



Center for Western Weather
and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO

Overview of Real-Time Support Provided For 2023 Reservoir Operations At Lake Mendocino and Prado Dam

9/21/2023

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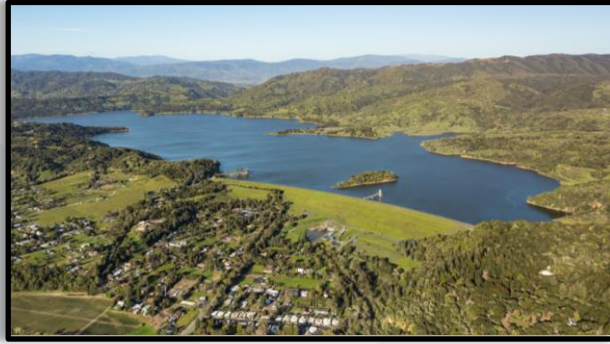
UC San Diego



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Ensemble Forecast Operations (EFO)

2023 real time support provided for 2 reservoirs in California



Lake Mendocino

- On the Russian River
- Support implementation of major deviation
- Emails sent daily with forecast discussion



Prado Dam

- Santa Ana River
- Support minor deviation



Forecast Informed Reservoir Operations

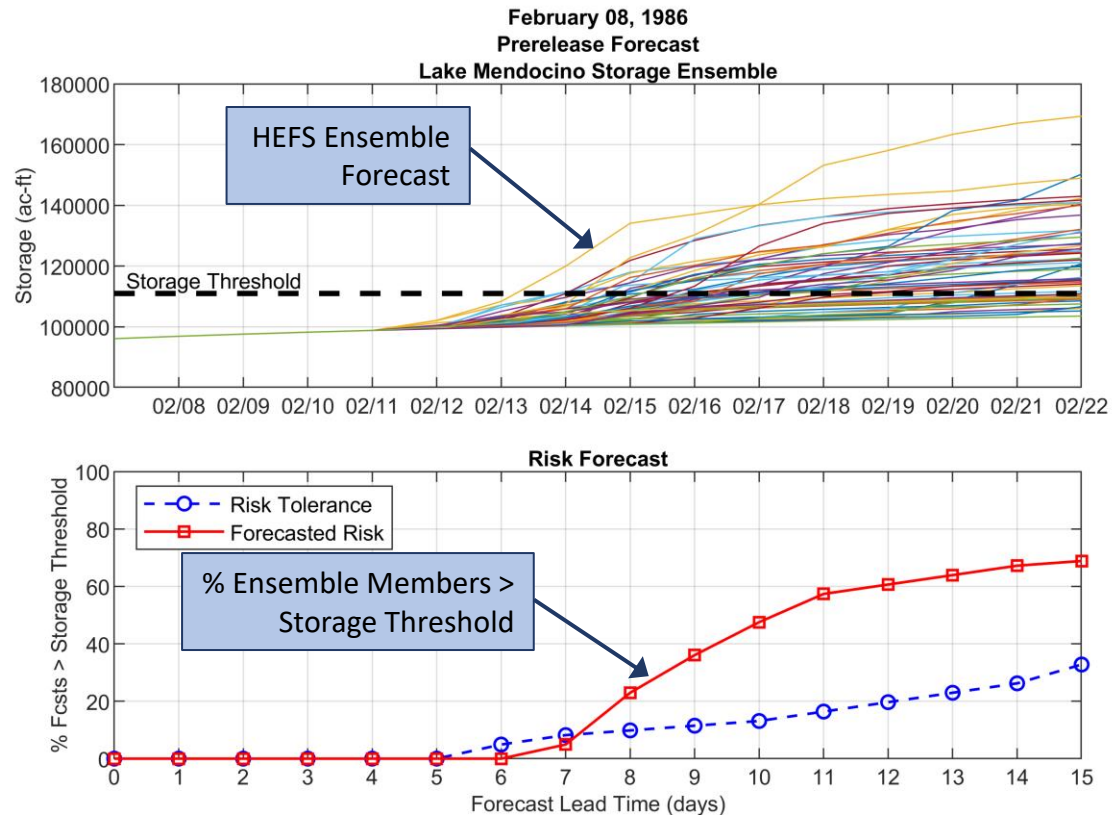
Using Ensemble Streamflow Predictions for a Multi-Purpose Reservoir in Northern California

10.1029/2019WR026604

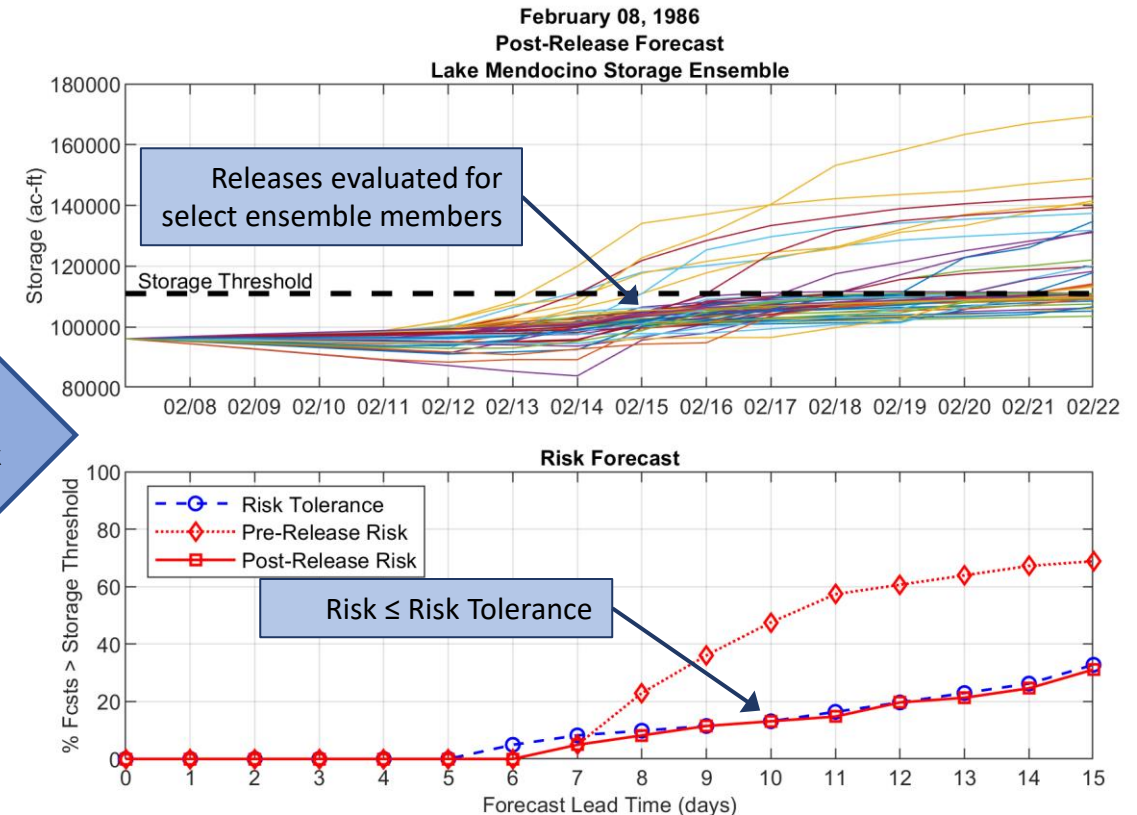
Chris J. Delaney¹, Robert K. Hartman², John Mendoza¹, Michael Dettinger³, Luca Delle Monache³, Jay Jasperse¹, F. Martin Ralph³, Cary Talbot⁴, James Brown⁵, David Reynolds⁶, Simone Evett⁷

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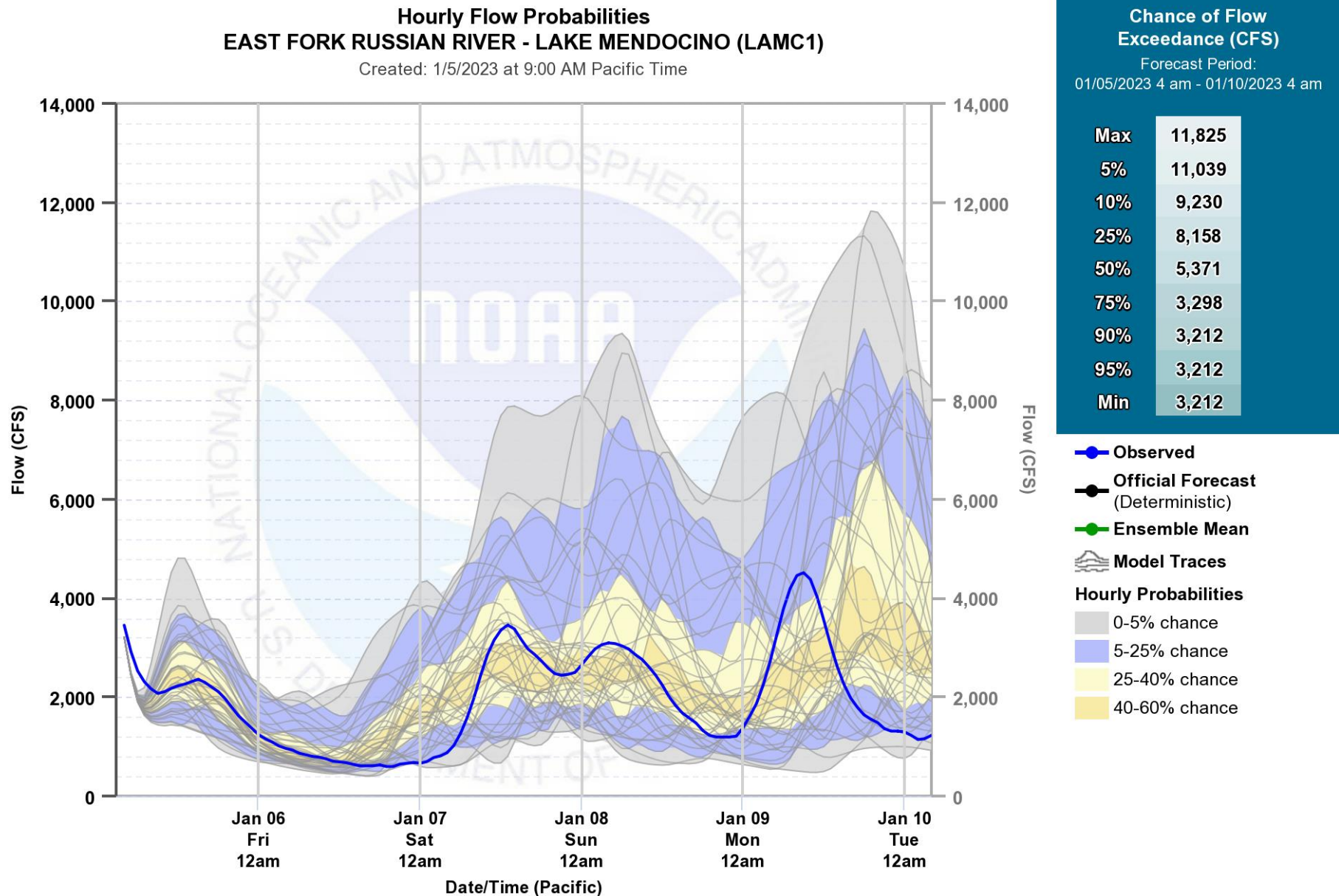
- Ensemble Forecast Operations is probabilistic decision support system for reservoir flood control operations.
- Utilizes ensemble streamflow predictions (ESPs), which account for forecast variability, to manage to forecasted risk of exceeding critical storage levels.
- Demonstrates improved reservoir storage reliability for water supply and ecosystems.



