INFORMATION ITEM

Lead Scientist Report

Summary

In California, El Niño and La Niña events are typically associated with wet and dry conditions, respectively, with the recent drought associated with a strong La Niña event. However, these climate patterns have been challenging to predict, giving water managers little advance warning for drought. In the spotlighted article, Fasullo and team demonstrate that the La Niña conditions that led to the 2020-2022 drought were likely triggered by intense wildfires in Australia in 2019-2020. Their work argues for better representation of wildfires in climate models and charts a course for providing more advance warning to California water managers of impending drought.

A multiyear tropical Pacific cooling response to recent Australian wildfires in CESM2

Fasullo, John T., Nan Rosenbloom, and Rebecca Buchholz. 2023. A multiyear tropical Pacific cooling response to recent Australian wildfires in CESM 2. *Science Advances* 9, eadg1213.

El Niño and La Niña are part of a natural climatic cycle, characterized by opposing patterns of cool and warm temperatures in the eastern and western Pacific that drive distinct patterns of atmospheric circulation. Typically, El Niño conditions, such as those forecast for the upcoming water year, bring wet conditions to California, whereas La Niña conditions tend to be associated with dry conditions. El Niño and La Niña are generally understood to be driven by natural and randomly occurring processes internal to the climate system—that is, they are not thought to be

strongly influenced by climate change or other human activity. And because they are often triggered by random fluctuations (e.g., in air or ocean temperature, circulation), they cannot be well forecasted more than a year in advance, giving water managers little time to prepare for hydrologic extremes. The strong La Niña event associated with California's 2020-2022 drought was even more challenging to anticipate than is typical. Unlike most La Niña events, it was not preceded by an El Niño, and the distinctive pattern of ocean temperatures that indicates a developing La Niña did not emerge until much later in the year than is typical.

There is one known exception to internal mechanisms dominating the El Niño/La Niña cycle: volcanic eruptions in the southern hemisphere. Volcanic eruptions emit large amounts of aerosols that contribute to more clouds in the southern hemisphere and cooling of southern oceans, with cascading impacts to ocean temperatures in the Pacific. Recognizing that wildfires, like volcanic eruptions, can contribute large loads of aerosols to the atmosphere, Fasullo and team developed and tested a hypothesis that the 2019-2020 wildfire season in Australia triggered the La Niña conditions that precipitated the 2020-2022 California drought. The hypothesis was grounded in the observation that aerosols in the southern hemisphere at the end of the fire season were four times the typical amount.

To test their hypothesis, the researchers used a new Earth system model (the National Center for Atmospheric Research's Community Earth System Model version 2) that simulates several important aerosol processes that are not included in other Earth system models. They compared a set of "control" runs characterized by typical levels of aerosols with a set of "fire" runs in which aerosol inputs matched those measured by satellite during and following the 2019-2020 Australian fire season. They found that, relative to the control runs, the fire runs produced substantial ocean cooling capable of triggering La Niña. The cooling effect lasted for two years, commensurate with the 2020-2022 California drought.

With climate change, wildfires are projected to become more severe globally and may contribute to future drought in California. Though a challenge for water management, these future droughts may be more predictable, thanks to the results of this study and the new generation of Earth system models capable of simulating aerosol dynamics. These models, however, do not explicitly simulate wildfires. Thus, more model development is needed to evaluate how the likelihood of fire-

induced La Niña and California drought conditions will change over longer time periods and under different emissions scenarios.

This paper is relevant to the 2022-2026 Science Action Agenda's Management Need 6: Assess and anticipate impacts of climate change and extreme events to support successful adaptation strategies.

Delta Science Program Activities

Delta Science Program independent review panels

The Delta Science Program (DSP) advances its mission to provide the best possible scientific information to inform water and environmental decision-making in the Delta through multiple means, including by convening independent peer review panels to evaluate scientific and technical programs, plans, and products. The DSP is currently in the process of facilitating three independent scientific peer reviews: one for the Department of Water Resources (DWR) and two for the US Bureau of Reclamation (Reclamation), detailed below. Review materials and panel member bios are posted on the Council's peer review webpage (https://deltacouncil.ca.gov/delta-science-program/scientific-peer-review).

Review of the State Water Project-Delivery Capacity Report

DWR manages the State Water Project (SWP), a multi-purpose water storage and delivery system that delivers water across California for residential, agriculture, municipal, and industrial uses and controls Delta inflows and exports from the Delta. To provide essential information about the current and projected future water supply reliability, DWR issues a Delivery Capacity Report (DCR) every two years. The DCR is used extensively by SWP contractors and others to plan their water uses. DWR has requested that DSP convene an independent peer review of recent updates to the DCR development process.

The two-part review will evaluate two major changes to the data and methods used to model climate change-related conditions for the next DCR, due in December 2023. The first part of the DCR review will evaluate the strategy for adjusting how the model uses historical hydrologic data in order to account for non-stationarity due to a changing climate. The second part will evaluate the use of risk-informed climate change scenarios to model future performance of the SWP system. For

each part, a panel of three subject matter experts will review the data, models, and methods used to prepare the 2023 DCR. Each reviewer will prepare an individual review letter for each part of the review. Review work will occur during summer 2023, and review letters are expected to be available in fall 2023.

