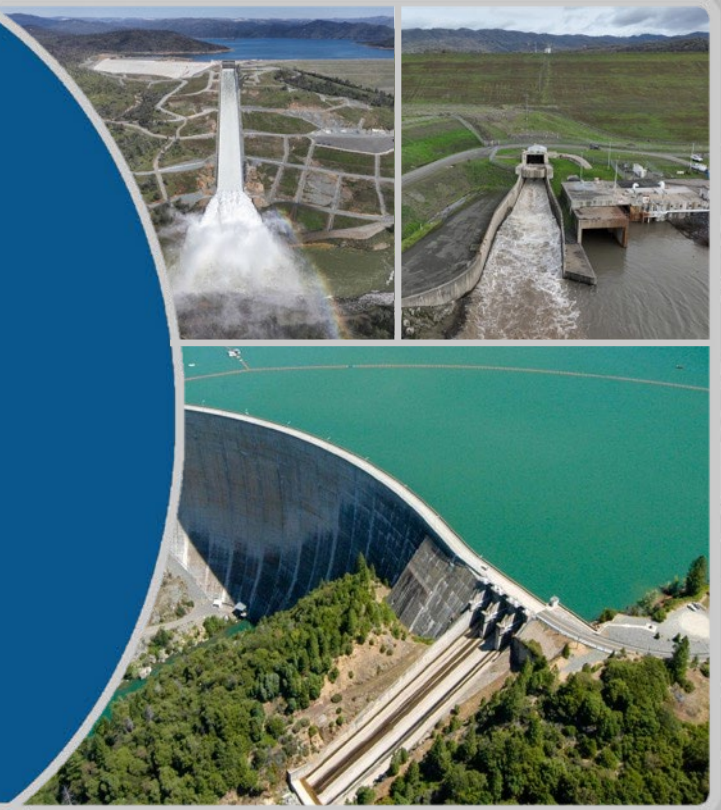
Importance of AR Recon Observations to Water Management Within the U.S. Army Corps of Engineers



Cary Talbot, PhD, PE
Forecast-Informed Reservoir Operations Program National Lead
Coastal and Hydraulics Laboratory
US Army Engineer Research and Development Center

AR Recon Workshop 2023
27 June 2023

US Army Corps of Engineers

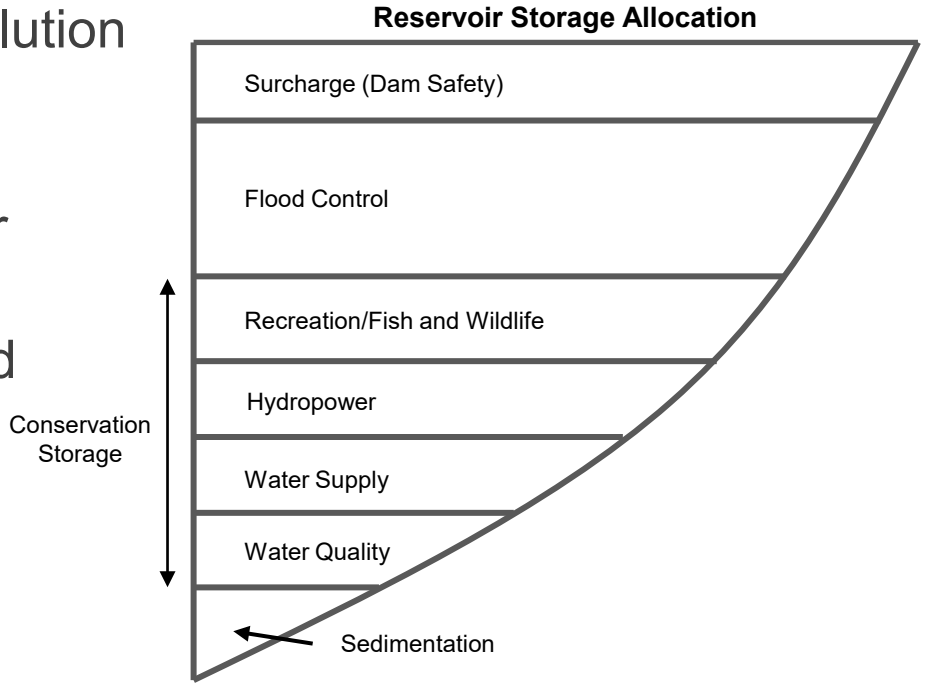
ERDC
ENGINEER RESEARCH & DEVELOPMENT CENTER

USACE Water Management Role

- US Army Corps of Engineers (USACE) is the flood risk management (FRM) agency within the US Government
- Part of USACE “Civil Works” mission that includes navigation, coastal shoreline, ecosystem restoration and wetlands regulation
- USACE owns and operates over 700 dams nationwide which have various authorized purposes including FRM, navigation, hydropower, recreation, water supply, etc.
- The FRM mission is a primary motivator for water management policy and regulation within the USACE

Reservoir Operations Overview

- Reservoirs are an engineering solution intended to address one or more issues
- Typically designed to meet one or multiple purposes
- How reservoir storage is allocated depends on:
  - Location
  - Size
  - Authorized purposes



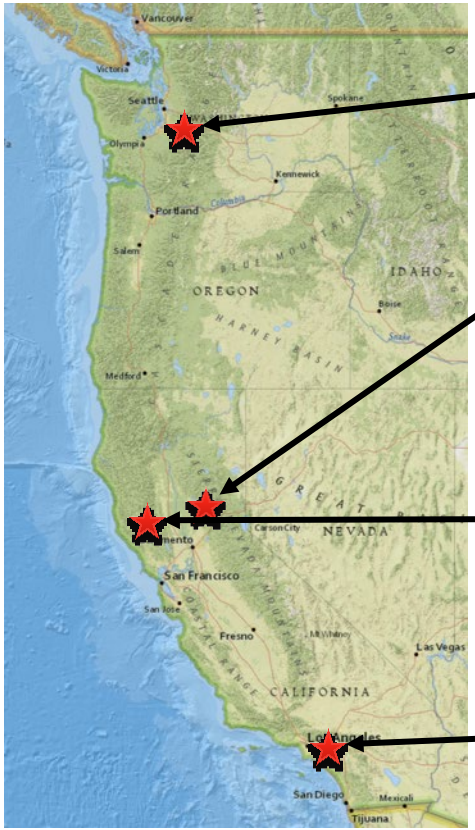
Forecasts in USACE Water Management

- For decades, official guidance dictated that USACE operates based on principle of “water on the ground”
- May 2016 update to Water Control Management regulation adds this sentence:
  - “Forecasted conditions may be used for planning future operations, but releases should follow the water control operations plan based on observed conditions within the watershed to the extent practicable.” *(emphasis added)*
- Policy change to *allow* Corps use of forecasts in water operations is in place, but doesn’t define how the change is to be implemented

