

Folsom Dam

Water Control Manual Update

Public Workshop

April 3, 2014

*Location: Sterling Hotel Ballroom
1300 H Street, Sacramento*



WELCOME & INTRODUCTIONS



PURPOSE OF MANUAL UPDATE

- Revise operation rules for Folsom Dam to reduce flood risk based on the capabilities of the Folsom Joint Federal Project (JFP).
- Reflect operational capabilities created by improved weather forecasts.
- Potentially reduce the volume of flood control reservation in Folsom Reservoir at any particular time by comparison to the operations that have been in effect since 1995.



OBJECTIVES OF MANUAL UPDATE

- Pass the Probable Maximum Flood while maintaining 3 feet of freeboard below the top of dam to stay within the dam safety constraints of the U.S. Department of Interior, Bureau of Reclamation.
- Control a 1/100 annual chance flow (“100-year flood”) to a maximum release of 115,000 cubic feet per second as criteria set by the Sacramento Area Flood Control Agency to support Federal Emergency Management Agency levee accreditation along the American River.
- Control a 1/200 annual chance flow (“200-year flood”) as defined by criteria set by the State of California (State) Department of Water Resources to a maximum release of 160,000 cubic feet per second, when taking into account all the authorized modifications within the American River Watershed.



PURPOSE OF TODAY'S AGENDA

- Project Schedule
- Introduction to Basin Wetness and Forecasts in Folsom Reservoir Operations
 - Presentation by National Weather Service, California / Nevada River Forecast Center
- Group Discussion & Summary Comments

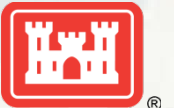


PUBLIC ENGAGEMENT ACTIVITIES

- Periodic Public / Stakeholder Sessions
- In-Depth Sessions – Government Entities
 - Engineering and Technical Work Group
 - Environmental Effects Work Group
- In-Depth Sessions – Non-Governmental & Public
 - Meetings convened by SAFCA



PROJECT MILESTONE SCHEDULE



MILESTONE SCHEDULE UPDATE

(Arrows denote activities of non-Federal project input)

Project Milestone	Completion Date
Complete NEPA/CEQA Public Scoping ←	Nov 2012
Periodic stakeholder meetings: Aug 2011, Sep 2012, Feb 2013, Mar 2013, Oct 2013, Apr 2014	Ongoing
<ul style="list-style-type: none"> -Complete development of baseline models -Establish NEPA/CEQA baseline conditions -Complete technical review of baseline conditions 	Feb 2014 May 2014 Feb 2015
Complete Interim Engineering Report - Baseline Conditions	May 2015
Final Project Partner/Stakeholder input to project alternatives ←	Aug 2014
<ul style="list-style-type: none"> -Complete Project model (from which the alternatives will be derived) -Establish NEPA/CEQA project alternatives -Complete Technical Review of project documentation 	Apr 2014 Sep 2014 Jul 2015
Complete Interim Engineering Report – Alternatives Formulation	Aug 2015
Final Project Partner/Stakeholder input to alternative selection models ←	Mar 2015
<ul style="list-style-type: none"> -Complete alternative selection models -Complete Cumulative Effects Analysis -Select recommended operations plan -Complete technical review for plan selection 	Aug 2015 Sep 2015 Dec 2015 Mar 2016
Complete draft final Engineering Report and EIS/EIR	May 2016
-Complete public review of draft EIS/EIR (45 days) ←	Jul 2016
-Complete Biological Opinion from NMFS and USFWS (135 days)	Sep 2016
-Complete Public Review of final EIS/EIR (30 days) ←	Feb 2017
Complete Final Engineering Report, Water Control Manual, and signed Record of Decision	Apr 2017



NATIONAL WEATHER SERVICE PRESENTATION & DISCUSSION

Introduction to Basin Wetness & Forecasts in Folsom Reservoir Operations



CALIFORNIA-NEVADA RIVER FORECAST CENTER (CNRFC)

- CNRFC Overview
- Basin Wetness Methodology
- Ensemble Forecasts/Hindcasts

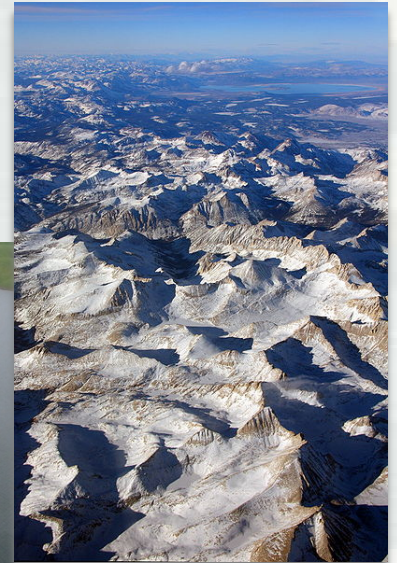
MISSION OF NWS HYDROLOGIC SERVICES PROGRAM

