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

PROJECT PARTNERS

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SCRIPPS INSTITUTION OF OCEANOGRAPHY UCSD
NOAA
USGS science for a changing world
US Army Corps of Engineers® San Francisco District
U.S. DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION
Integrated Water Resources Science and Services SUMMIT TO SEA
DEPARTMENT OF WATER RESOURCES STATE OF CALIFORNIA
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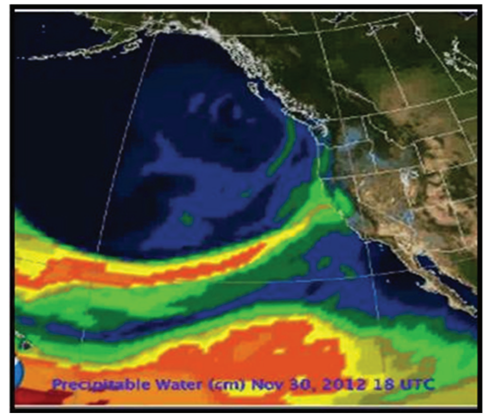

BACKGROUND

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. Sonoma County Water Agency is the local partner that manages water stored in Lake Mendocino for water supply.

The control 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 County Water Agency, was formed to explore methods for better balancing flood control and water supply needs. The committee, has developed a Lake Mendocino Forecast FIRO work plan that describes an approach for using modeling, forecasting tools and improved information to assess whether deviations from the Lake Mendocino Water Control Manual can maintain flood risk reduction while improving water supply and achieving additional ecosystem benefits. Implementation of the Lake Mendocino FIRO pilot project is anticipated to demonstrate ways in which improved weather forecasts can aid the decisions made by Army Corps and other water-resource managers to balance flood and drought risks, maximize reservoir-storage potential, and minimize 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 applied 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 could 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 will permit earlier supply capture 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:

- Observations and monitoring to improve understanding of extreme precipitation behavior, impacts, prediction and flood risk.
- Improved reliability and skill of extended weather forecasts for atmospheric rivers and for probability of extreme precipitation events.
- Operational and experimental hydrometeorological modeling and probabilistic forecasts at the appropriate spatial and temporal scales to inform reservoir operations.