Forecast Informed Reservoir Operations (FIRO)

- R&D effort to define how forecast information can be safely and effectively implemented officially in water control manual updates and practice
- FIRO viability assessed at candidate reservoirs through a careful, deliberate and collaborative process
  - FIRO pilot studies being conducted at pilot sites with a variety of watershed, reservoir volume, and atmospheric and hydrologic driving conditions
  - Results indicate 5-20% potential improvement in water availability where FIRO is shown to be viable

Current FIRO Pilot Project Locations



Howard Hanson Dam
Green River, Seattle District USACE

New Bullards Bar Dam
Yuba River, Yuba Water Agency
Oroville Dam
Feather River, CA Dept. of Water Resources
Sacramento District, USACE

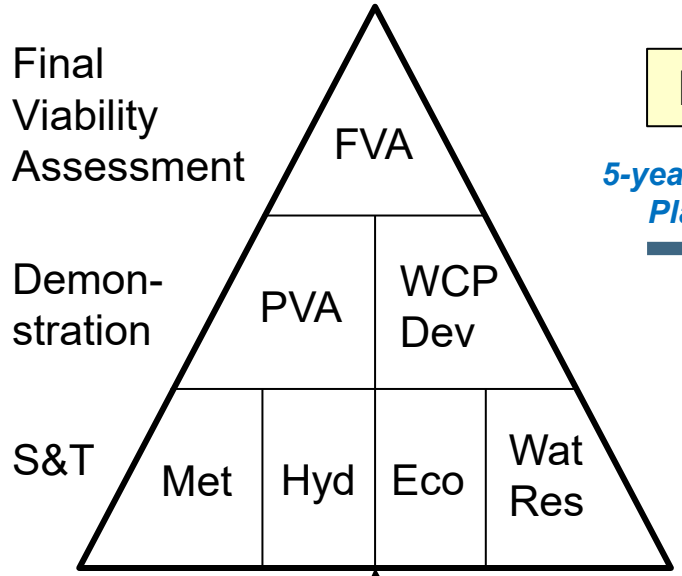
Lake Mendocino
Lake Sonoma (added in FY22)
Russian River, San Francisco District USACE

Prado Dam
Seven Oaks Dam (added in FY22)
Santa Ana River, Los Angeles District USACE

Collaboration is Key to FIRO Success

- FIRO pilots are led by interagency Steering Committees carefully formed with senior representatives from stakeholder agencies and academic partners
  - Blend of engineers and scientists from research, operations and regulatory perspectives
  - Each agency responsible for supporting their engagement

FIRO Viability Assessment Process



Interim

5-year Water Control Plan Deviation

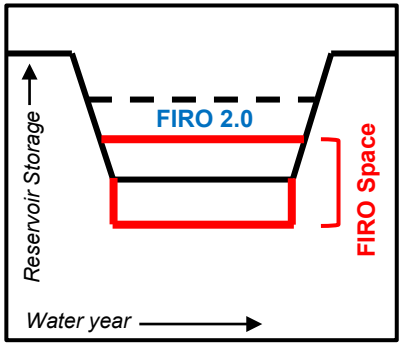
Meteorological Research	Hydrologic Research
Ecosystem Factors	Water Resources Ops

