Emerging Climate Research Symposium: Considerations for the Delta Region

Delta Independent Science Board

Revised Final Prospectus

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Motivation:

As global climate change[1] intensifies, heavily altered and engineered landscapes around the world are beginning to face increasing stressors and shocks, and hazards that threaten their stability and functionality. Coastal areas are predicted to be particularly affected by climate change effects of sea level rise and storm surges, intense rainfall, flooding, and severe storms (EPA, 2024). California, a state that already experiences significant hydrometeorological variability, could be faced with increasing risks of mega-floods due to atmospheric rivers, decreased snow pack, extreme droughts, wildfires, and warmer ocean temperatures (Huang & Swain, 2022, Shi et al., 2021).

As part of its legislative mandate to provide scientific oversight of adaptive management, the Delta Independent Science Board (Delta ISB) seeks to stay informed on pressing and important topics affecting the Sacramento-San Joaquin Delta system. There is a timely need for Delta ISB members, the scientific community, and public at large to better understand the **rapidly evolving science** of ongoing and anticipated climate change effects to the Delta region. These can inform a range of possible climate futures and associated uncertainties that are relevant to decision making. While there has been a significant amount of research on climate change effects in the region, it is a quickly changing field and therefore important to stay current with the latest developments. To help achieve the goal of staying informed of current knowledge, the Delta ISB will host a two-day symposium to explore recent climate science research as it relates to effects in the

[1] Climate change in the context of this prospectus is defined as the long-term alteration in the average weather patterns that define the climate of the Sacramento-San Joaquin Delta system driven primarily by anthropogenic changes due to increase in greenhouse gasses.

Delta region and its relevance to planning for the near and distant future. This symposium will build on the Delta ISB's decision-making under deep uncertainty (DMDU) review, which explores the scientific tools and concepts that can increase the capacity to anticipate and adapt to uncertainty of future conditions in the Delta.

In the context of the proposed symposium, the emphasis will be on both primary climate stressors—including precipitation, hydrologic patterns, air temperature, and sea level rise—and secondary climate stressors such as wind patterns and both inland and ocean water temperatures. It will also address climate hazards resulting from evolving climate stressors, including, but not limited to, flooding, extreme heat events, droughts, and wildfires.

The proposed symposium will help address the Delta-wide management needs identified by the 2022-2026 Science Action Agenda, specifically Management Need 6, which prompts researchers to "assess and anticipate impacts of climate change and extreme events to support successful adaptation strategies." The Science Actions within Management Need 6 directly call for an increased understanding of how rapidly changing conditions will effect water supply and quality, food web dynamics, invasive species, and management. To answer these vital management questions, an understanding of the current climate research and applicability of models and model projections is needed.

Goals:

The Delta ISB's goal is to organize and host a symposium in 2025 that explores 1) the current climate projections for the region and related uncertainties, including the compounding and interactive effects of both climatic and non-climate stressors and hazards; and 2) how organizations in the Delta are incorporating the current knowledge of climate change and the effect on Delta communities into their decision-making. The symposium will provide an opportunity for the Delta ISB to learn and review how the current state of climate science is being integrated into decision-making in the Delta and how these approaches align with the latest research in the field. To help inform discussion at the symposium, the Delta ISB may prepare a summary of select literature relevant to its goals. The symposium will build upon what is learned from the summary paper and engage experts to address the questions below and elicit the current state of knowledge regarding

climate change and projections as they relate to the Delta system. These questions may change and evolve as planning occurs.

Current Climate Projections

1. What are the important climate stressors and hazards for planning under future conditions (e.g., atmospheric rivers, warming, flooding, droughts, and wildfires)?
    a. What changes in these stressors and hazards are already being observed?
    b. What changes in these stressors and hazards are expected in the future?
2. What are state-of-the-science projections for the Delta region based on existing climate scenarios (e.g., sea level rise, precipitation and temperature changes, extreme events), and what are associated ranges of uncertainty?
3. What do we know about the potential for compounding effects (e.g., extreme precipitation, sea level rise, warming and changing runoff patterns along with sequential events (e.g., rapid succession of atmospheric river events and mega droughts)?
4. How reliable are current downscaled climate products for regional application in the Delta region?
5. What missing information needs to be incorporated into existing models used for improving decision-support? How do we address and prioritize what is missing?

State of Integrating Science for Decision Support

1. How are organizations in the Delta region integrating climate projections and future effects of climate drivers into planning?
2. What types of uncertainties and projections are most useful and critical for decision-support by these organizations?
3. How can an understanding of the evolving effects and risks help to build resilience in the region?
4. Are the current and previous efforts to address climate change in the region adequate for enhancing resilience of the Bay Delta system?

Audience:

This symposium is intended to inform the Delta ISB, researchers, practitioners, and affected parties on the latest climate science and climate projections as they relate to the Delta region. The symposia will be open to the public, and all interested parties can attend.

Input:

The symposium will be organized by the Delta ISB and its support staff. The Delta ISB will discuss symposium planning at its monthly public meetings and will take public comments on format and potential speakers into consideration. In addition, this prospectus was circulated for public comment via the Delta Stewardship Council listserv and other mailing lists. The Delta ISB will also conduct scoping discussions with the community to help inform the scope.