- Provide river and flood forecasts and warnings for the protection of lives and property

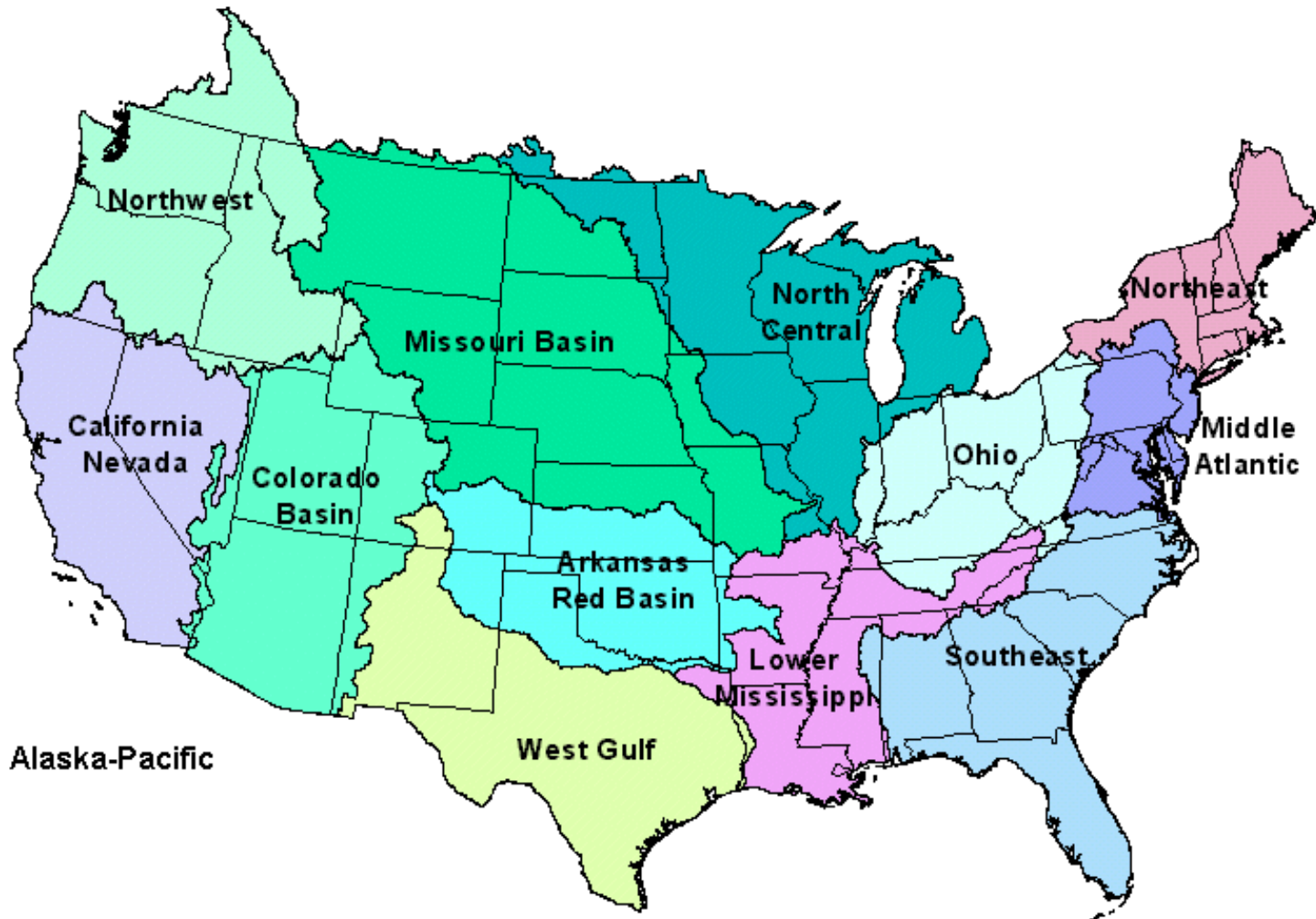


MISSION OF NWS HYDROLOGIC SERVICES PROGRAM