R&D Process

WCM Studies

Additional Technical Studies for WCM Update Process
Study 1
Study 2
etc…

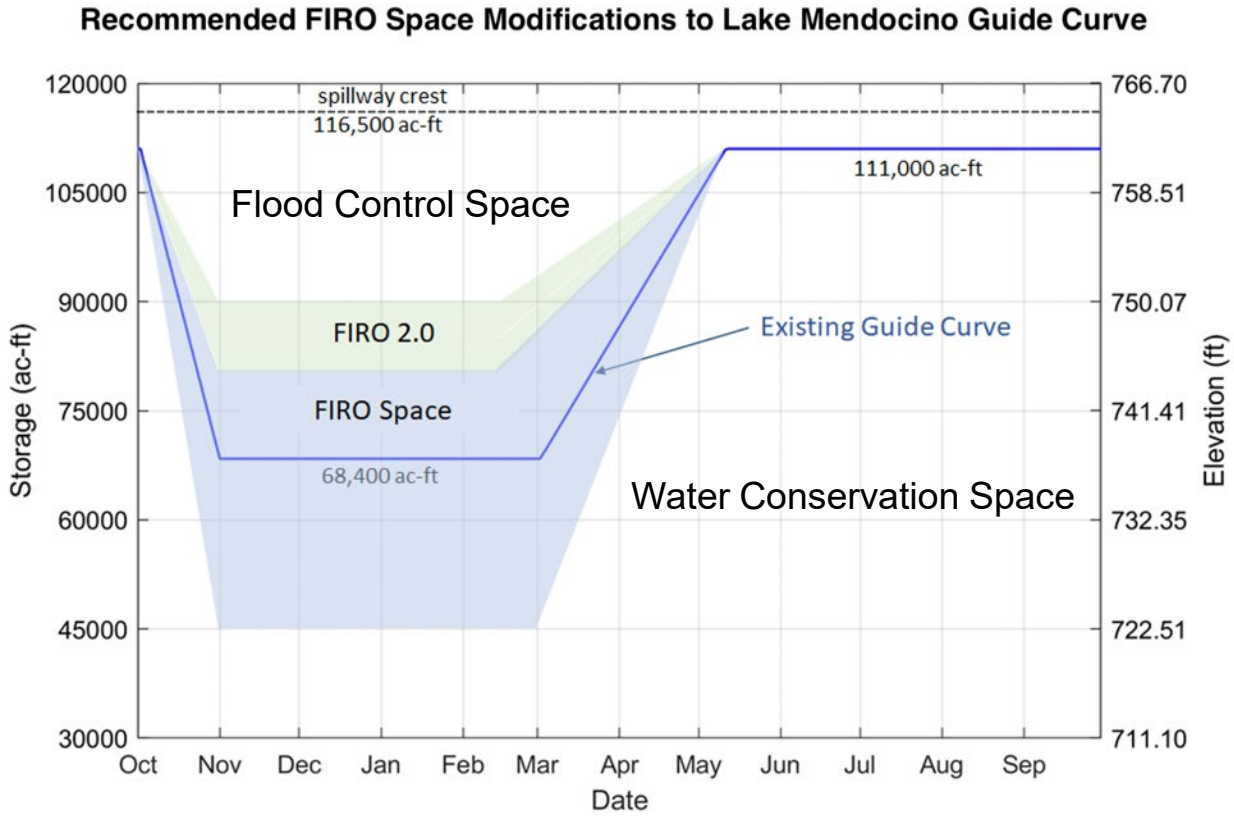
WCM Update



Operations Process

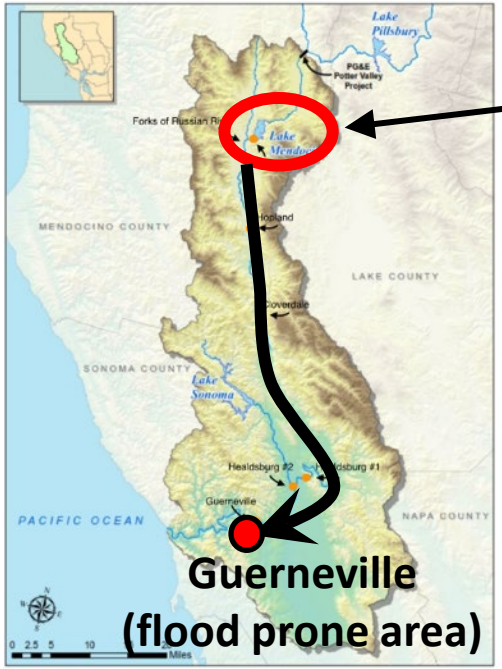
FIRO is based on a research and operations partnership that spans the entire assessment and WCM update process

FIRO = Flexibility for Water Managers



How much forecast lead time is required to enable FIRO on Lake Mendocino?

Lake Mendocino Release *Approximate* Travel Time



Lake Mendocino

Takes 1-3 days to flow 74 miles*

→ Guerneville → Ocean

Bottom Line

- Two days to release the extra water, plus
- 1-3 days to flow past flood-prone area downstream

➔ **Predictive skill is needed at 3-5 days lead-time for the storms that produce heavy rain and possible flooding**

Slide courtesy Marty Ralph, CW3E

*Based on information from Coyote Valley Dam and Lake Mendocino Water Control Manual (1986)

Lake Mendocino FIRO Benefits – WY 2020

3rd driest winter on record in Russian River watershed

10,825 ac-ft is enough water for ~22,000 homes for a year

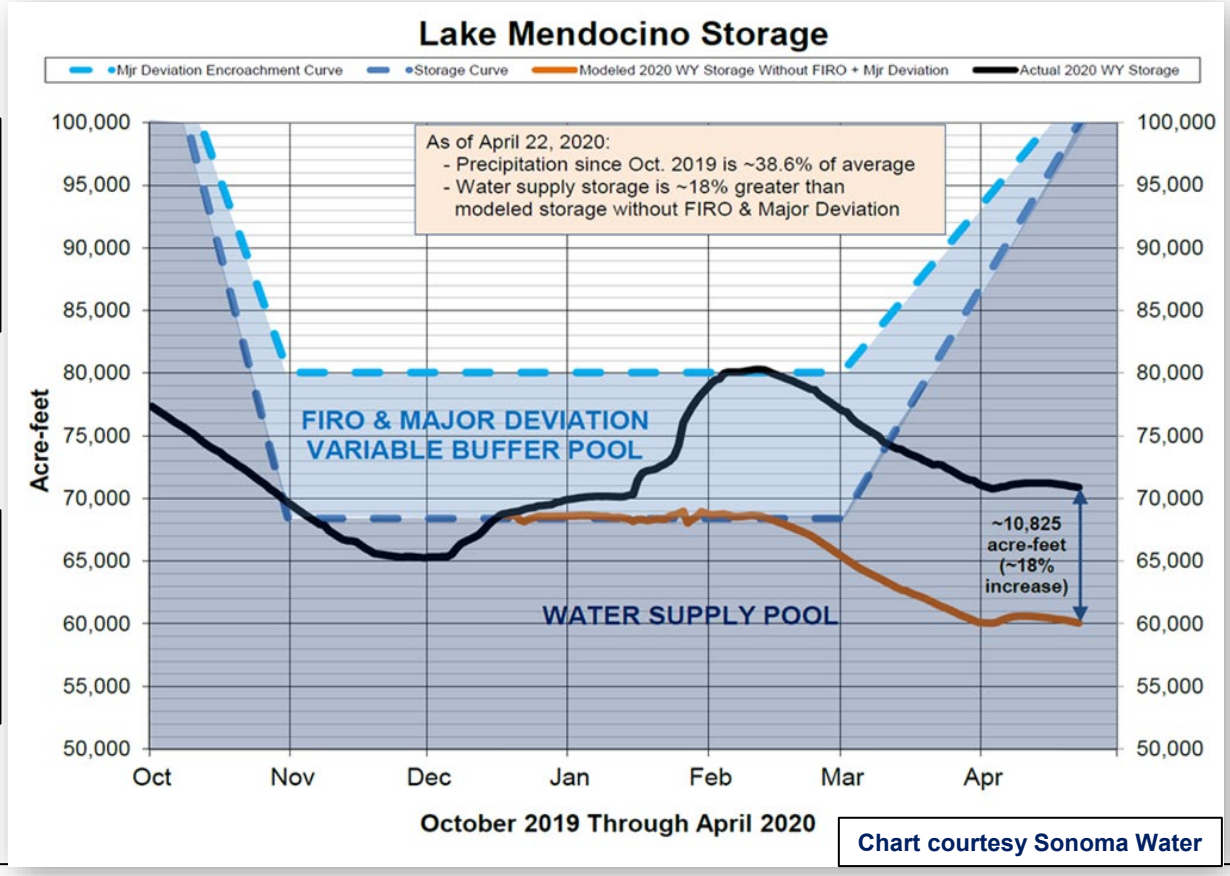
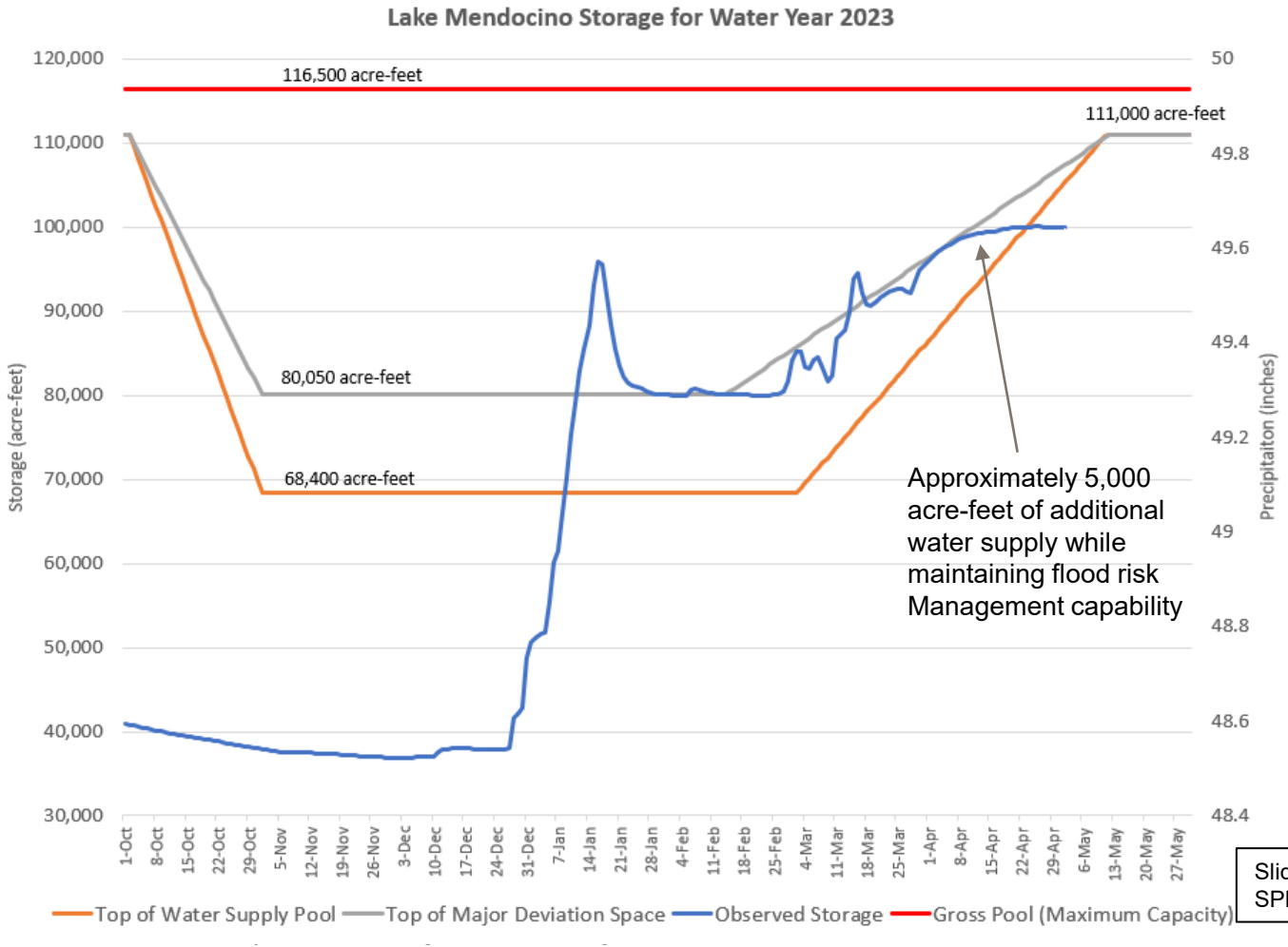