Release
mitigates risk



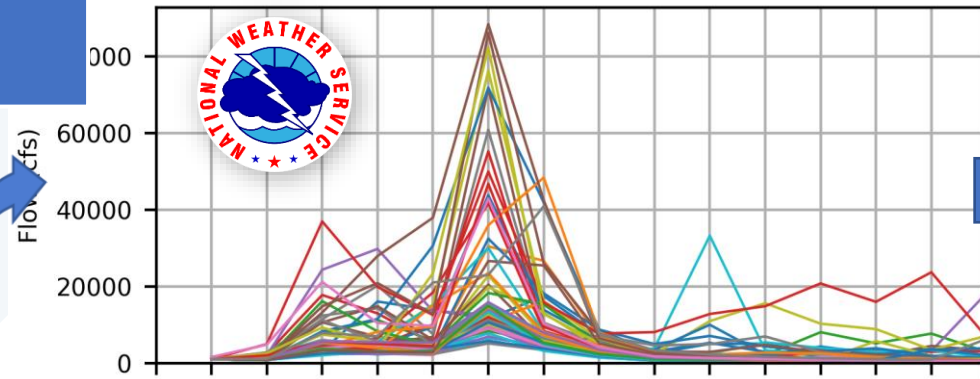
Hydrologic Ensemble Forecast System (HEFS)



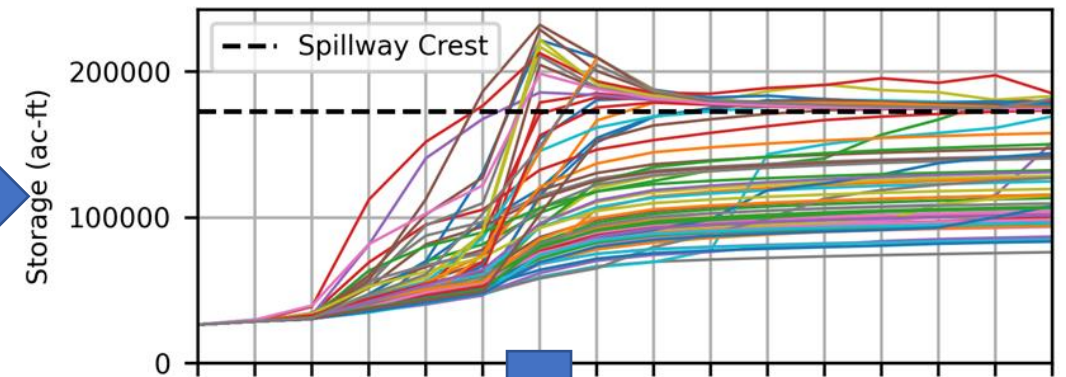
Overview of EFO Methodology

Process repeated
with each
forecast cycle

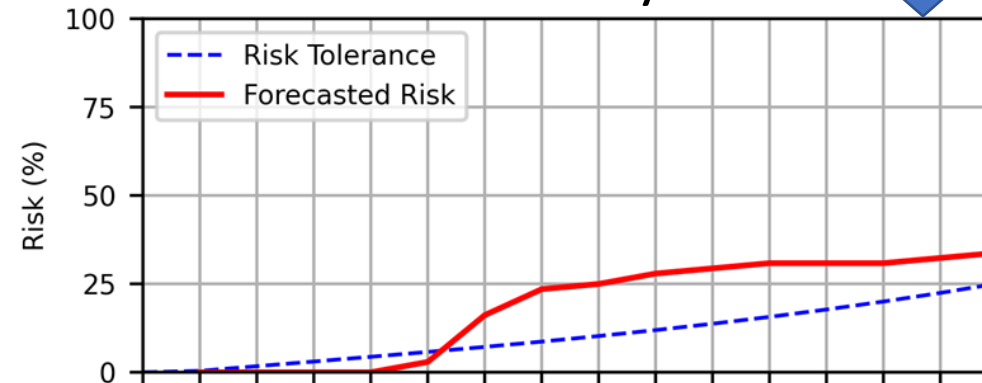
Ensemble Inflow Forecast (Scaled Synthetic Event)



Storage Forecast (Scaled Synthetic Event)