Water Temperature Modeling Platform Peer Review Panel

The Central Valley Project (CVP), owned and operated by Reclamation, extends approximately 400 miles across California from the Cascade Range in the north to the Kern River in the south. The CVP has 20 dams and reservoirs that can store nearly 12 million acre-feet of water, more than 500 miles of major canals and natural channels for water conveyance, and 11 hydroelectric powerplants that generate about 5.6 billion kilowatt hours of clean energy. As with the SWP, operation of CVP reservoirs governs Delta inflows and exports from the Delta and is a critical tool in meeting the water supply reliability goal of the Delta Reform Act.

Temperature management is a key parameter for protection of species with specific cold-water needs and is one of the most complex subjects related to CVP operation. Reclamation has developed a Water Temperature Modeling Platform (WTMP), which comprises a set of modeling tools to assist resource managers of major CVP reservoirs with balancing water resources for downstream uses and temperature needs. An important element in developing the temperature model framework for the CVP is putting in place model development guidelines and quality control actions to ensure the final models are effective and representative.

An independent review Panel with five members from various backgrounds is reviewing the temperature models, model framework, and implementation of the WTMP Project. A public meeting for a mid-term review occurred July 2022, with a report to Reclamation in September 2022 (accessible at https://deltacouncil.ca.gov/pdf/science-program/review-materials/2022-10-21-water-temperature-modeling-platform-mid-term-review-final-report.pdf). Reclamation has integrated the review's recommendations into the completion of the WTMP, and a final review will occur at a public meeting in September 2023, with the final report due October 2023. The final review covers application of the WTMP to a different set of tributaries within the CVP system than those covered by the mid-term review.

Review of Fish and Aquatic Effects Analysis

Reclamation reinitiated Endangered Species Act (ESA) Section 7 consultation for the long-term operations (LTO) of the CVP and SWP based on anticipated modifications to the LTO which may cause effects to ESA-listed species or designated critical habitats not analyzed in the current U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) Biological Opinions. The Fish and Aquatic Effects Analysis is a portion of the Environmental Impact Statement, a report mandated by the National Environmental Policy Act, that is being developed by Reclamation for the LTO of the CVP and SWP. The analyses inform a Biological Assessment, which USFWS and NMFS will then evaluate to determine whether the modifications to the LTO will jeopardize listed species and hence whether the proposed modifications are acceptable under federal law.

The intent of this review is to evaluate the approach and methods adopted by Reclamation to assess how the LTO affect the aquatic environment and the exposure, response, and risk to select ESA-listed species. The review panel consists of five experts who will review the project's materials and produce a Panel Letter Review of the Fish and Aquatic Effects Analysis. The review process is anticipated to start in early fall, with the letter review to be available in late 2023.

2023 Adaptive Management Forum

On May 4th, the Delta Science Program hosted the first day of the 2023 Adaptive Management Forum. The event featured a storytelling session, a keynote presentation, and a series of panel discussions exploring governance needs and barriers as they relate to adaptation in the Delta. These sessions and conversations highlighted important issues related to governance in the Delta including tribal representation, environmental justice, regulatory limitations, and equity. The recording is available at https://www.youtube.com/watch?v=UtNQApr8VbM

A follow-up workshop will be held on Tuesday, June 27th from 1-5pm. This workshop will be based around breakout groups in which participants build on the themes identified during the May 4th forum. Participants will work together to identify barriers, opportunities, and visions for collaborative solutions to create more inclusive and equitable adaptation processes in the Delta. The workshop will

be hybrid, with the in-person component being held at the California Natural Resources Agency Building at 715 P St., Sacramento. Registration details are available on the Council's website.

Decision-making Under Deep Uncertainty Seminar Series

The Delta Independent Science Board (ISB), with support from the Delta Science Program, is hosting a seminar series to explore concepts from decision-making under deep uncertainty and present tools that can help managers and stakeholders evaluate and plan for a wide range of plausible futures in the Sacramento-San Joaquin Delta. This seminar series will help inform the Delta ISB's decision-making under deep uncertainty review. Experts will speak on sources of and approaches for managing uncertainties and incorporating human behavior in anticipatory planning efforts.

The series began on April 26 with guest speaker Alice Hill, the David M. Rubenstein senior fellow for energy and the environment at the Council on Foreign Relations, who provided an overview of the challenges and benefits of planning for extreme events, as well as effective ways to organize government entities around these issues. In the series' second seminar on June 14, Robert Lempert, principal researcher at the RAND Corporation and director of the Frederick S. Pardee Center for Longer Range Global Policy and the Future Human Condition, presented examples of successful applications of tools for decision-making under deep uncertainty, and Andrew Schwarz, the State Water Project climate action coordinator for the CA Department of Water Resources, presented on his department's use of decision-making under deep uncertainty.

The April seminar recording can be watched via this link (https://www.youtube.com/watch?v=COB-As2SDeA), and the June seminar recording will be available online soon. More seminar dates and speakers will be announced throughout the year.

By the Numbers

Science Program staff will summarize current numbers related to Delta water and environmental management. The summary (Attachment 1) will inform the Council

of recent counts, measurements, and monitoring figures driving water and environmental management issues.

List of Attachments

Attachment 1: By the Numbers

Attachment 2: Visual Summary of Wildfires Article

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