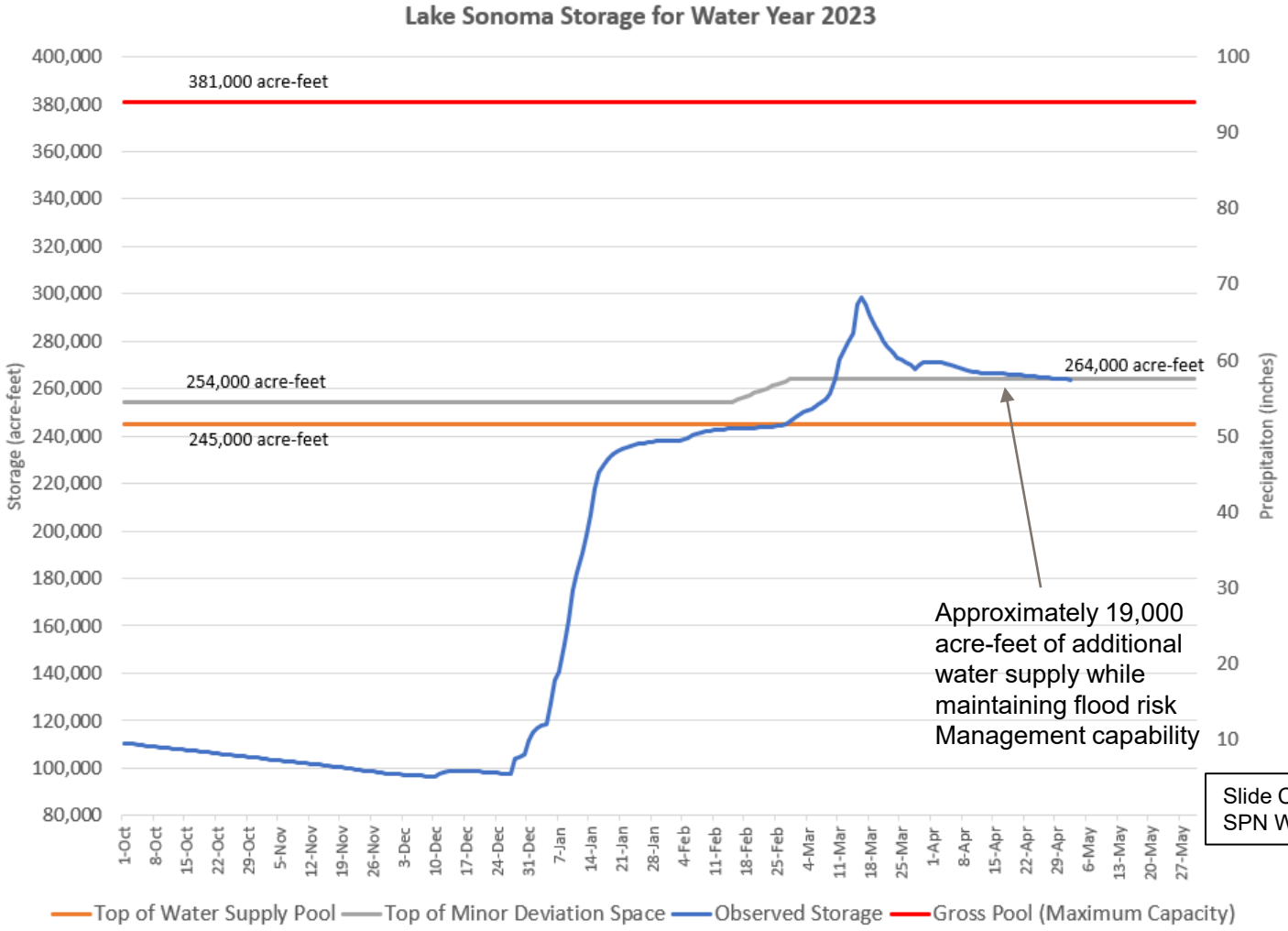
Chart courtesy Sonoma Water

Seeing the lake so full makes Kyle Farmer, a rancher in Potter Valley, happy every time he drives by it. “It’s a huge deal to become adaptive like that. I don’t think bureaucracies do that naturally,” he said. “It restored my faith in the government, obviously, a little bit.”

