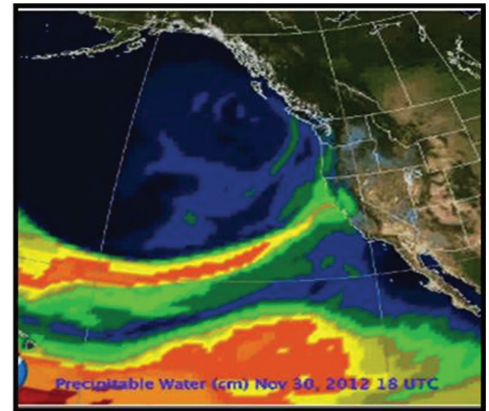


Improving Reliability for Droughts and Floods: Forecast-Informed Reservoir Operations (FIRO)

PROJECT PARTNERS



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BACKGROUND

Created in 1958 by the Coyote Valley Dam on the East Fork of the Russian River in Mendocino County, California, Lake Mendocino provides flood control, water supply, recreation and stream flow regulation. The U.S. Army Corps of Engineers (Corps) operates the dam in accordance with the Lake Mendocino Water Control Manual (Manual). Sonoma County Water Agency is the local partner that manages water stored in Lake Mendocino for water supply.

The Manual specifies elevations for an upper volume of reservoir storage that must be kept available for capturing storm runoff and reducing flood risk and a lower volume of storage that may be used for water supply. During a flood event, runoff is captured by the reservoir and released soon after to create storage space for the next potential storm. The Manual is based on typical historical weather patterns— wet during the winter, dry otherwise.

THE CHALLENGE

The Manual utilizes estimates of flood potential to establish reservoir storage and release requirements. It does not account for changing conditions in the watershed—for example, increased variation in dry and wet weather patterns and reductions to imported flows into the Lake that have occurred since 1986. Also, the Manual's reservoir operations procedures were developed decades ago, without the benefit of current science that more accurately predicts weather and streamflow.

Given reduced supplies, changed hydrologic conditions, and technological advances, some adjustments to the current reservoir operating procedures may be possible to optimize the goals of maintaining flood control while bolstering water supply reliability for downstream users and the environment (e.g., to support recovery of endangered and threatened fish). Modern observation and prediction technology provide opportunities to reduce flood risk by supporting decisions of greater reservoir level drawdown in advance of storms, or to improve supply reliability by permitting more storm runoff to be retained for water supply while preserving flood risk reduction objectives.

For example, following an atmospheric river-type storm in December 2012, water was released to create flood space according to the Manual, dropping reservoir levels by more than 35%. 2013 was the driest year on record, resulting in little inflow to refill the reservoir. By December 2013 lake levels were extremely low and remained low through 2014. Ideally, water from the December 2012 event could have been retained based on a longer-term precipitation forecasts, lessening the impact of drought.

THE POTENTIAL SOLUTION

An interagency Steering Committee, consisting of state and federal agencies, the Center for Western Water and Weather Extremes (CW3E) at UC San Diego and Sonoma Water Agency, was formed to explore methods for better balancing flood control and water supply needs. The committee has developed a draft Lake Mendocino FIRO Hydrologic engineering management plan (HEMP) to evaluate of water control plan alternatives for a Final Viability Assessment (FVA). These reports describe an approach for using modeling, forecasting tools and improved information to assess whether deviations from the Lake Mendocino Water Control Manual can reduce flood risk while enhancing water supply and achieving additional ecosystem benefits. Implementation of the Lake Mendocino FIRO pilot project is being used to demonstrate how improved forecast information can aid the decisions made by the U.S. Army Corps of Engineers and other water resource managers to balance flood and drought risks, maximize reservoir storage potential and flood control, while minimizing conflict among competing water users.

FIRO is a management strategy that uses data from watershed monitoring and modern weather and water forecasting to help water managers selectively retain or release water from reservoirs in a manner that reflects current and forecasted conditions. FIRO's utilization of modern technology can optimize the use of limited resources and represents a viable climate change adaptation strategy. The Lake Mendocino FIRO pilot project is envisioned as a model that can be tailored to the management of other reservoirs.

Tangible benefits include:

- *Improve Supply Reliability for Downstream Uses* — When storms cause moderate-to-high reservoir levels, normal operation is to release water to re-establish flood control space. With FIRO, some of that water would be retained for future supply as long as no major precipitation is predicted for several days and it can be demonstrated that the retained water can be released past downstream flood prone areas before the arrival of the next storm.

This strategy permits earlier supply storage in some years, improving summer season supply reliability for downstream water users and improving the timing and volume of releases to protect water quality and provide flows needed for recovery of fish populations.

- *Enhance Flood Risk Reduction* — When a storm is predicted to cause flooding, normal operations call for release of reservoir water and drawdown of water levels. With FIRO, release decisions would consider weather observations and predictions, which, in some cases, would indicate greater drawdown for flood risk reduction so long as there is confidence that the amount of precipitation and runoff will restore reservoir levels for water supply after the storm.

NOAA'S CONTRIBUTIONS

NOAA is working with FIRO partners to maximize the use of NOAA products and services to more effectively balance flood and drought risks in the Russian River Basin. NOAA supports FIRO through participation in the NOAA Habitat Blueprint (habitat.noaa.gov/habitatblueprint), the National Integrated Drought Information System (NIDIS; drought.gov), the NOAA Hydrometeorology Testbed (HMT; hmt.noaa.gov), and the National Water Center (water.noaa.gov).

Actionable science being developed by NOAA includes:

- Hydrologic Ensemble Forecast Service (HEFS) as the foundational input for the implementation of FIRO at Lake Mendocino
- Targeted observations and monitoring to improve understanding of extreme precipitation behavior, impacts, prediction and flood risk.
- Experimental hydrometeorological modeling and probabilistic forecasts at the appropriate spatial and temporal scales to inform reservoir operations.
- Identification of additional watersheds with environmental flow requirements related to NOAA stewardship mission to conserve and manage coastal and marine ecosystems and resources.
- Enhanced reliability and skill of extended weather forecasts and subseasonal outlooks for atmospheric rivers and probability of extreme precipitation events with the full implementation of near-term improvements to the NOAA Unified Forecast System (UFS).
- Improved forecasting of extreme precipitation with the establishment of the Earth Prediction Innovation Center (EPIC) as a catalyst to accelerate the incorporation of weather forecast modeling advances from across academic, private and federal research community into NOAA operational model forecast systems.