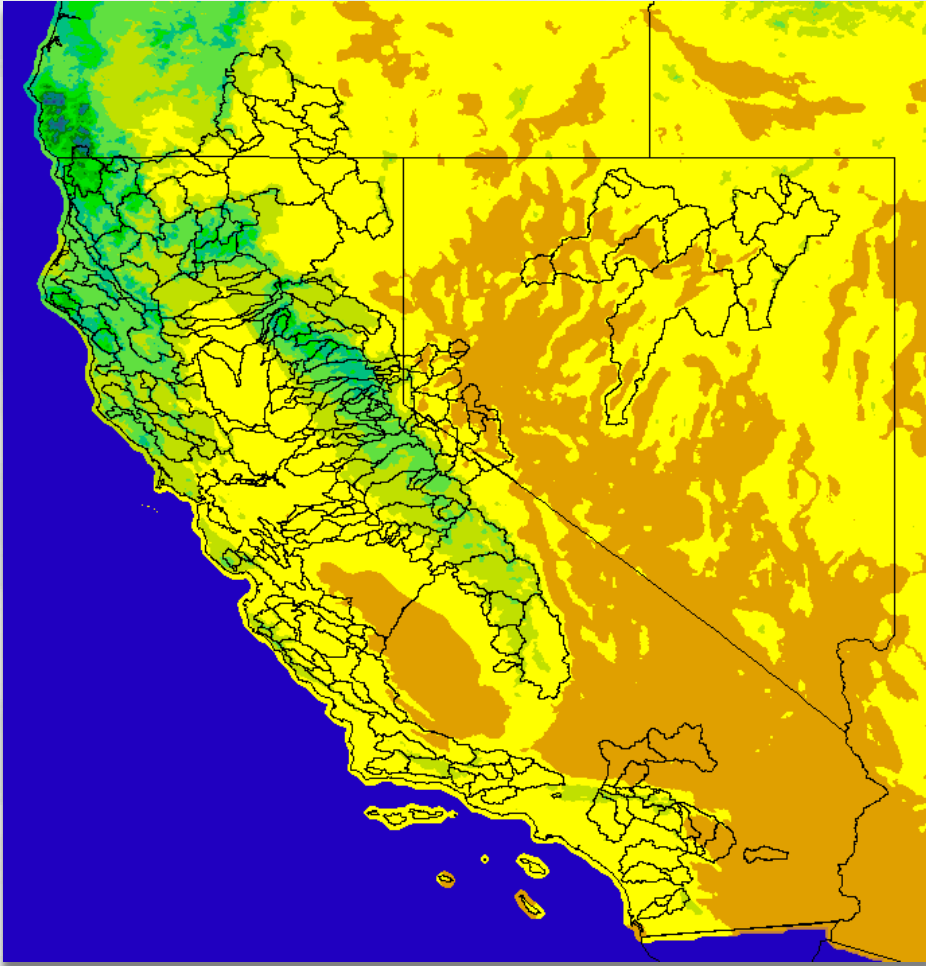
- Provide basic hydrologic forecast information for the nation's environmental and economic well being