Drought or dangerous flooding? Research aims to tame atmospheric river risks — and save California’s rain
By Rachel Becker
www.CalMatters.org
25 February 2020



Slide Courtesy Patrick Sing
SPN Water Manager

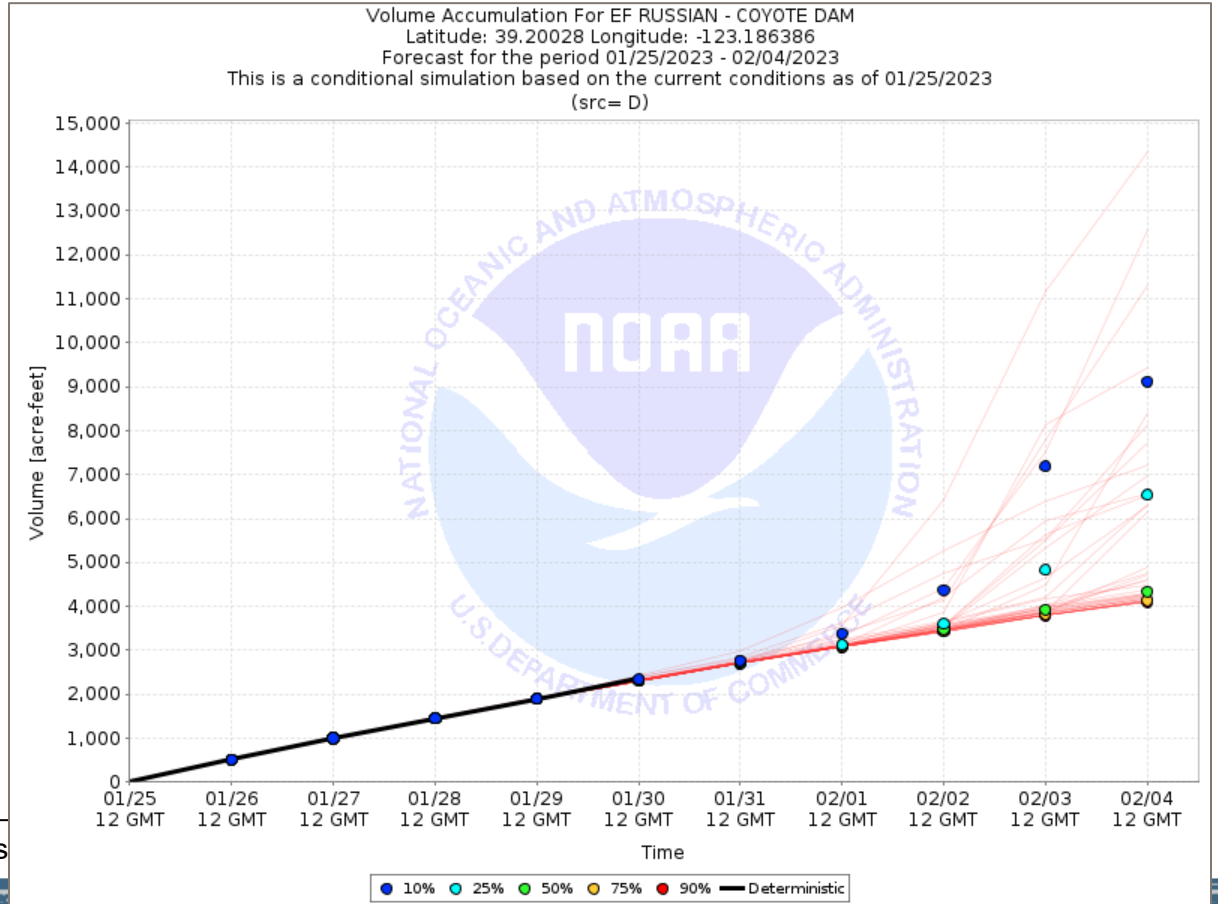


Slide Courtesy Patrick Sing
SPN Water Manager

Example of Dry Weather Forecasts to Inform Release Decisions in the Russian River Watershed

Quantitative assessment: Example of reservoir cumulative inflow volume forecast from 25 January 2023 for Lake Mendocino