For the prospectus, the Delta ISB received the following public comments:

- Lucy Andrews (received 10/29/24)
- Richard Norgaard (received 10/31/24)
- Todd Plain (received 11/14/24)
- California Department of Water Resources (received 11/14/24)
- Denise Colombano (received 11/14/24)
- Gonzalo Castillo (received 11/19/24)
- Morgan Chow (received 11/19/24)
- Delta Conservancy (received 11/20/24)
- Lisamarie Windham-Myers (received 11/27/24)
- California Water Research (received 12/4/24)

A common theme based off the public comments was the importance of focusing on how climate change affects human communities in the Delta, including farmers, landowners, and Tribes. The comments include a suggestion to include socioecological perspectives in examining direct and indirect climate stressors and hazards. Several commenters also highlighted the need to address how climate projections interact with other factors, such as management decisions. The Delta ISB will consider these public comments as it plans the symposium.

Expected Products and Outcomes:

The goal of the symposium is to stay current and increase understanding among Delta ISB members, researchers, practitioners, and affected parties about the latest climate science. Prior to the symposium, the Delta ISB, based on select documents, may release a brief summary of what is known on climate projections, existing research and modeling efforts relevant to its goals.

After the symposium, the Delta ISB's current plan is to prepare a summary/ memorandum about the symposium that highlights the key takeaways, including key sources of uncertainties related to climate hazards and stressors, and how existing efforts to address climate change align with the latest research in the field.

The Delta ISB will contact Maven's Notebook to see if it can prepare a proceedings report. Based on the event, the Delta ISB may consider drafting a perspective manuscript for publication in a peer reviewed journal or other publication.

Timeframe:

The symposium will take place in fall 2025.

Target Date	Benchmark
October 2024	Release draft prospectus for public comments, and request for ideas for speakers
January 2025	Finalize prospectus to address public comments. Revise final prospectus as needed.
February to April 2025	Conduct scoping discussions on the symposium
Summer 2025	Finish agenda and open registration Consider releasing a summary of select documents to inform discussion at the symposium

Target Date	Benchmark
Fall 2025	Host symposium
Winter 2025	Prepare and release summary/memorandum
Throughout 2026	Prepare manuscript for peer review publication

Related Reviews and Events:

As previously mentioned, the symposium will build on the Delta ISB's DMDU review, which the Delta ISB will complete as it plans for the symposium. Extensive work has been conducted on the topic of climate change, such as reports produced by the International Panel on Climate Change (IPCC). We will coordinate with the following activities occurring in the region and may prepare a brief summary of select documents to help inform symposium discussion:

- The Spring and Summer 2025 special edition of the State of Bay Delta Science, facilitated by the Delta Science Program, that synthesizes relevant information for management in the region, which will focus on "Extreme Events."

- California's Climate Change Assessment, which provides scientific information at the local and State scale to inform policy, plans, and programs to promote resilience in the face of climate change. The upcoming Fifth assessment will include: 1) Regional Synthesis Reports that cover key Delta issues, and 2) the Vulnerable Communities Platform that provides Delta-specific information on sea level rise, flooding, heat, drought, and wildfire.

- the Interagency Ecological Program Climate Change Project Work Team, which synthesizes relevant science and develops conceptual models for understanding the effects of climate change on the aquatic resources of the upper San Francisco Estuary.

- The Delta Stewardship Council's climate initiative known as Delta Adapts, which consists of two parts: (1) a Climate Change Vulnerability Assessment for the Delta and Suisun Marsh, and (2) an Adaptation Plan (formerly referred to as the Adaptation Strategy) detailing strategies and actions to adapt and respond to the identified vulnerabilities. The Delta ISB reviewed the draft Adaptation Plan that was released for public comment. The strategies and actions noted in this plan highlight the data and science needs for making adaptation in the region a reality. This draft plan answers the second question that the Delta ISB has been exploring, which is how organizations currently, and hope to, use climate change in their decision-making. The Adaptation Plan will be finalized in summer 2025.

- The State of California Sea Level Rise Guidance: 2024 Science and Policy Update, developed and adopted by the Ocean Protection Council (OPC). It provides updated scenarios and policy recommendations tailored to California's coastline.

- The California Department of Water Resources' (DWR) Climate Action Plan, which is the Department's guide to addressing climate change in the programs, projects, and activities over which it has authority.
    - Phase I: Greenhouse Gas Emissions Reduction Plan (Update 2023) lays out DWR's greenhouse gas emissions reduction targets and the strategies to achieve these goals. To reflect the latest reduction targets and associated state regulations, an update (with supporting documents) has been prepared, highlighting the latest actions and policies to meet both near-term and long-term emissions reduction goals.
    - Phase II: Climate Change Analysis Guidance develops a framework and guidance for consistent incorporation and alignment of analysis for climate change effects in DWR's project and program planning activities.
    - Phase III: Climate Change Vulnerability Assessment (VA) describes, evaluates, and quantifies the vulnerabilities of DWR's assets and business to potential climate change effects. The Phase III: Adaptation

Plan (AP) will help prioritize DWR resiliency efforts such as infrastructure improvements, enhanced maintenance and operation procedures, revised health and safety procedures, and improved habitat management.