NWS RIVER FORECAST CENTERS

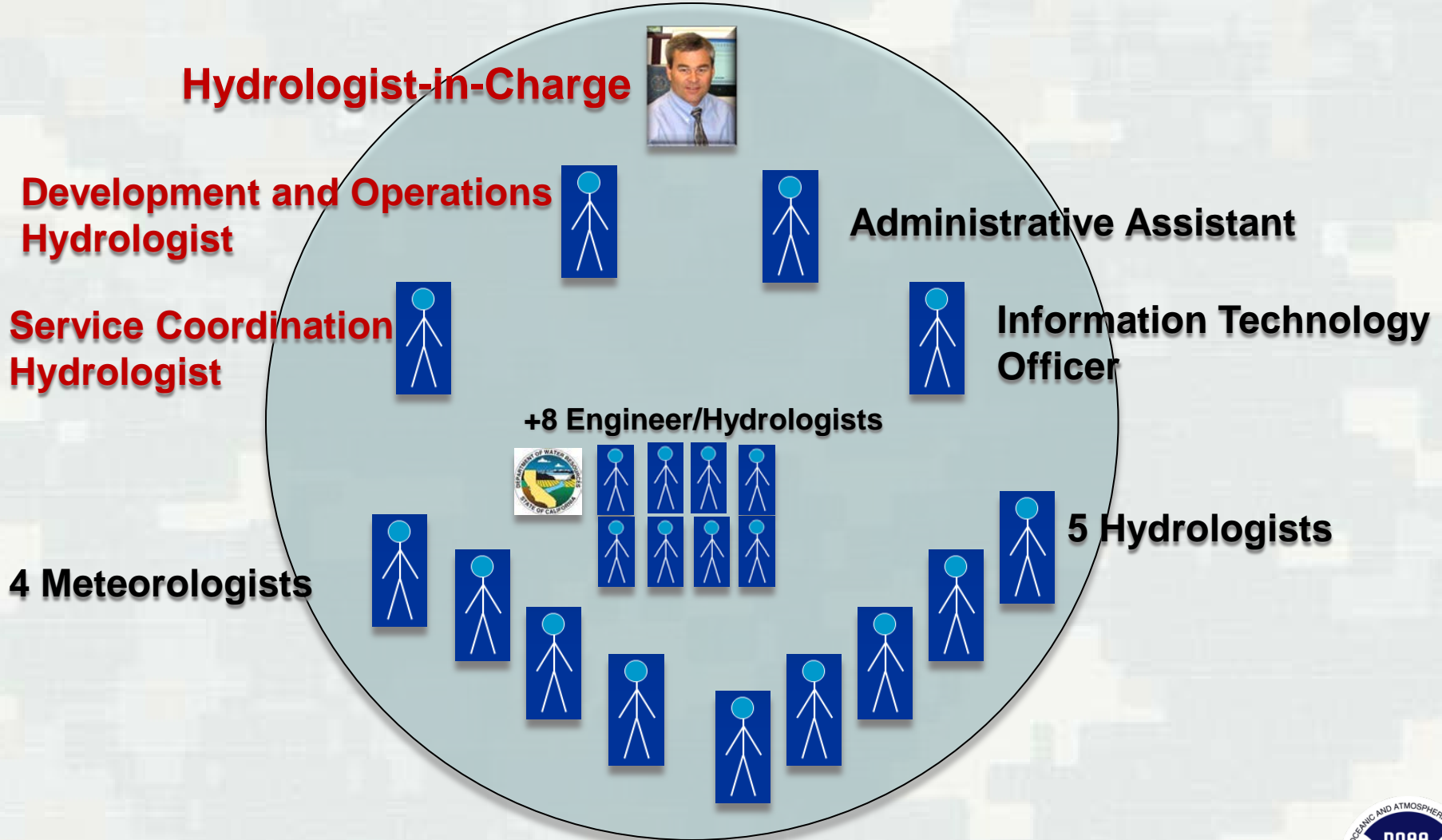


CNRFC OPERATIONS

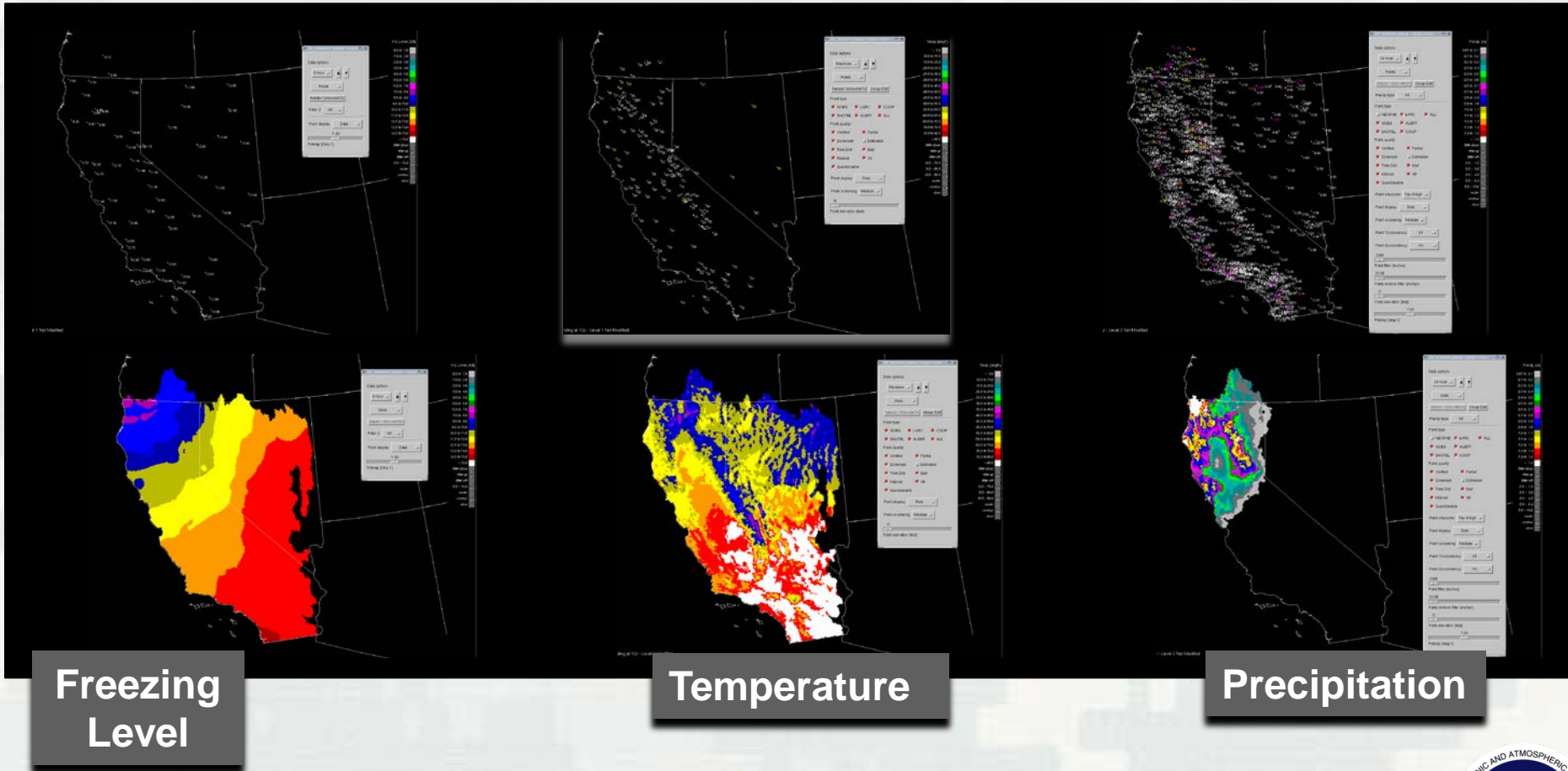


- 245,000 sq. miles
- ~270 Basins modeled
- 92 Forecast Points