No indication of potential significant inflow event

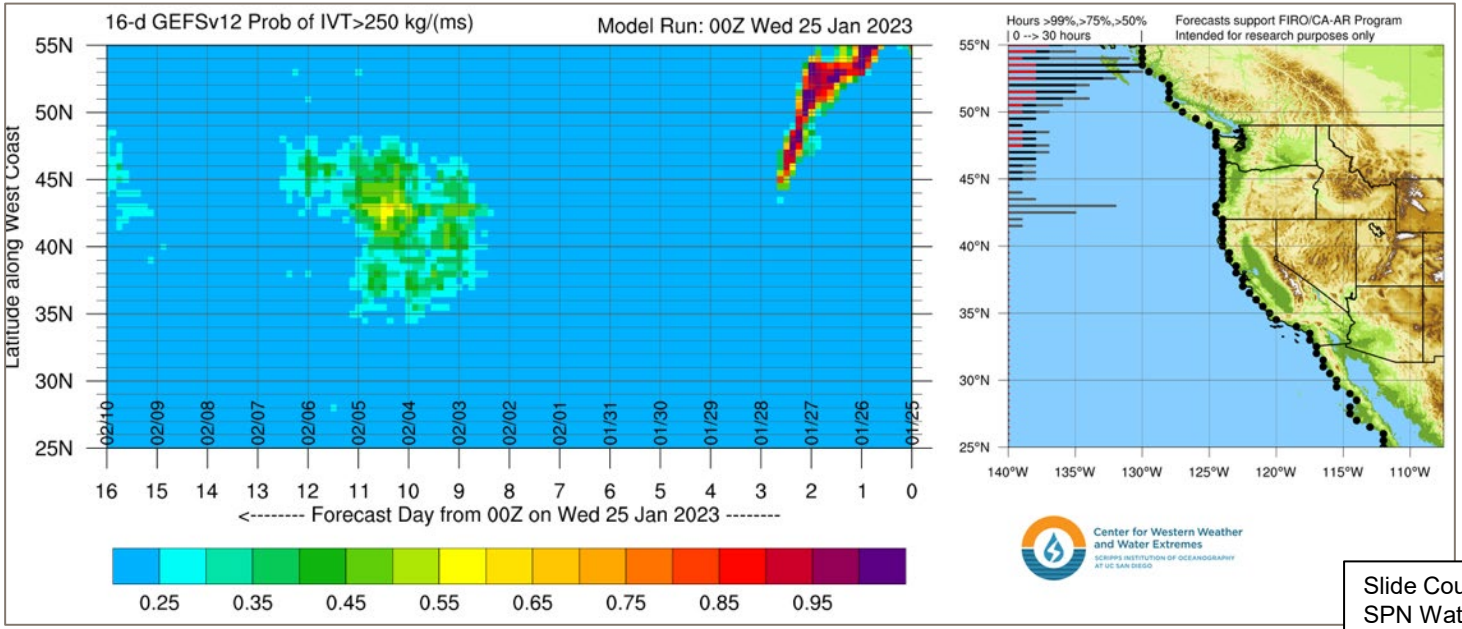


Slide Courtesy Patrick Sing
SPN Water Manager

Example of Dry Weather Forecasts to Inform Release Decisions in the Russian River Watershed

Qualitative assessment: Plot for 25 January 2023 of forecasted landfall of atmospheric rivers.

No strong indication of landfall of atmospheric rivers for most of the 16-day forecast period



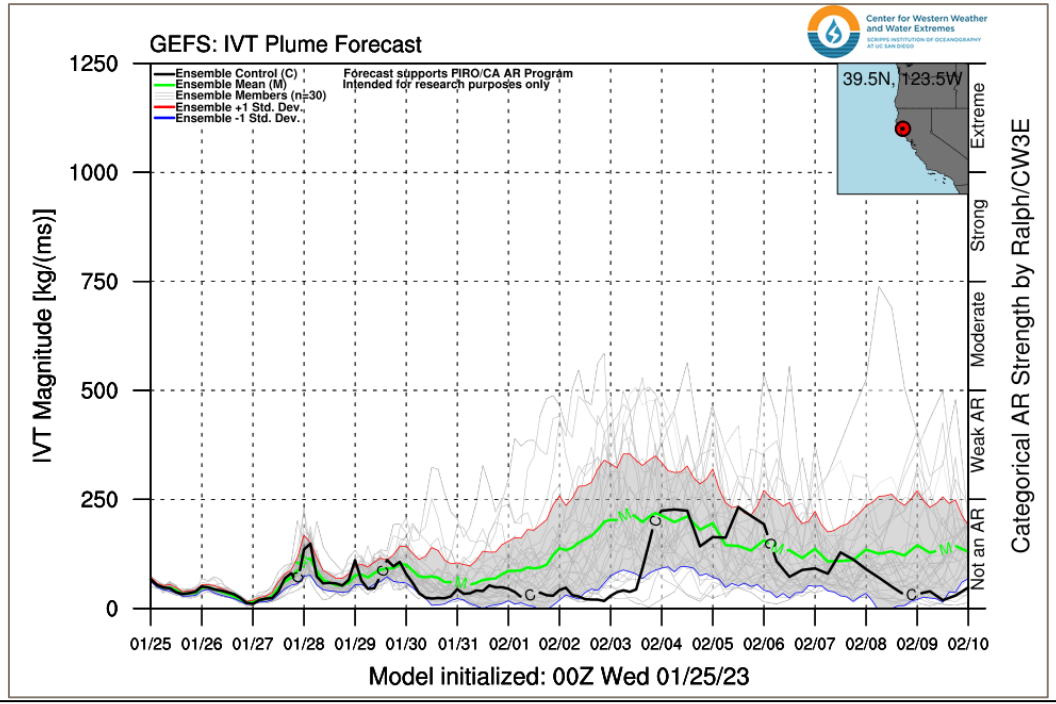
Slide Courtesy Patrick Sing
SPN Water Manager

Plot is forecasted probability of integrated vapor transport greater than 250 kg/m-s. Color is not related to intensity. More purple means greater probability.

Example of Dry Weather Forecasts to Inform Release Decisions in the Russian River Watershed

Qualitative assessment: Example plot of magnitude of integrated vapor transport for 25 January 2023.

No strong indication of atmospheric rivers for most of 16-day forecast period for the upper Russian River Valley