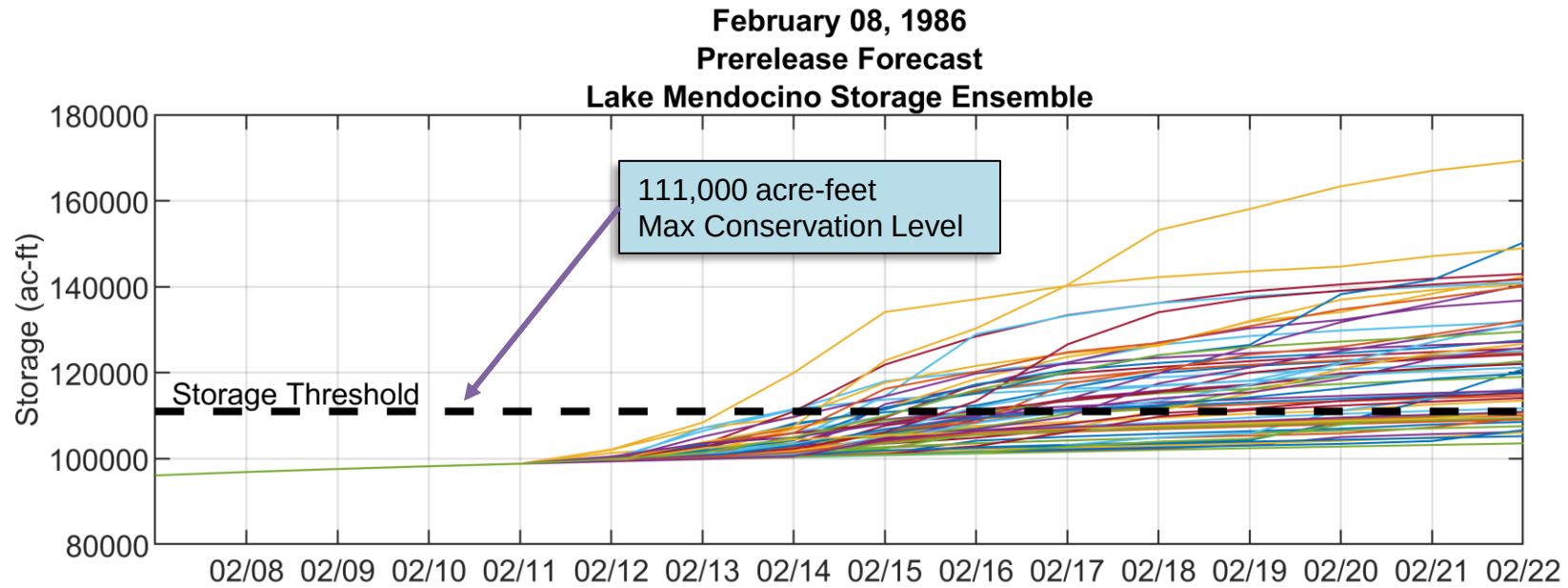


Flood Risk Analysis

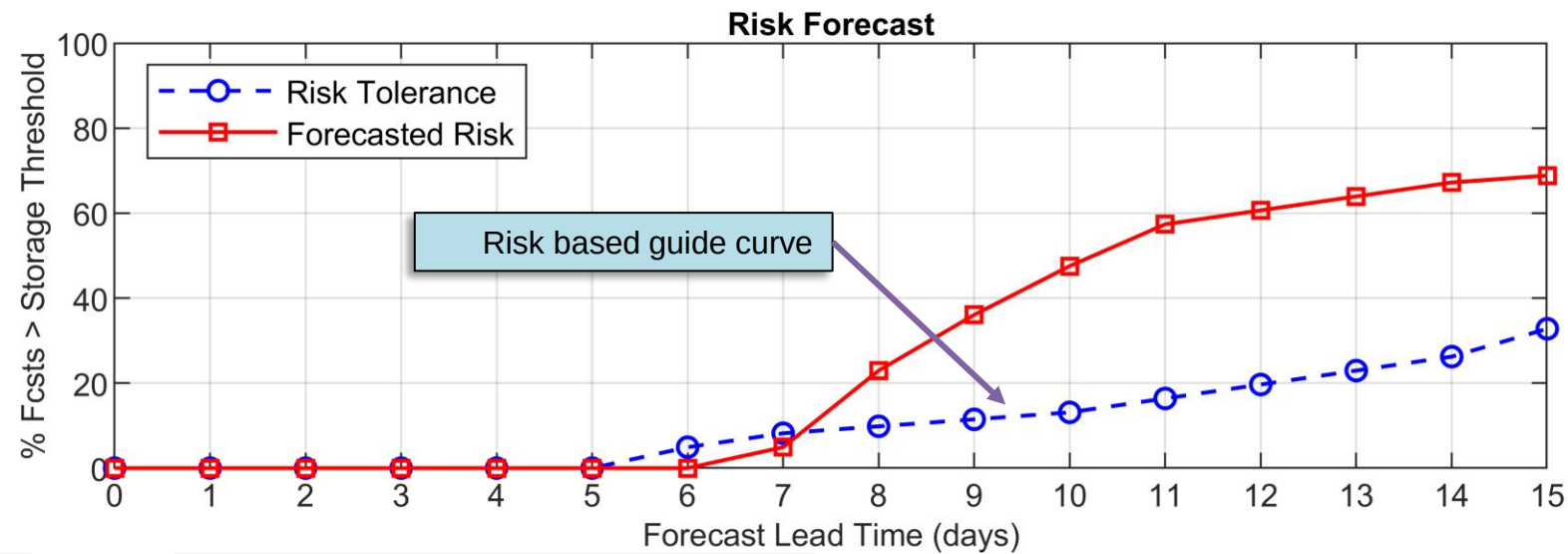
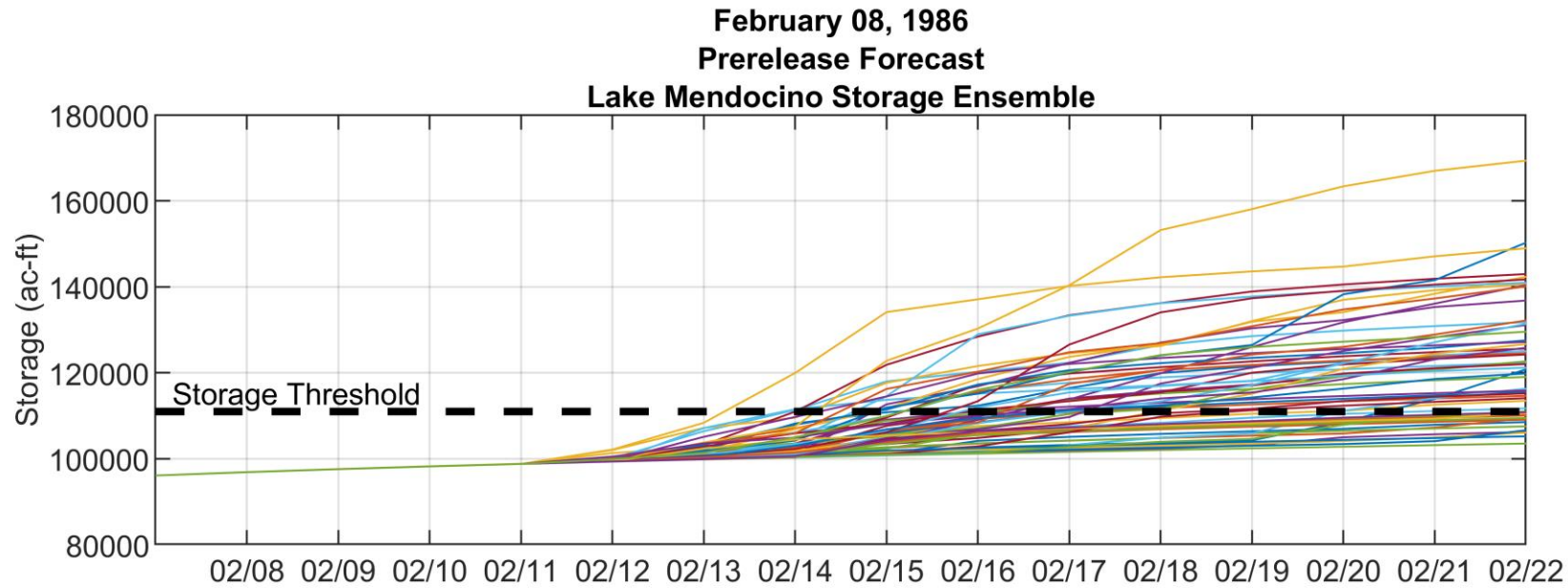


Flood
Release

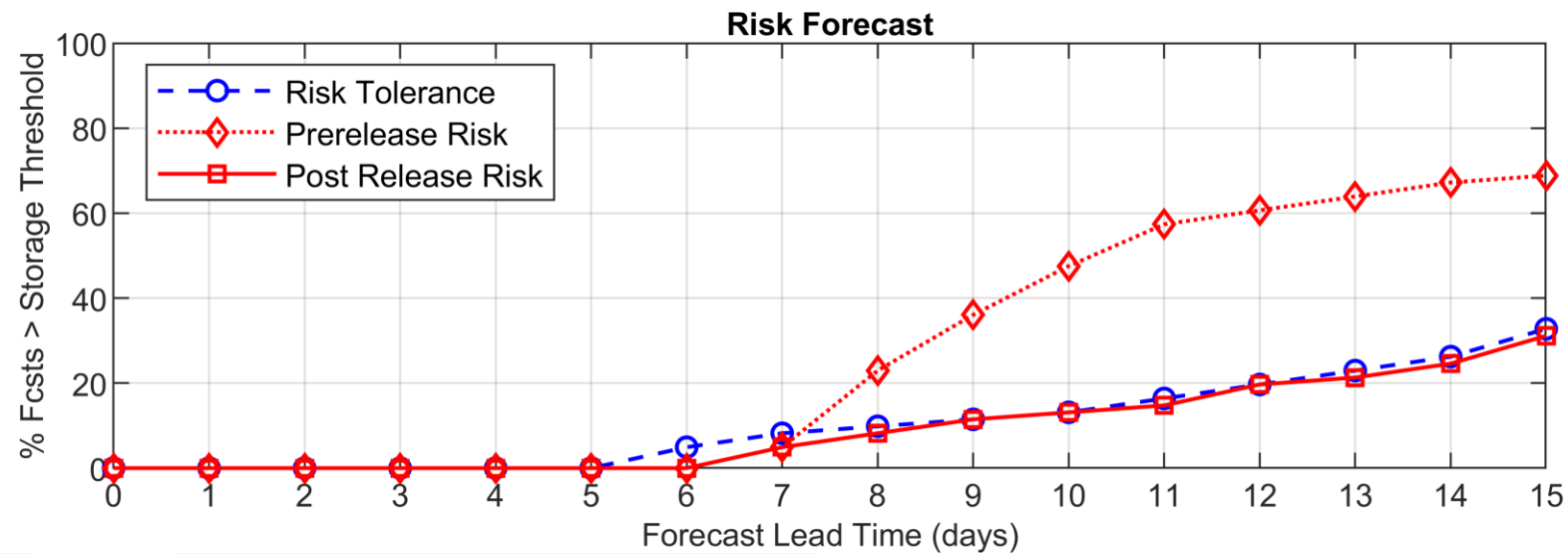
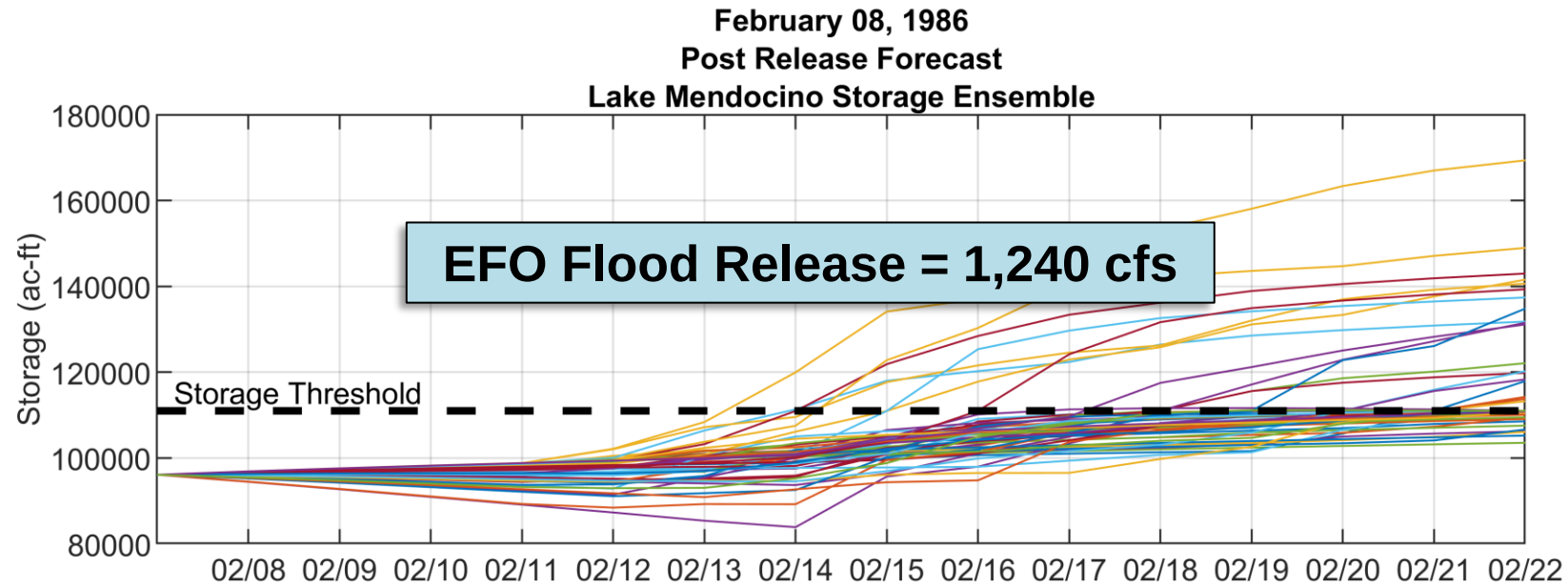
February 8, 1986, EFO Example