- 42 Reservoir Inflows
- 50 Water Supply Points

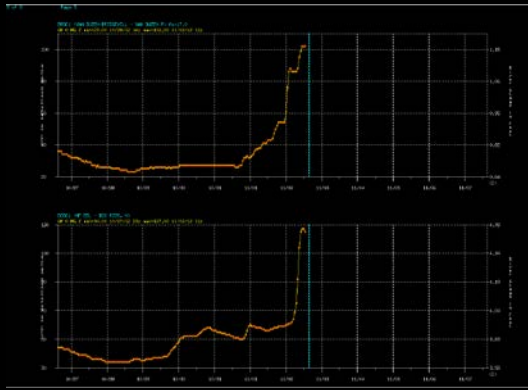
CNRFC STAFFING (14)



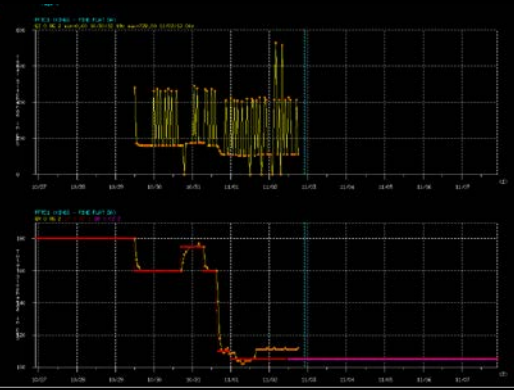
QUALITY CONTROL (QC) & PROCESS OBSERVED METEOROLOGY