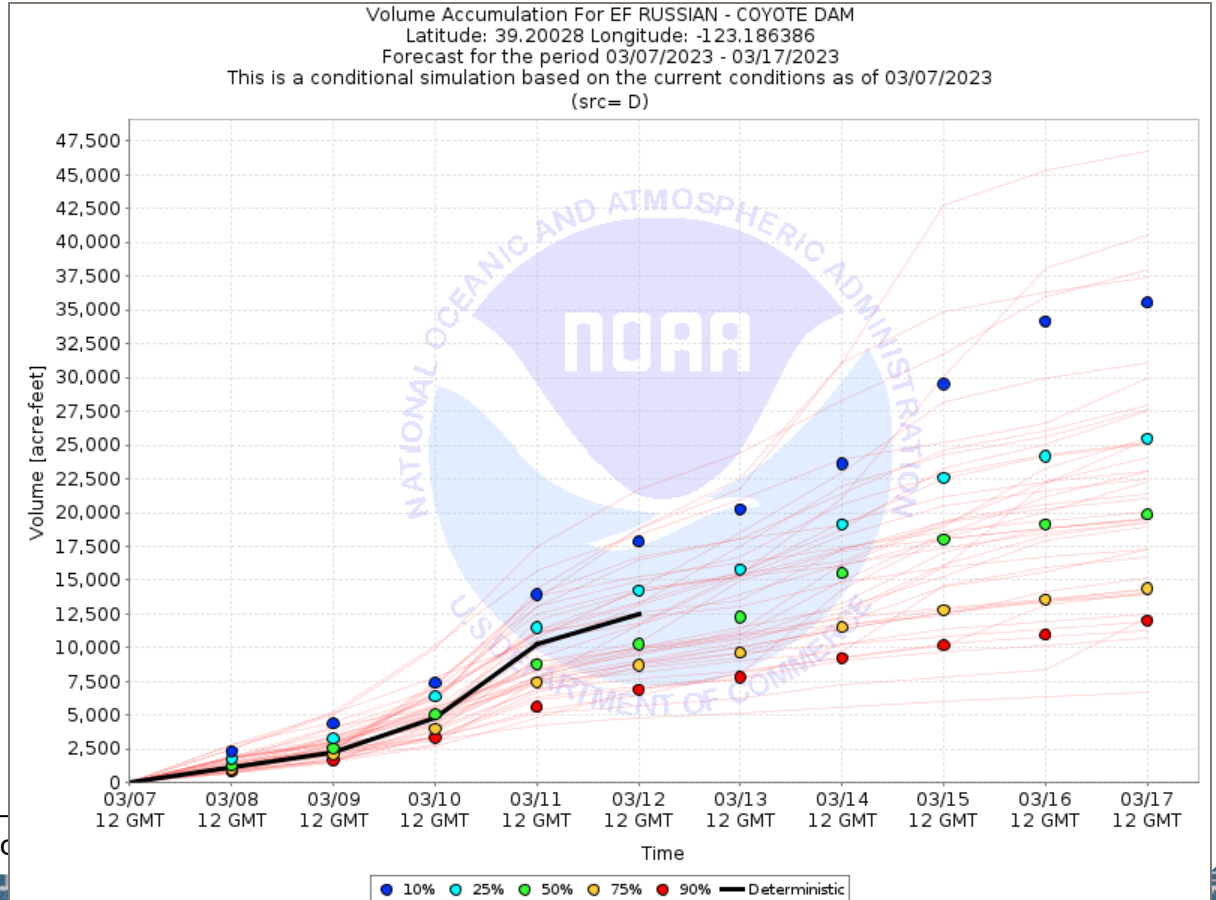
Plot is forecasted range of values for integrated vapor transport specific to 39N latitude, as shown by y axis.

Slide Courtesy Patrick Sing
SPN Water Manager

Example of Wet Weather Forecasts to Inform Release Decisions in the Russian River Watershed

Quantitative assessment: Example of reservoir cumulative inflow volume forecast from 7 March 2023 for Lake Mendocino.

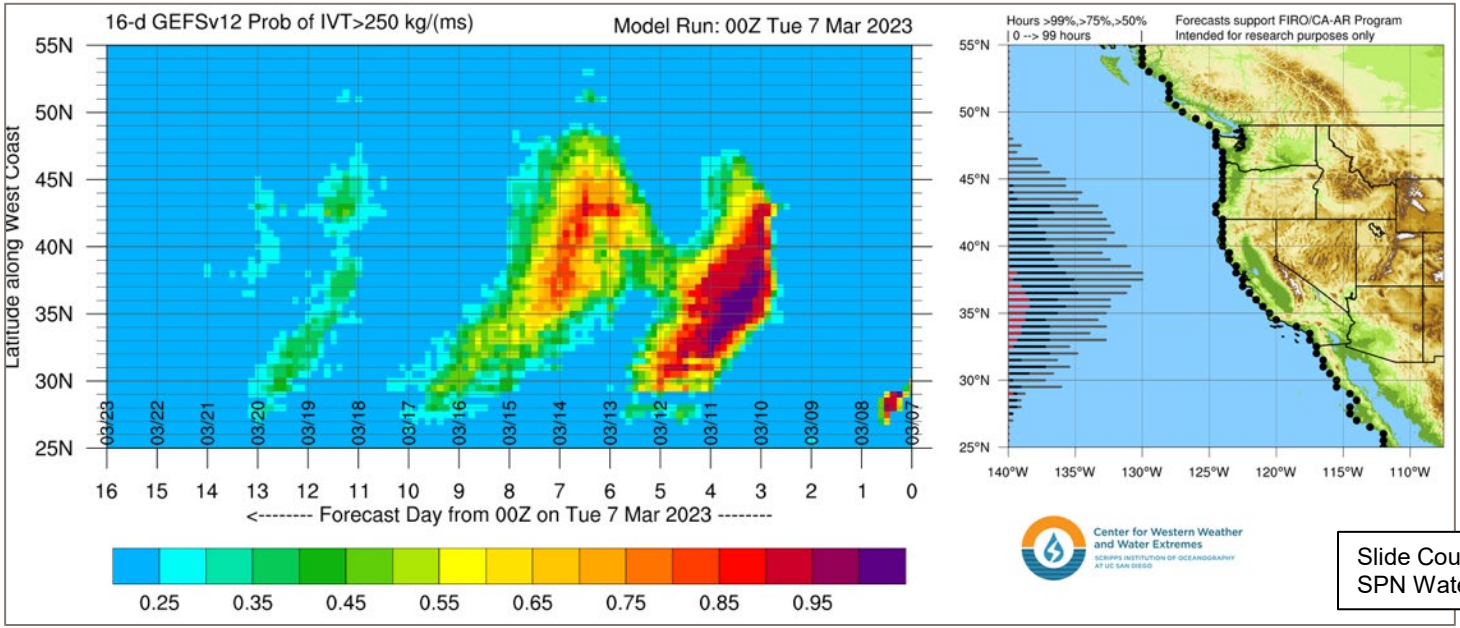
Strong indication for significant inflow to occur.



Slide Courtesy Patrick Sing
SPN Water Manager

Example of Wet Weather Forecasts to Inform Release Decisions in the Russian River Watershed

Qualitative assessment: Example plot for 7 March 2023 of forecasted landfall of atmospheric rivers. Strong indication of landfall of atmospheric rivers for most of the 16-day forecast period.