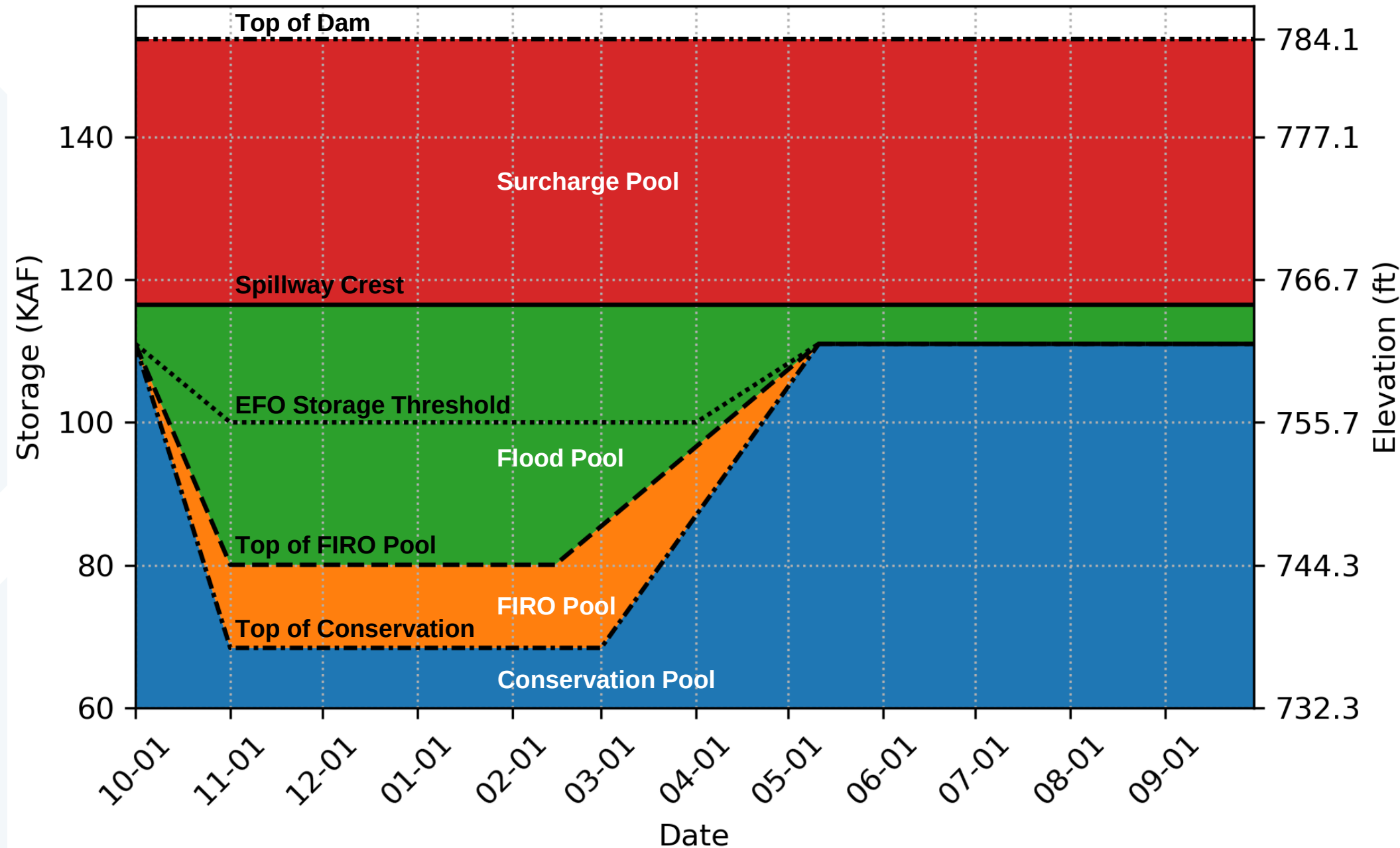
February 8, 1986, EFO Example



February 8, 1986, EFO Example

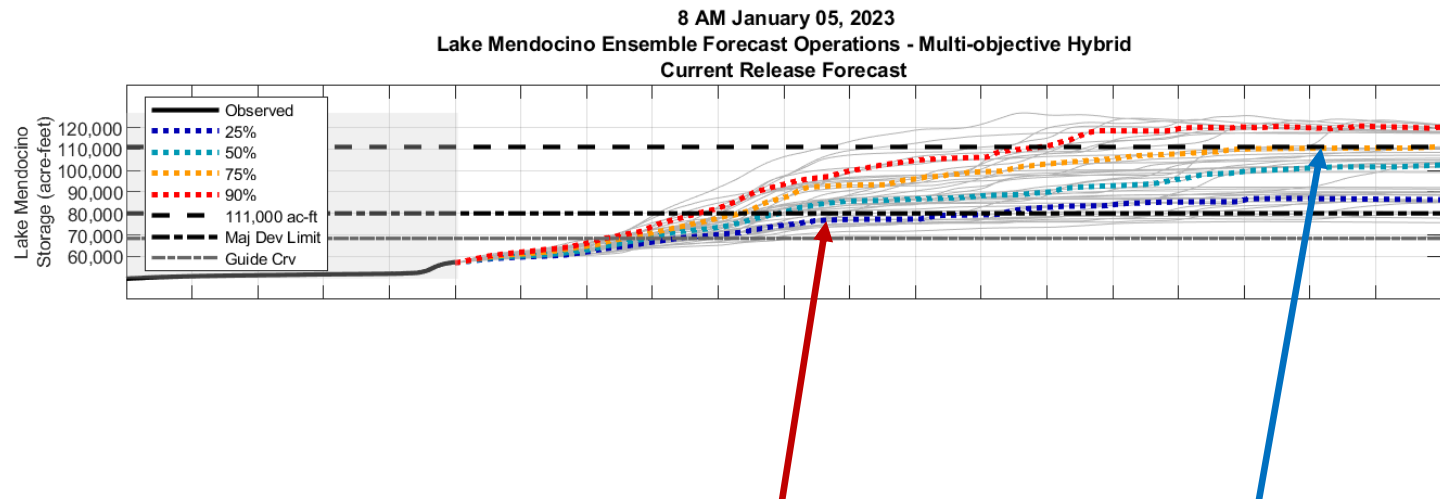


2023 Major Deviation for Lake Mendocino

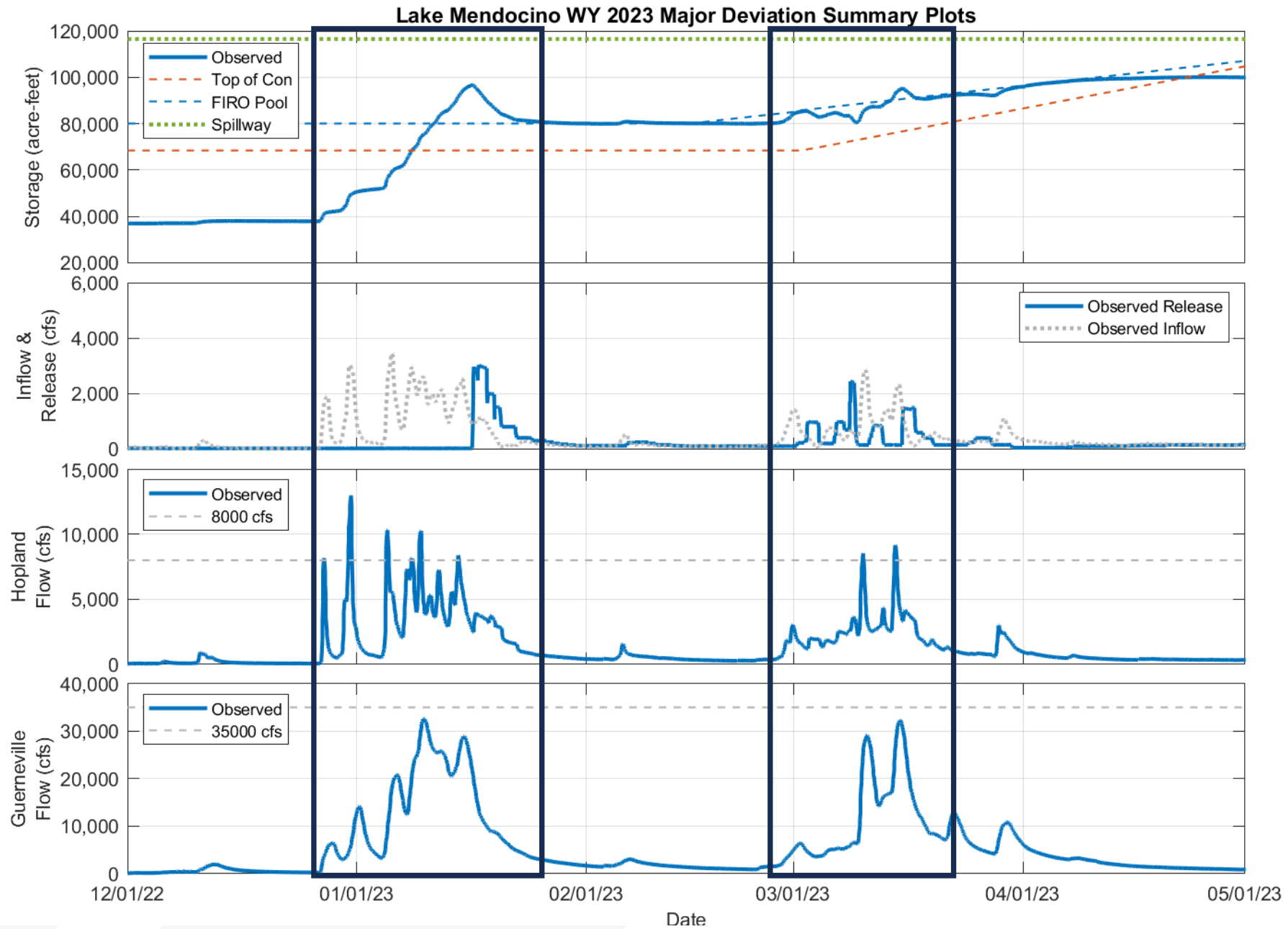


EFO Forecast Figures

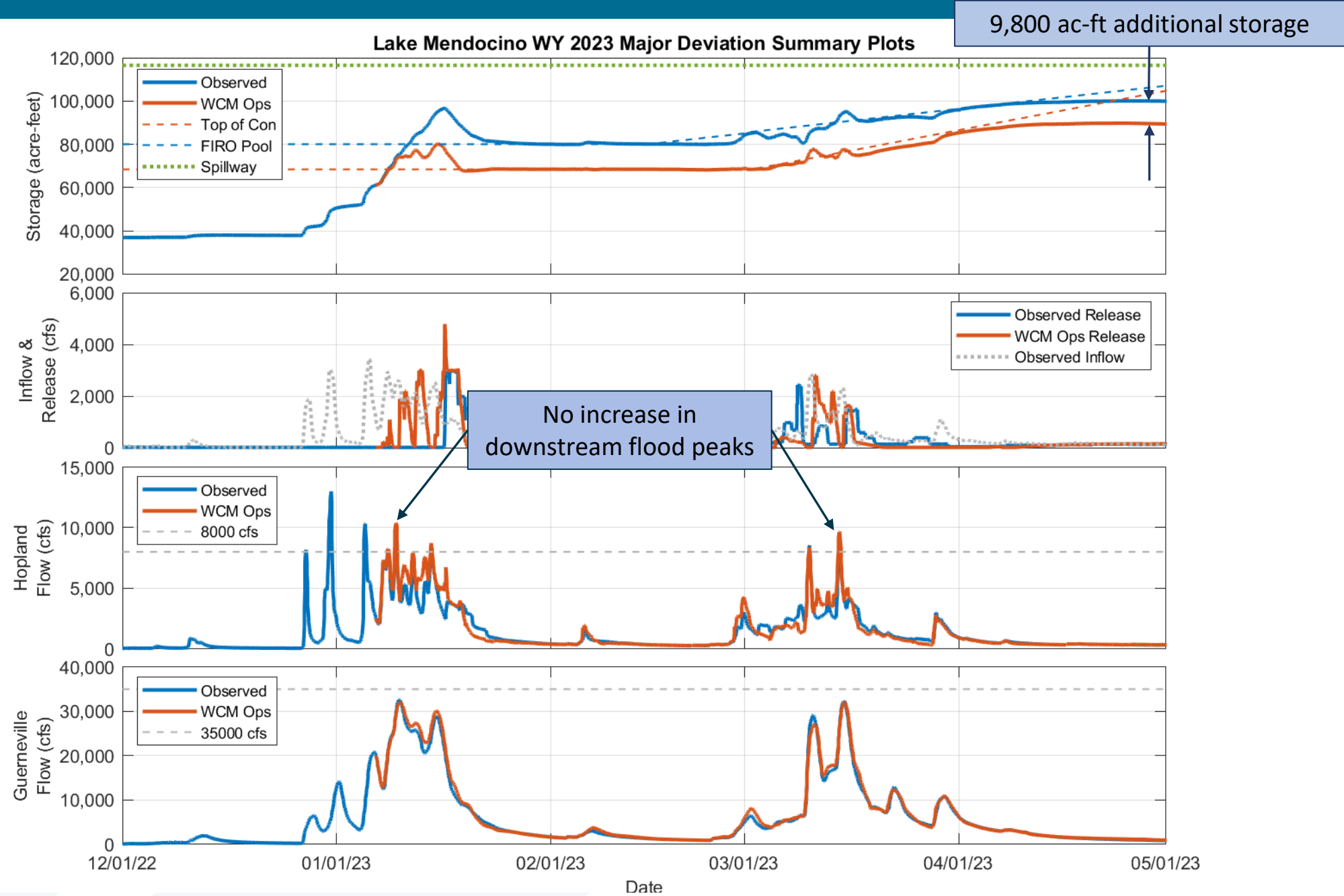