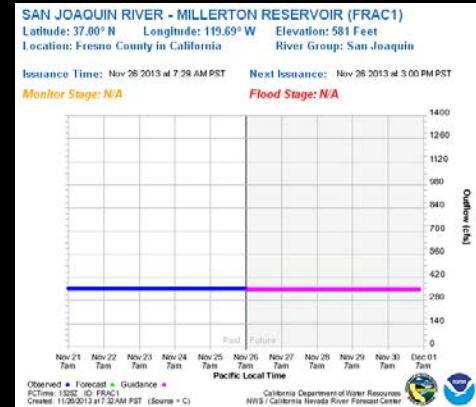
QC & PROCESS HYDROLOGIC DATA



Hourly Stage & Flow



Reservoir Inflow/Outflow & Storage



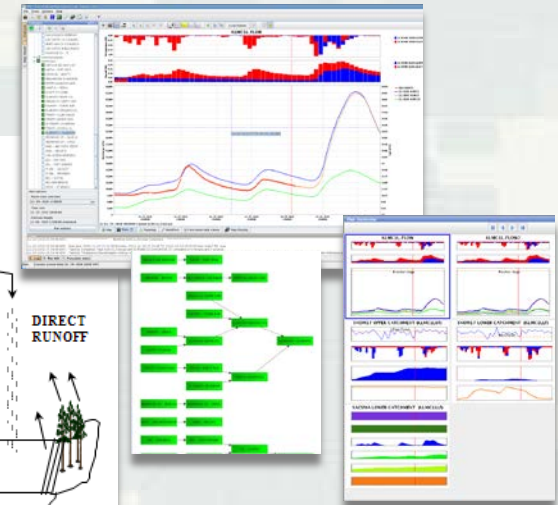
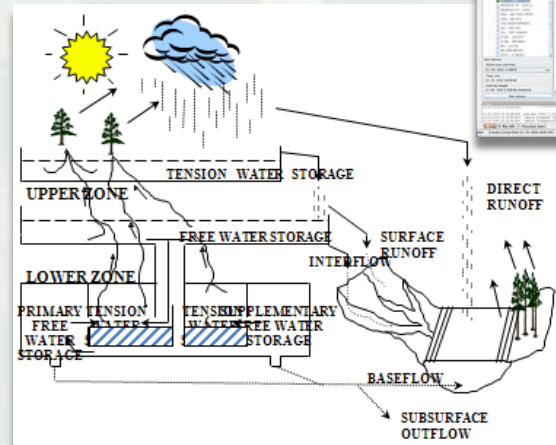
Projected Reservoir Releases



HYDROLOGIC MODELING

Modeling Components

- Rain-Snow Elevation
- Snow-17
- Soil Model (SAC-SMA)
- Unit Hydrograph
- River Routing Models
- Reservoir Models



Model Characteristics

- Basins include elevation zones
- Six Hour Time-Step

DETERMINISTIC RIVER FORECASTS

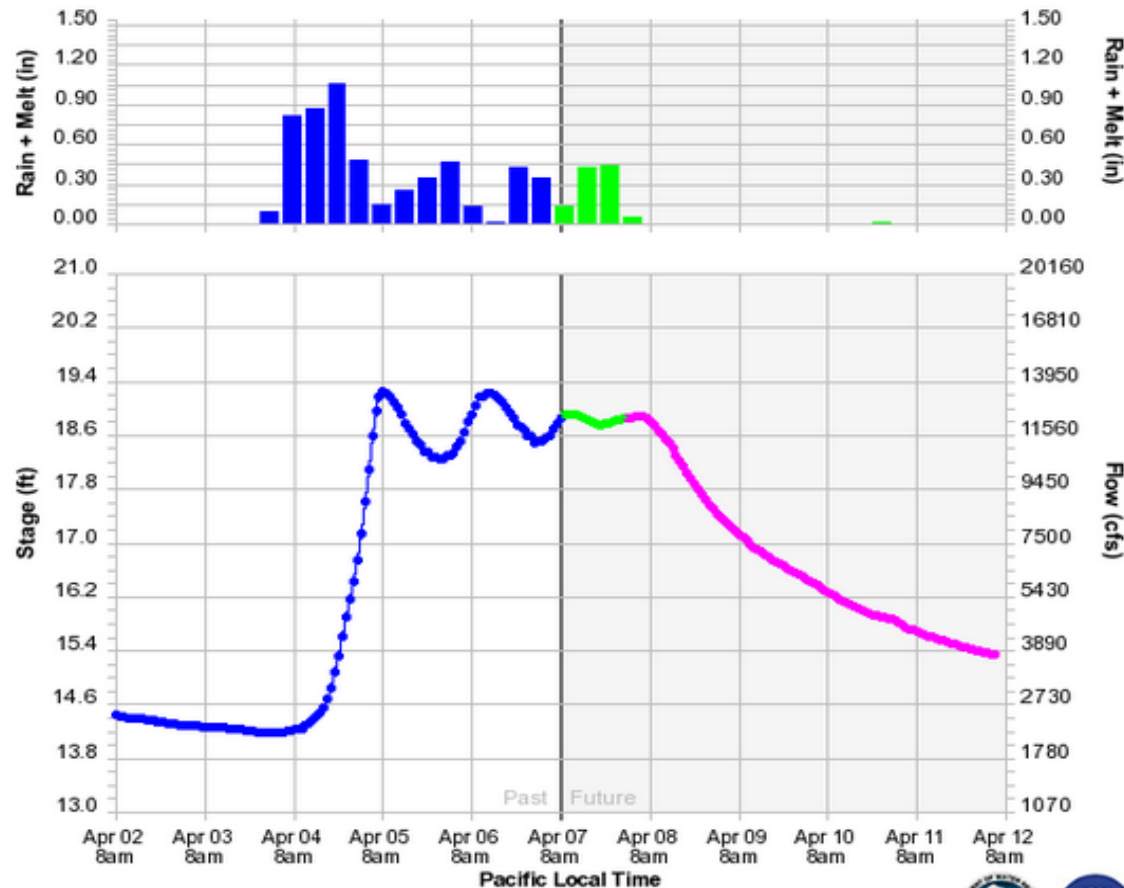
SMITH RIVER - DOCTOR FINE BRIDGE (FTDC1)