- A Climate Action Plan for the California Department of Water Resources, published in the Journal of American Water Works Association (JAWWA), recounts the significant drivers, lessons learned, and the road ahead for the Department's three-phased Climate Action Plan.

In addition, this symposium will be informed by previous work that has occurred in the Delta region. This includes, but is not limited to the:

- 2024 report titled, Priorities for California's Water: Are we ready for climate change? produced by the Public Policy Institute of California Water Policy Center. Climate change, forest fires and wildfires, and water supply and drought are import environmental issues facing the state. This report recommends that sectors consider adaptation pathways that increase funding and community involvement in decision making to help California increase resiliency to the effects of projected climate shifts. The report outlines risks, climate effects, and adaptation measures for key water uses and challenges in the state, along with identifying gaps and future directions.

- 2023 symposium titled, Implications of Rising Temperatures: Coastal, Marine and Estuarine Ecosystems, organized by UC Davis Coastal and Marine Sciences Institute and the Delta Science Program. This symposium brought together researchers from the natural and social sciences to discuss the state of research on the influence of extreme heat on organisms, communities, and socio-ecological systems.

- 2022 Adapting Restoration for a Changing Climate Symposium: This symposium, organized by the Delta Science Program, explored how restoration projects are incorporating climate change considerations into their planning and implementation in the San Francisco Estuary.

- 2022 IEP Technical Report 99 titled, Climate Change MAST (Climate Change - Management, Analysis and Synthesis Team) completed by the IEP Climate Change Project Work Team. This report uses a conceptual model to synthesizes data and studies related to the effect of climate change on the ecosystems and biota of the upper San Francisco Estuary. The ecological trends connected with climate change and the likely future effects are explored for three habitats: floodplain, tidal marsh, and open water, along with key consideration for management decisions in each.

- 2022 literature review article, Climate Change Impacts on San Francisco Estuary Aquatic Ecosystems: A Review by authors Herbold et al. and a product of the IEP Climate Change Project Work Team. This review synthesizes current and potential climate change effects on floodplain, tidal marsh, and open water ecosystems and on two native fish species, concluding that the estuary is experiencing shifts in baseline conditions, amplification of extremes, and changes in physical habitat and biological communities. The authors posit that fundamental changes in management are needed to adapt to climate change.

- 2016 State of Bay Delta Science: Climate Change and the Delta. This synthesis summarizes the current state of climate change science as it applies to the restoration and sustainability of the Delta environment, facilities, and ecosystems.

This symposium can help inform future updates to Delta policies, such as:

- The 2027 update to the Delta Conservancy's Climate Change Policy that was adopted in 2017. This document outlines the Delta Conservancy's 2017 policy on climate change adaptation and mitigation in the Sacramento-San Joaquin Delta. The policy emphasizes collaboration with various parties to build resilience to climate effects like flooding and drought, prioritizing projects that benefit both the environment and the regional economy. Specific strategies include wetland restoration to sequester carbon, improved levee maintenance, and the implementation of adaptive management plans.

Additional references to inform symposium scope and content:

- Missing eddy feedback may explain weak signal-to-noise ratios in climate predictions. https://www.nature.com/articles/s41612-022-00280-4
- The Effect of Physically Based Ice Radiative Processes on Greenland Ice Sheet Albedo and Surface Mass Balance in E3SM. https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2023JD040241
- Missing Climate Feedbacks in Fire Models: Limitations and Uncertainties in Fuel Loadings and the Role of Decomposition in Fine Fuel Accumulation https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2021MS002818
- Climate Models Underestimate Dynamic Cloud Feedbacks in the Tropics. https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2023GL104573
- The missing risks of climate change https://www.nature.com/articles/s41586-022-05243-6
- What Are Climate Models Missing? https://www.science.org/doi/10.1126/science.1237554
- Warming in the upper San Francisco Estuary: Patterns of water temperature change from five decades of data https://aslopubs.onlinelibrary.wiley.com/doi/full/10.1002/lno.12057
- Corridors of Clarity: Four Principles to Overcome Uncertainty Paralysis in the Anthropocene
    - https://academic.oup.com/bioscience/article/70/12/1139/5936130

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EPA. Climate Change Impacts on Coasts. Environmental Protection Agency. Accessed on August 16, 2024 at https://www.epa.gov/climateimpacts/climate-change-impacts-coasts

Huang, X. & Swain, D. 2022. Climate change is increasing the risk of a California megaflood. Science Advances. Vol 8, 32. DOI: 10.1126/sciadv.abq0995

Shi, H., Garcia-Reyes, M., Jacox, M., Rykaczewski, R., Black, B., Bograd, S., Sydeman, W. (2021). Co-occurrence of California Drought and Northeast Pacific Marine Heatwaves Under Climate Change. Geophysical Research Letters. Vol 48-17. https://doi.org/10.1029/2021GL092765