Storage Forecast



2023 Results



2023 Results



Ensemble Forecast Operations (EFO)

2023 real time support for Prado Dam

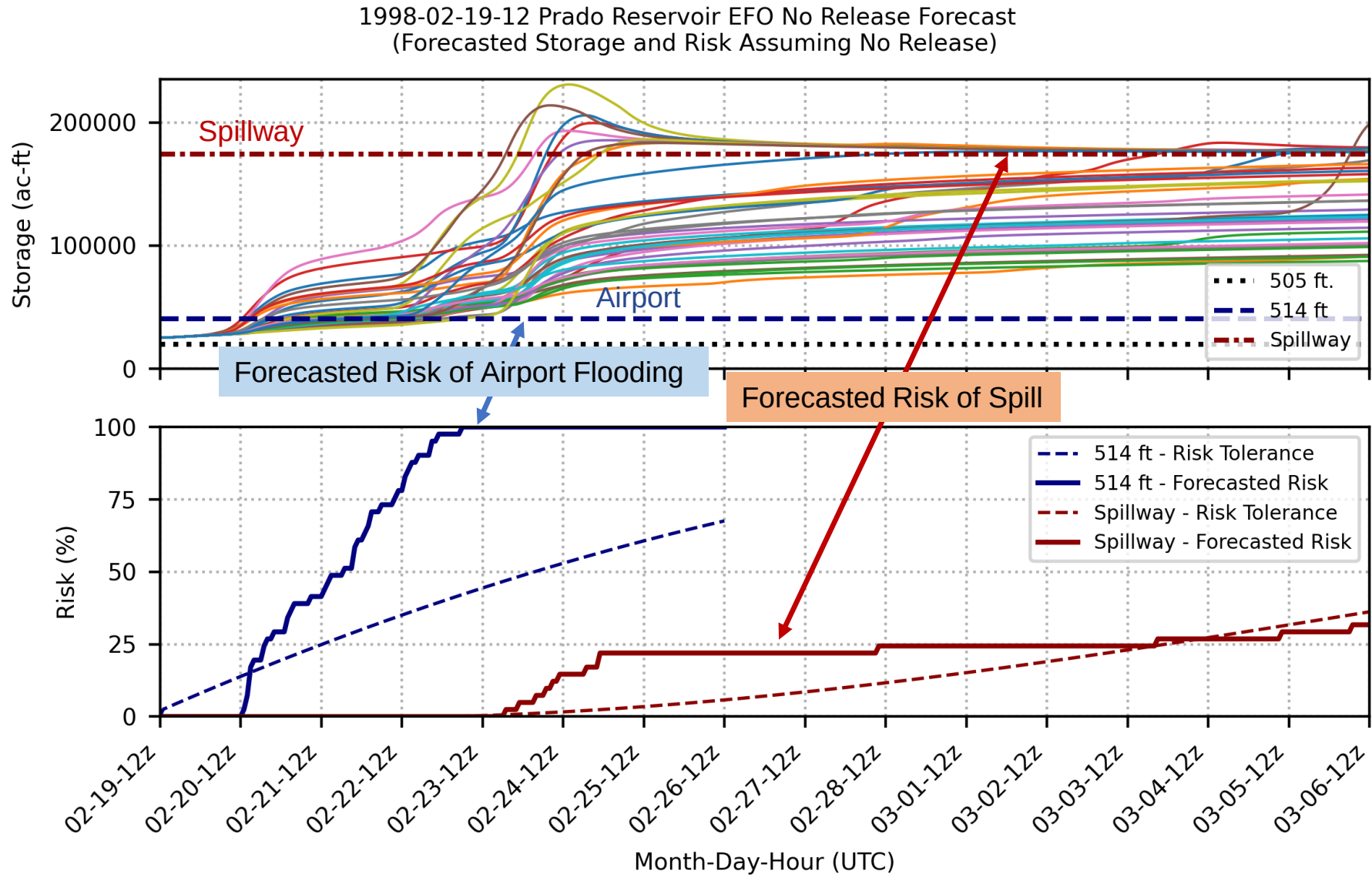


Prado Dam EFO

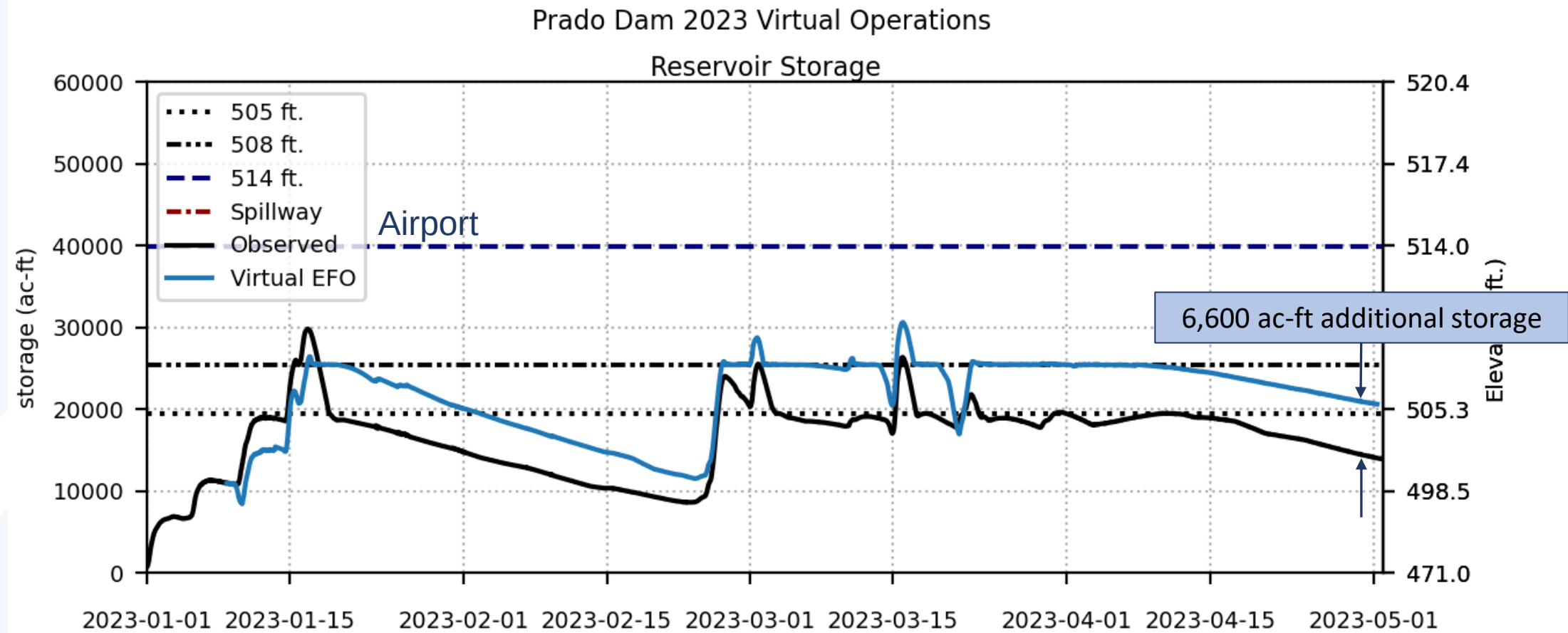
- Support minor deviation
- Simulate virtual operations
- Results posted to website