Latitude: 41.88° N Longitude: 124.14° W Elevation: 0 Feet
 Location: Del Norte County in California River Group: North Coast

Issuance Time: Apr 07 2013 at 8:18 AM PDT Next Issuance: Apr 08 2013 at 9:00 AM PDT

Monitor Stage: 27.0 Feet

Flood Stage: 33.0 Feet



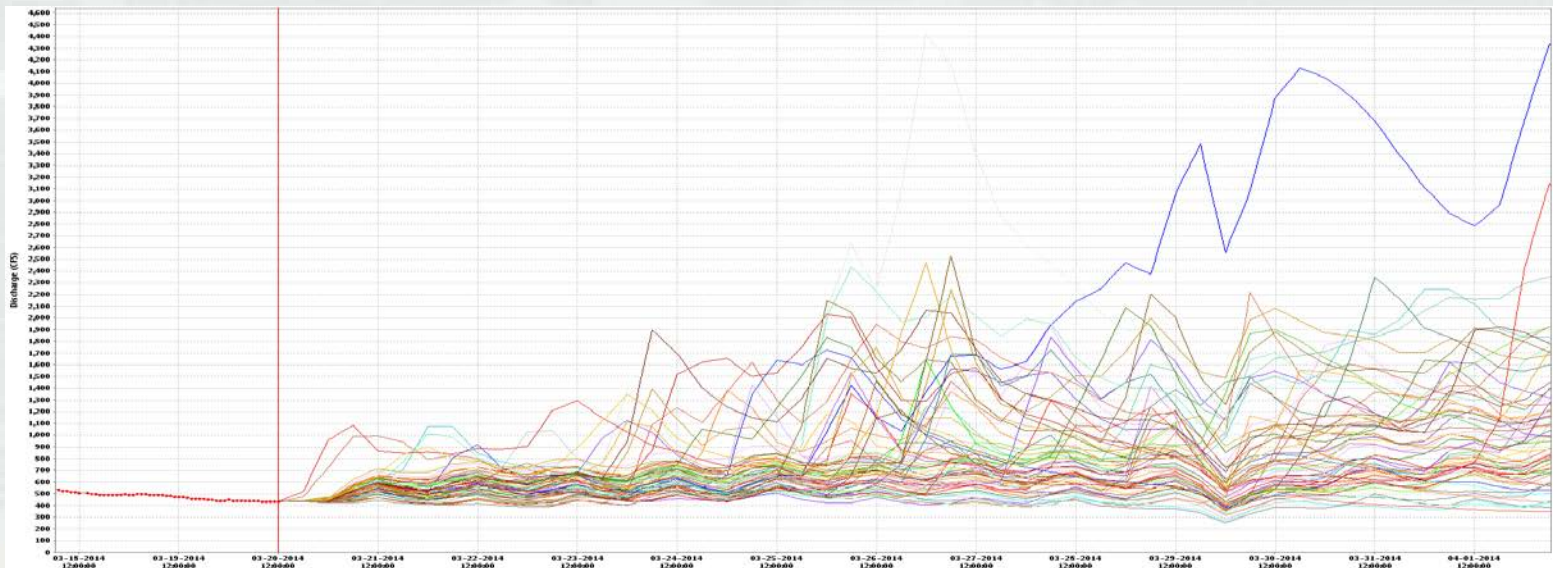
Observed ● Forecast ● Guidance ●
 FCTime: 1517Z ID: FTDC1
 Created: 04/07/2013 at 8:21 AM PDT (Source = C)