Slide Courtesy Patrick Sing
SPN Water Manager

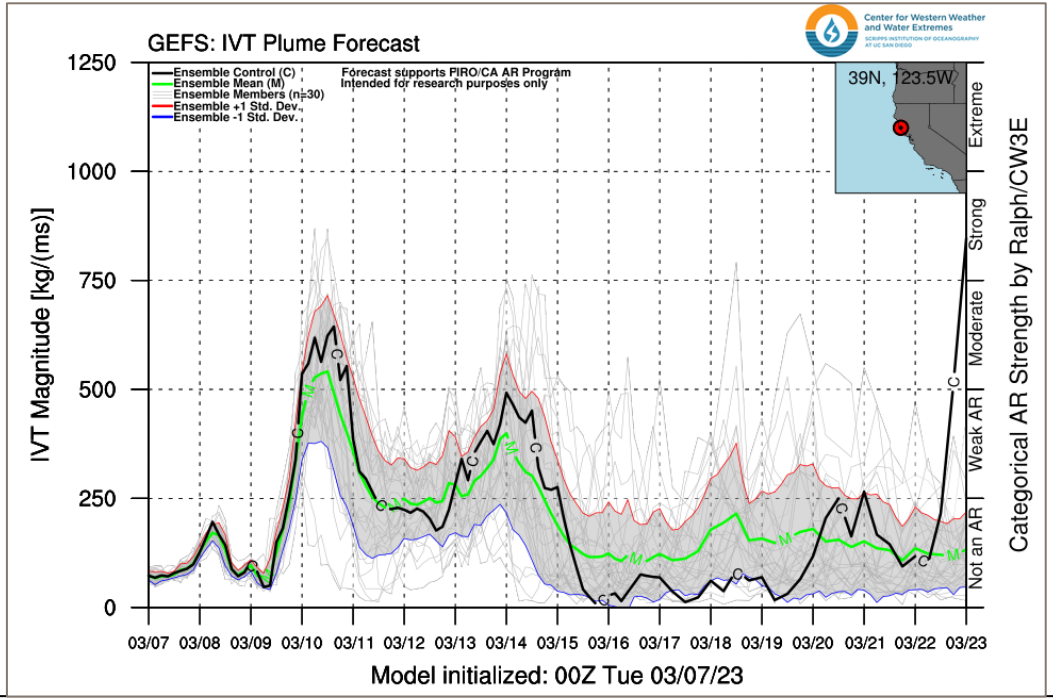
Plot is forecasted probability of integrated vapor transport greater than 250 kg/m-s. Color is not related to intensity. More purple means greater probability.

Example of Wet Weather Forecasts to Inform Release Decisions in the Russian River Watershed

Qualitative assessment: Example plot of magnitude of integrated vapor transport for 7 March 2023.

Strong indication of atmospheric rivers for most of the 16-day forecast period for the upper Russian River Valley.

Plot is forecasted range of values for integrated vapor transport specific to 39N latitude, as shown by y axis.



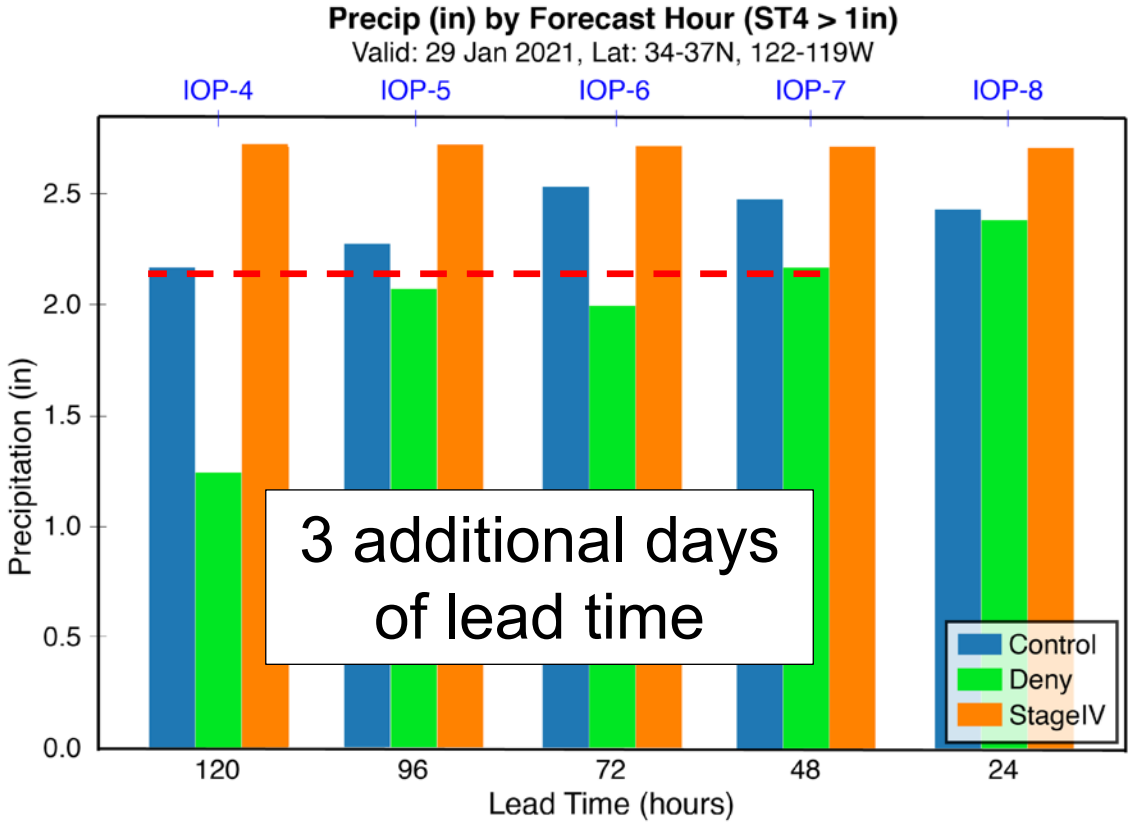
Slide Courtesy Patrick Sing
SPN Water Manager

AR Recon 21-26 Jan 2021 Sequence

AR Recon Data Denial Experiments

V. Tallapragada, F.M. Ralph, X. Wu, M. Zheng

Forecast Lead Time = Water



USACE Water Management Forecast Lead Time Needs

- For many western reservoirs, 5-7 days is sufficient to safely evacuate FIRO space held above existing guide curve levels *during rainy season (Nov – Mar)*
- Systems with lower elevation differences between reservoir and control points and/or limited downstream channel capacities (e.g. San Joaquin), longer forecast lead times would increase FIRO viability
- During snow melt season (Mar – Jul), longer-range forecasts of heat waves and potential warm rains would greatly improve water managers' ability to handle challenges induced by spring flows in systems with significant snow melt runoff

Key FIRO Takeaways

- USACE has entered a new phase of water management where forecasts are being officially incorporated into water control manuals and other water management practices
- Improved atmospheric forecasting skill in both short term and long term forecast horizons is critical to improving FIRO viability
- Research-supported improvements in forecasting skill of AR events (AR Recon, West-WRF, etc.) as well as S2S climate trends such as prolonged droughts and heat waves are critical to helping agencies like USACE realize the increased benefits of FIRO
- FIRO provides an effective means of increasing the efficiency and resiliency of existing water resources infrastructure to achieve multi-purpose benefits – all without costly construction projects

Thank you!

Cary Talbot
USACE FIRO Program National Lead
Cary.A.Talbot@usace.army.mil