Ensemble Forecast Operations - Dual Objective Risk Management

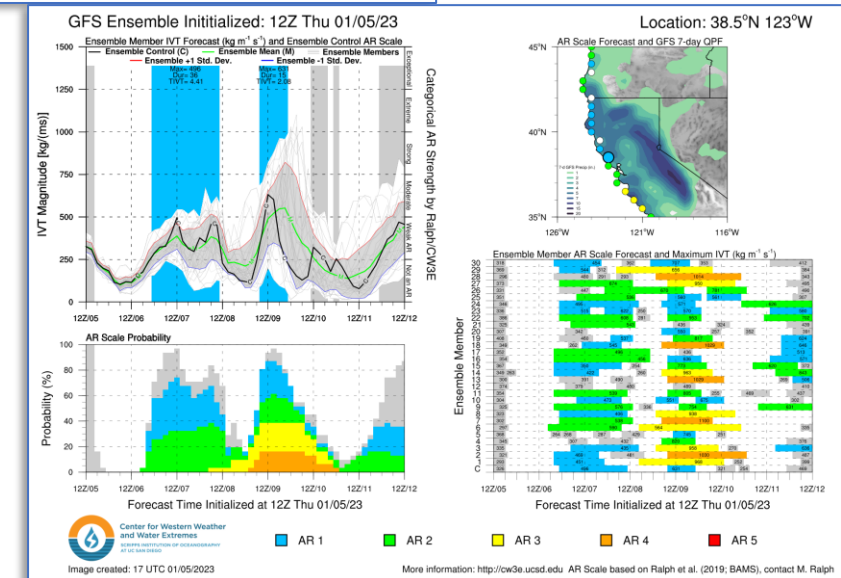
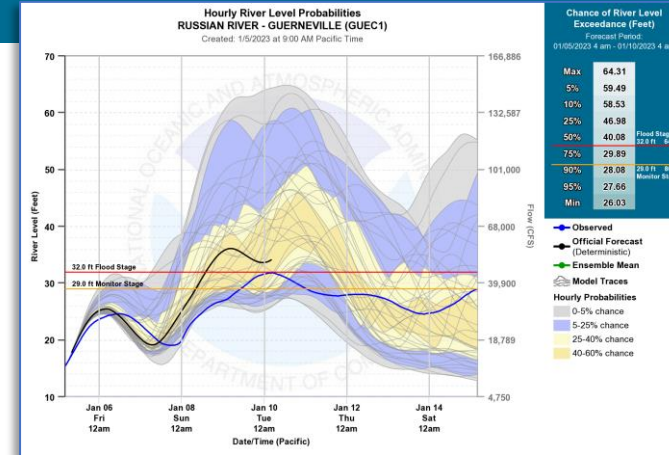


2023 Virtual Simulation of EFO Alternative

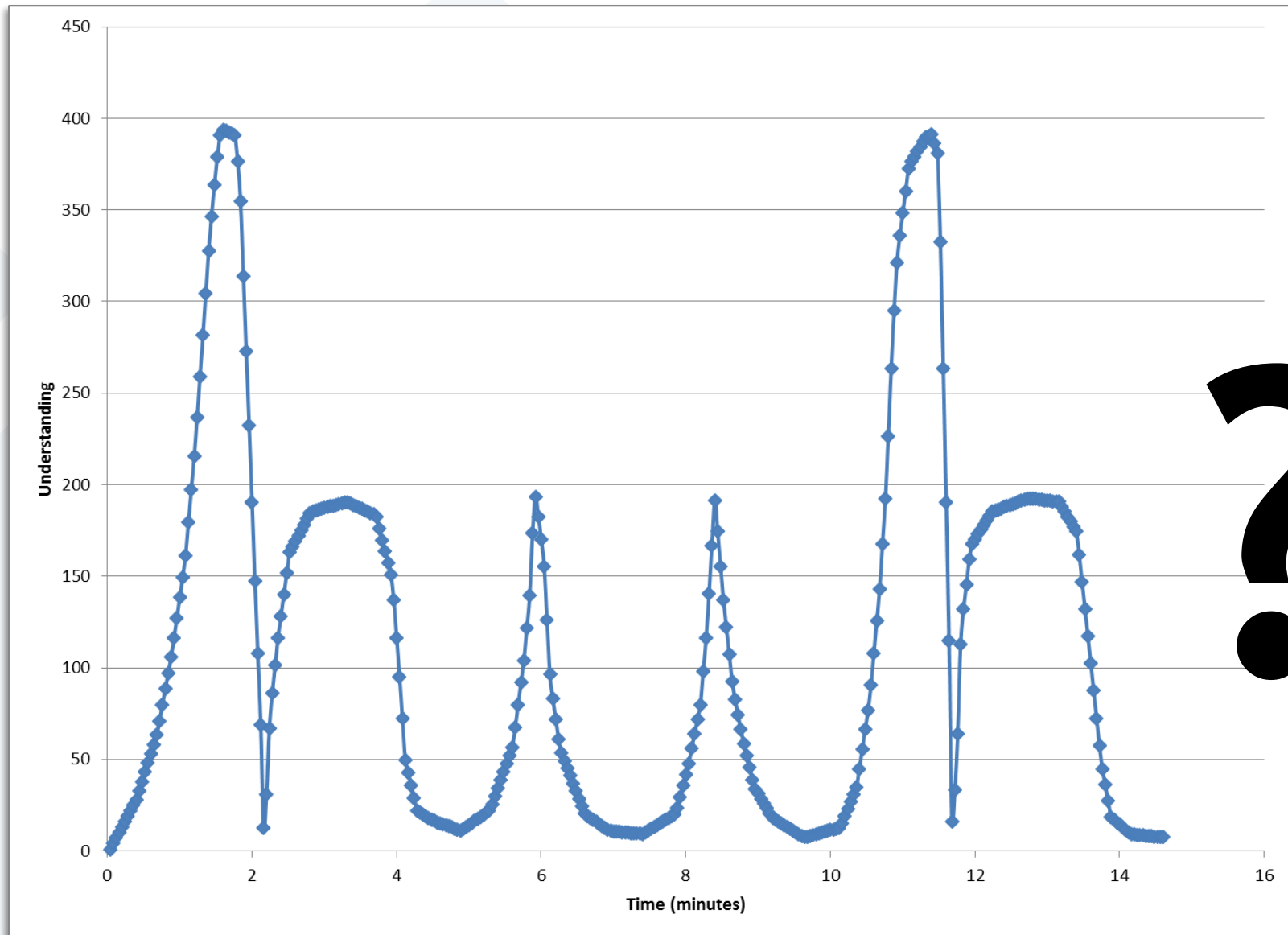


Lessons Learned

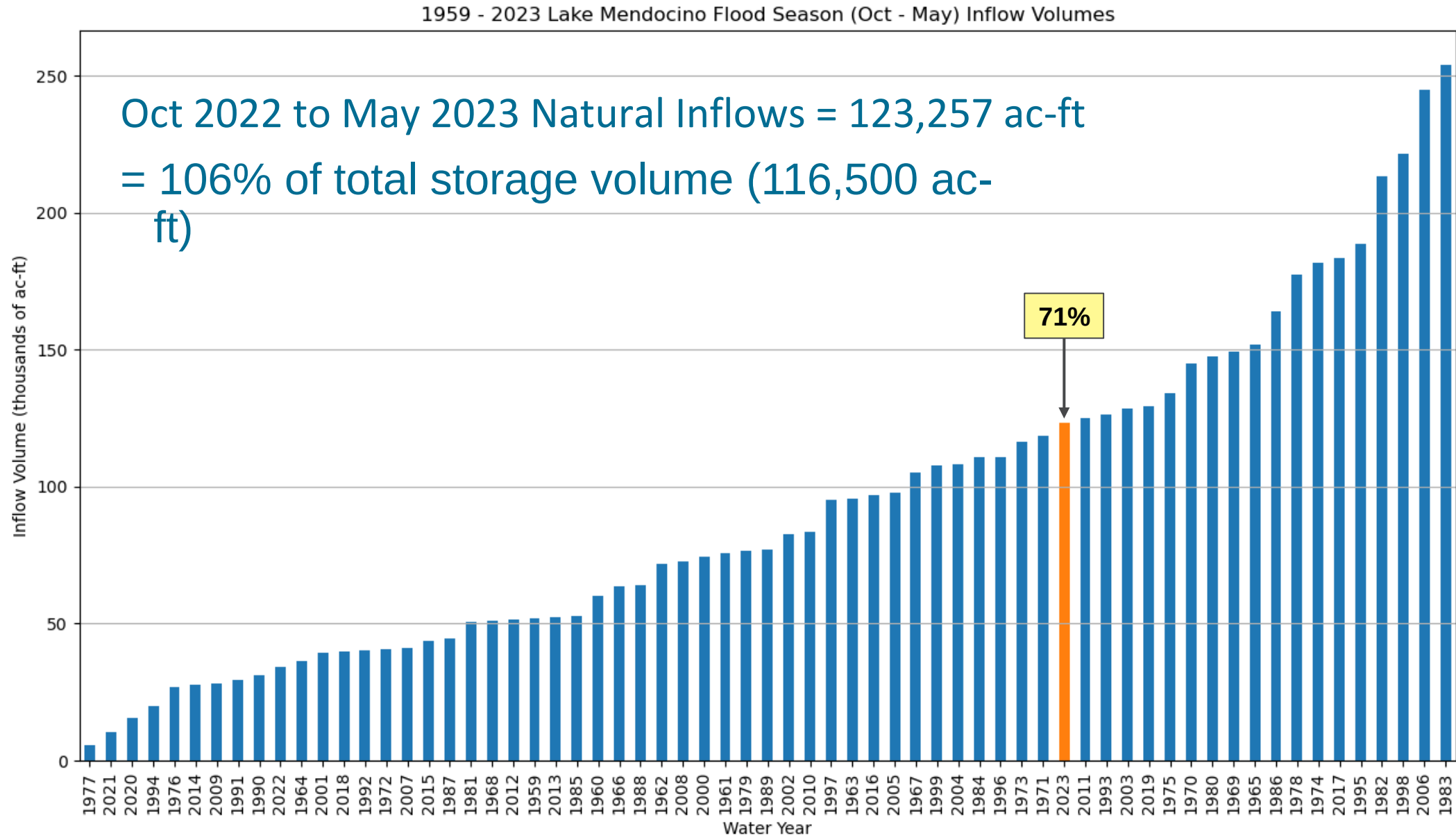
- **Forecasts can be very dynamic.**
 - Expect over forecasts and under forecasts.
 - Expect large changes between forecast cycles.
- **Important to utilize other forecast models and tool tools.**
 - West-WRF, ECMWF, GDPS
 - CW3E AR and precip tools



