from large wildfires in the Delta catchment (Dahm et al. 2025),
- a discussion of projections versus current observations of atmospheric rivers and precipitation trends affecting the Bay-Delta (Gershunov et al. 2025), and

- historical perspectives on how governance and drought management in the region has evolved in the region (Rudnick et al. 2025 and Hartman et al. 2025, respectively).

While each article in the edition focuses on a single type of extreme event within the context of the Bay-Delta region, extreme events do not occur in isolation and their impacts often overlap or intensify when one type of event coincides with or follows another. Forces driving climate change and increasingly frequent or severe extreme events are generally operating at regional or global scales, and policies or strategies to combat those factors are much broader than the Delta and its governance system. Nonetheless, there are approaches and actions that can be implemented at a local or regional scale to help communities and ecosystems prepare for and respond to the new climate realities of the century ahead.

The following table highlights key messages for future science and management shared throughout the edition. Additional details, including key findings from individual articles, are found in the attached information sheets.

Key messages from SBDS 2025

To be effective into the future, Delta climate governance must operate under high

Climate governance - Rudnick et al. 2025

Building resilience to future droughts that are more severe and more frequent requires

Droughts & management approaches – Hartman et al. 2025

Potential strategies for increasing resilience to rising temperatures and more frequent

Heatwaves & rising temperatures – Mahardja et al. 2025

As wildfires grow in size and severity in the future, threats to water quality and

Wildfires & water quality – Dahm et al. 2025

Flexible water management frameworks that balance flood control, groundwater

Atmospheric rivers & floods – Gershunov et al. 2025

To meet the challenges ahead, Delta scientists and decision-makers can leverage

Perspectives on science - Colombano et al. 2025

Who are the key audiences for the State of Bay-Delta Science? (and how will it be used?)

SBDS is created to inform a broad audience, including scientists, resource managers, policymakers, and the general public. For the scientific community, the peer-reviewed publications that comprise each edition provide a baseline synthesis, or ‘snapshot in time,’ for what is known, what remains unknown, and what research or management actions are needed next. Thus, SBDS helps scientists across disciplines to build a shared body of knowledge and can be used to develop research proposals, develop interdisciplinary collaborations, track changes, and assess progress being made over time.

Additional outreach and communication products - such as the attached information sheets or executive summaries from previous editions – translate and highlight key messages to support broader engagement with the management community, policymakers, and the general public. In addition to providing a high-level understanding of the science, SBDS is used by these audiences to inform

development of the SAA, guide funding or investment decisions, shape management actions, and support policy development across the Bay-Delta.

Where can you find more information?

Outreach to share insights from the 2025 edition and connect with science and policy audiences is now underway. Information about these activities and access to previous editions of the SBDS is available at <https://sbds.deltacouncil.ca.gov>.

Fiscal Information

The Council provided \$14,999.85 in funding to the University of San Diego to support the atmospheric rivers and flooding article. The Council contributed \$22,500.00 in funding to the University of San Diego to support the climate governance article.

List of Attachments

Not Applicable

Contact

Denise Colombano, Ph.D.
Senior Environmental Scientist (Specialist)
Phone: (916) 902-6585