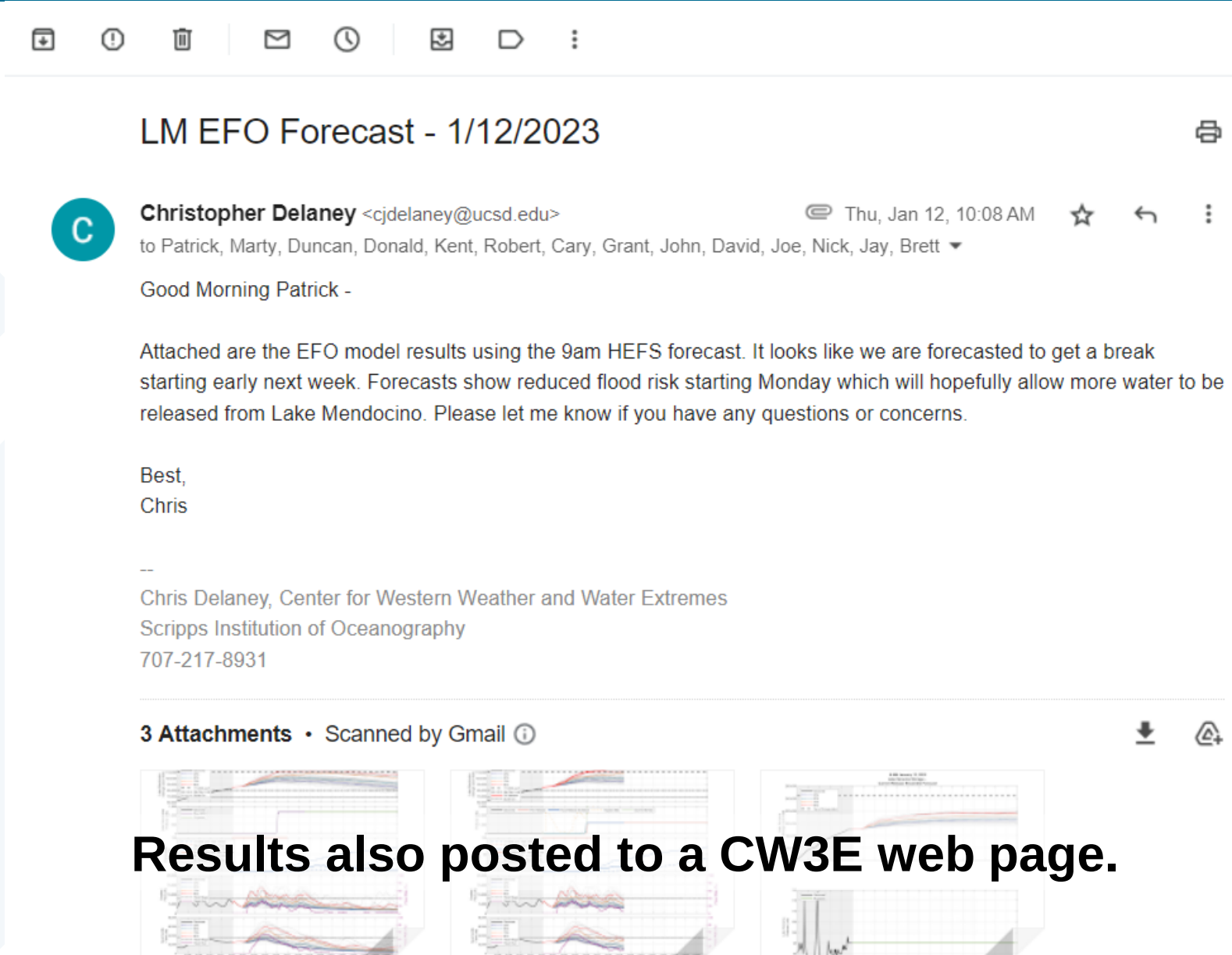
Questions?



2023 was a very active flood control season for Lake Mendocino. Right?

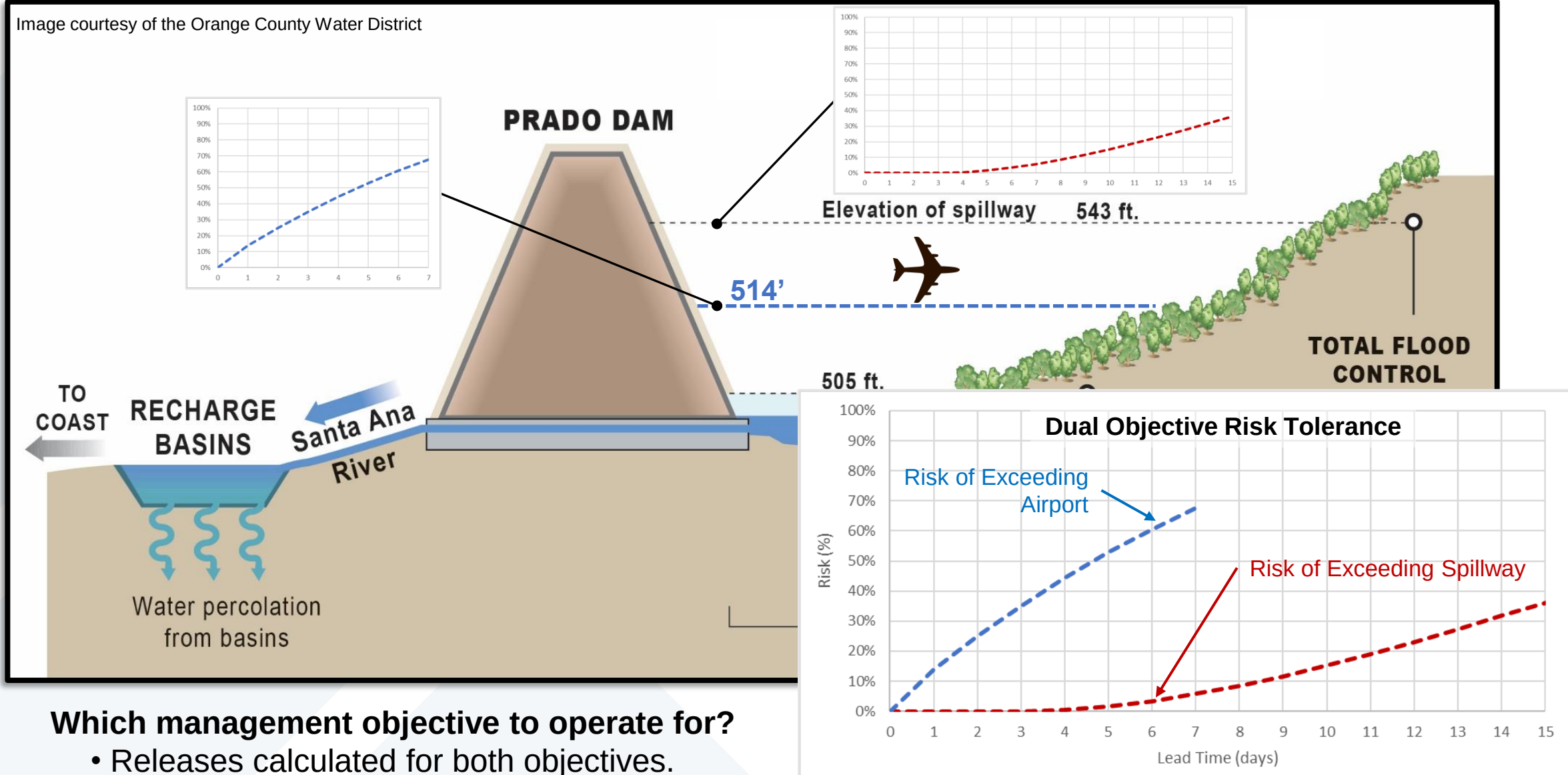


E-mail provided each day to operations



Prado Dam FIRO - Dual Objective EFO

Image courtesy of the Orange County Water District



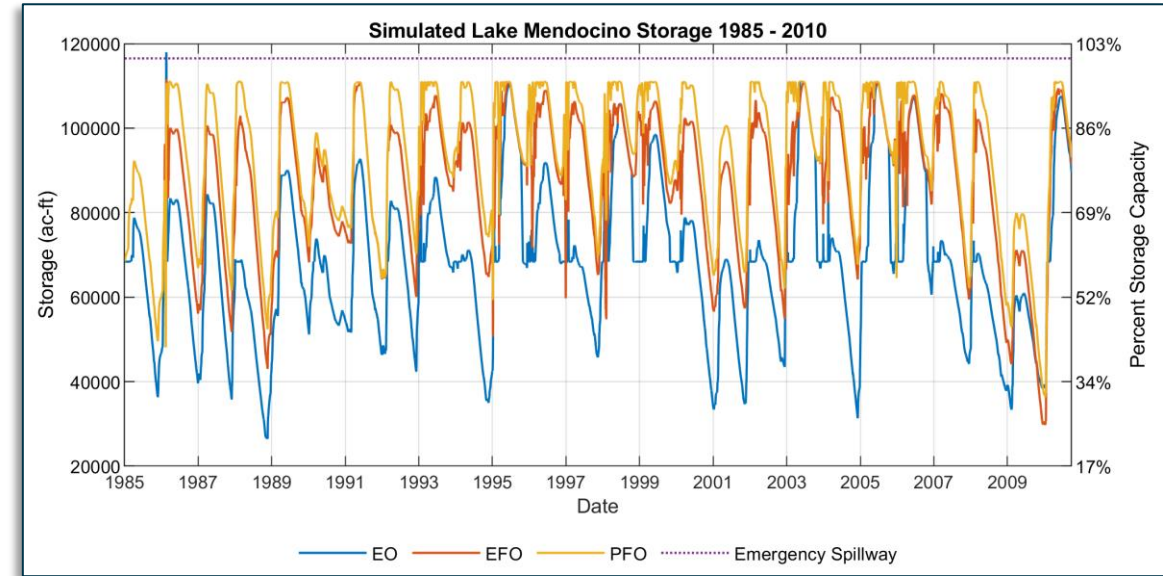
Which management objective to operate for?

- Releases calculated for both objectives.
- EFO model will recommend most conservative release.

Ensemble Forecast Operations serves dual purposes

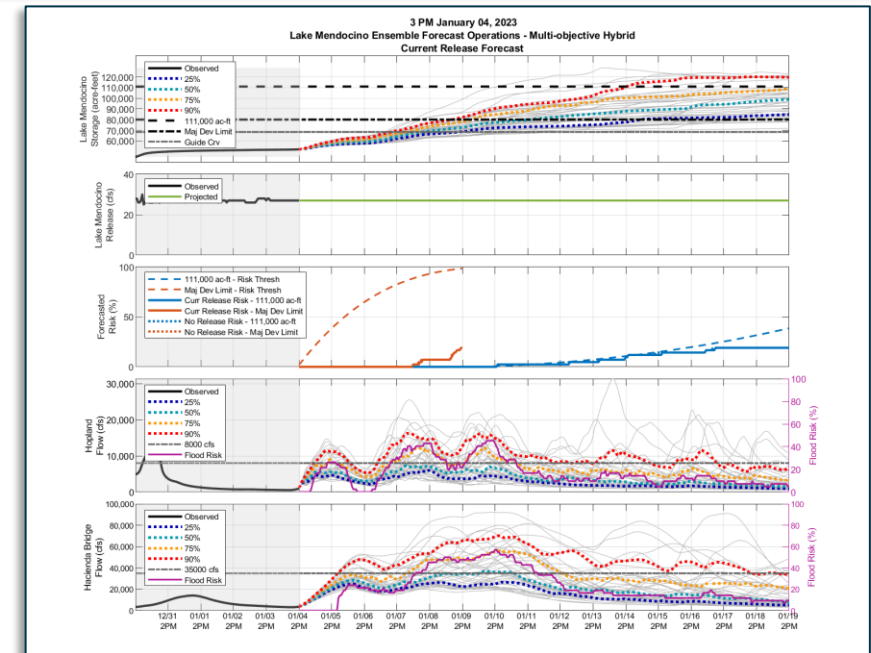
1. Simulation of FIRO for planning studies

- Assess viability of FIRO
- FIRO simulation for historical periods and scaled flood events

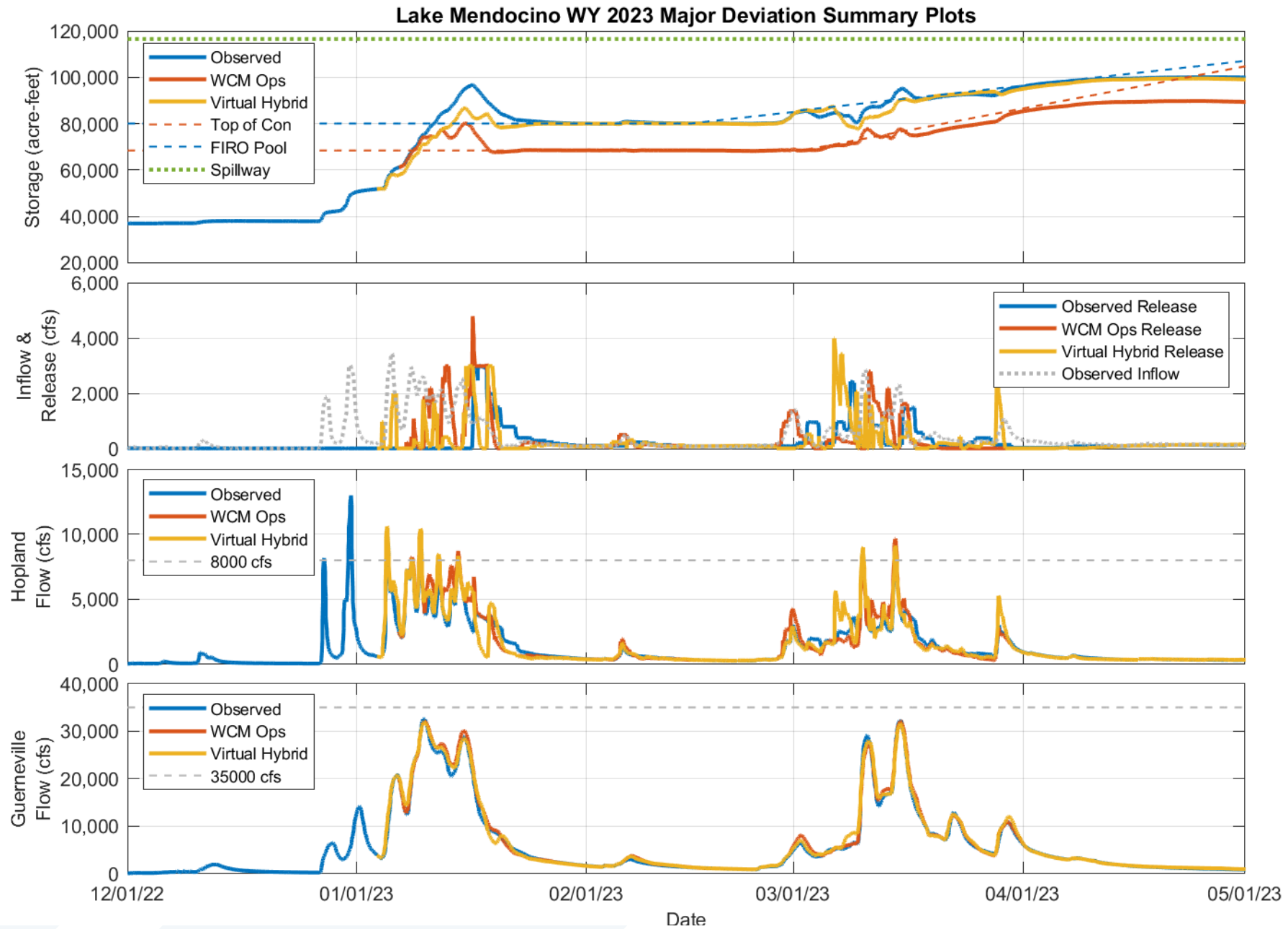


2. Provide decision support for real-time operations under FIRO

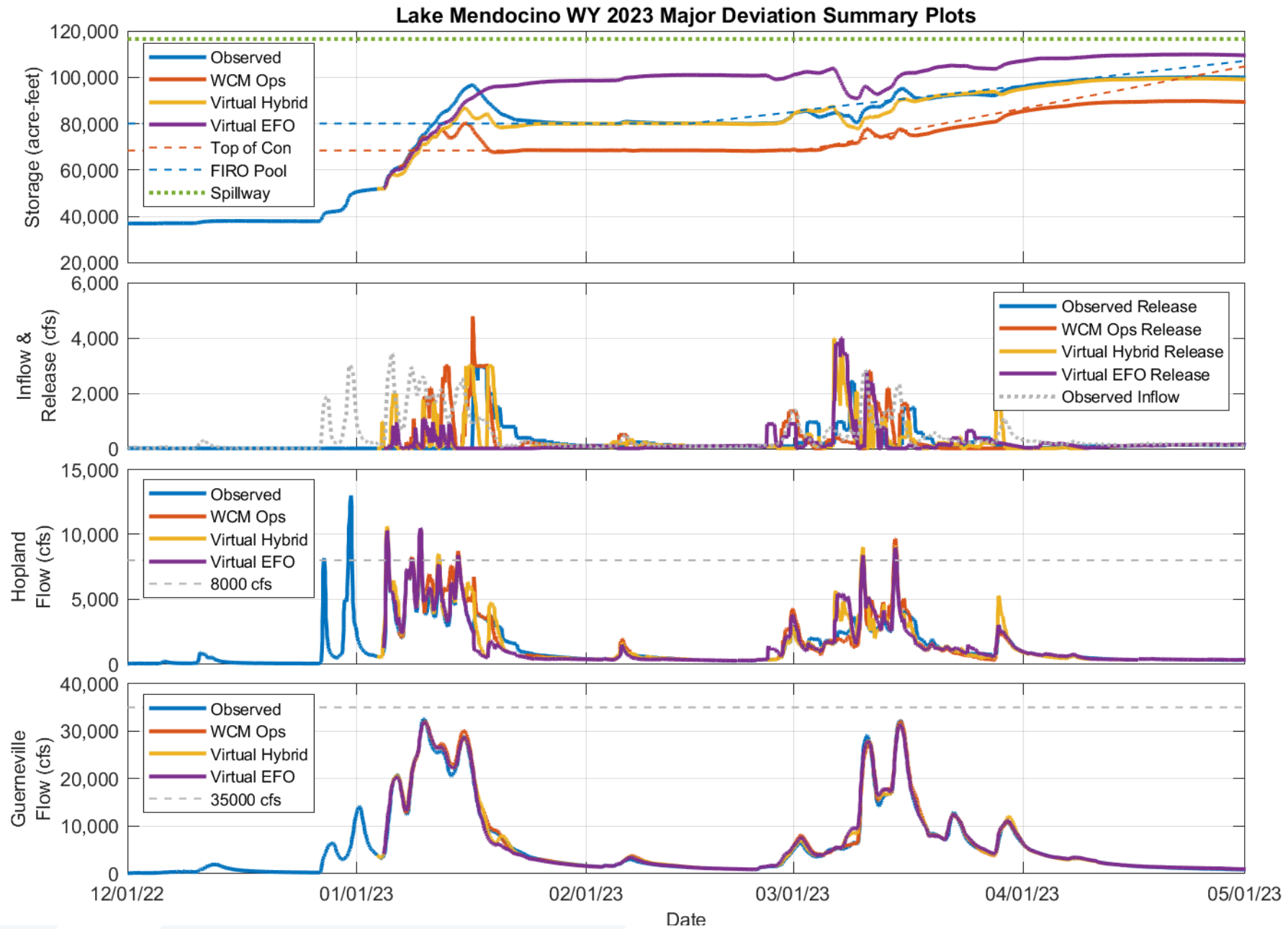
- Forecast dashboards



2023 Results



2023 Results



2023 Virtual Simulation of EFO Alternative