California Department of Water Resources
 NWS / California Nevada River Forecast Center



ENSEMBLE FORECASTS

- Start with current model states
- Feed hydrology model with multiple meteorological possibilities
- Result is 60+ hydrographs

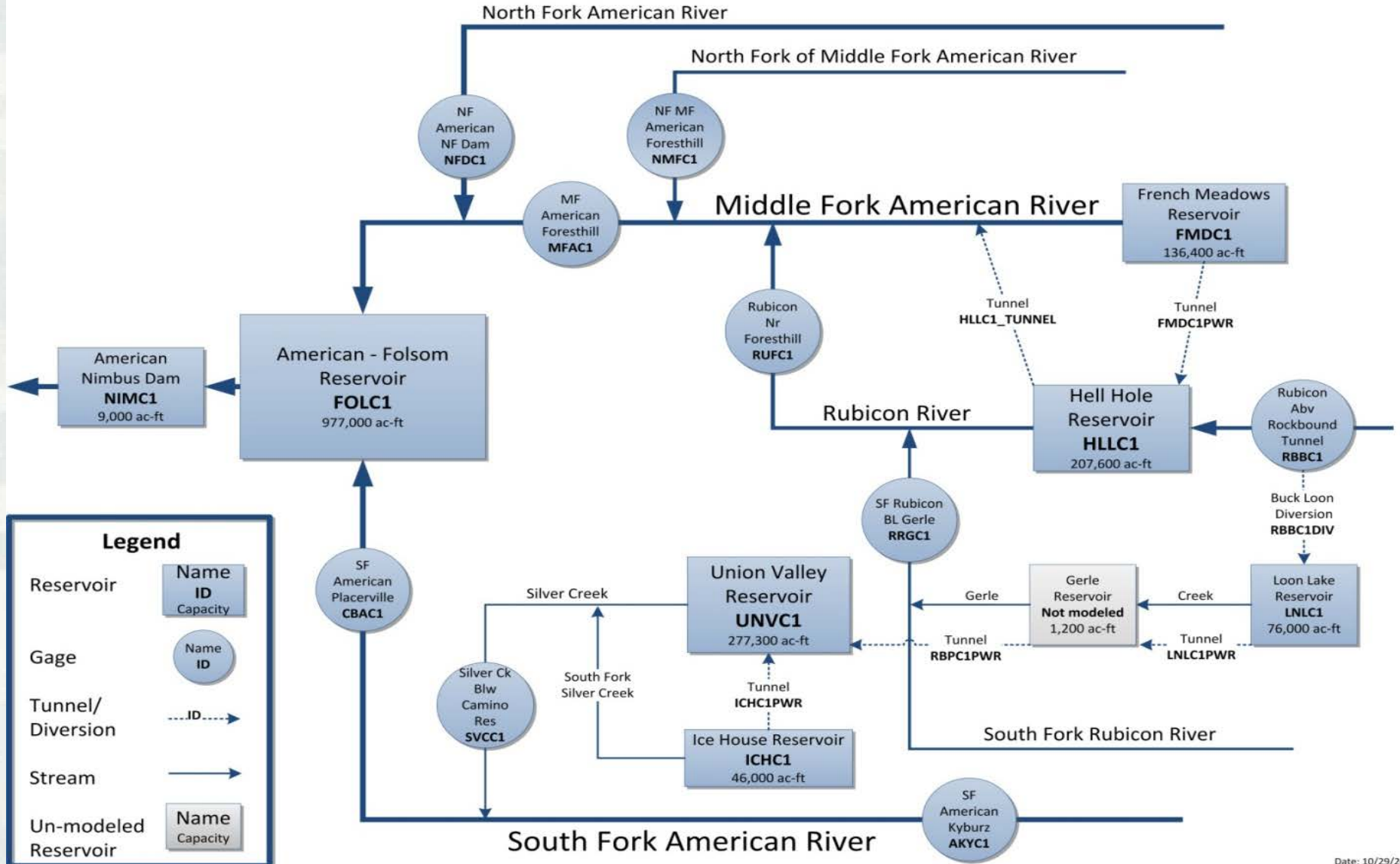


....More on this later

CNRFC AMERICAN RIVER HYDROLOGIC MODEL



CNRFC AMERICAN RIVER HYDROLOGIC MODEL

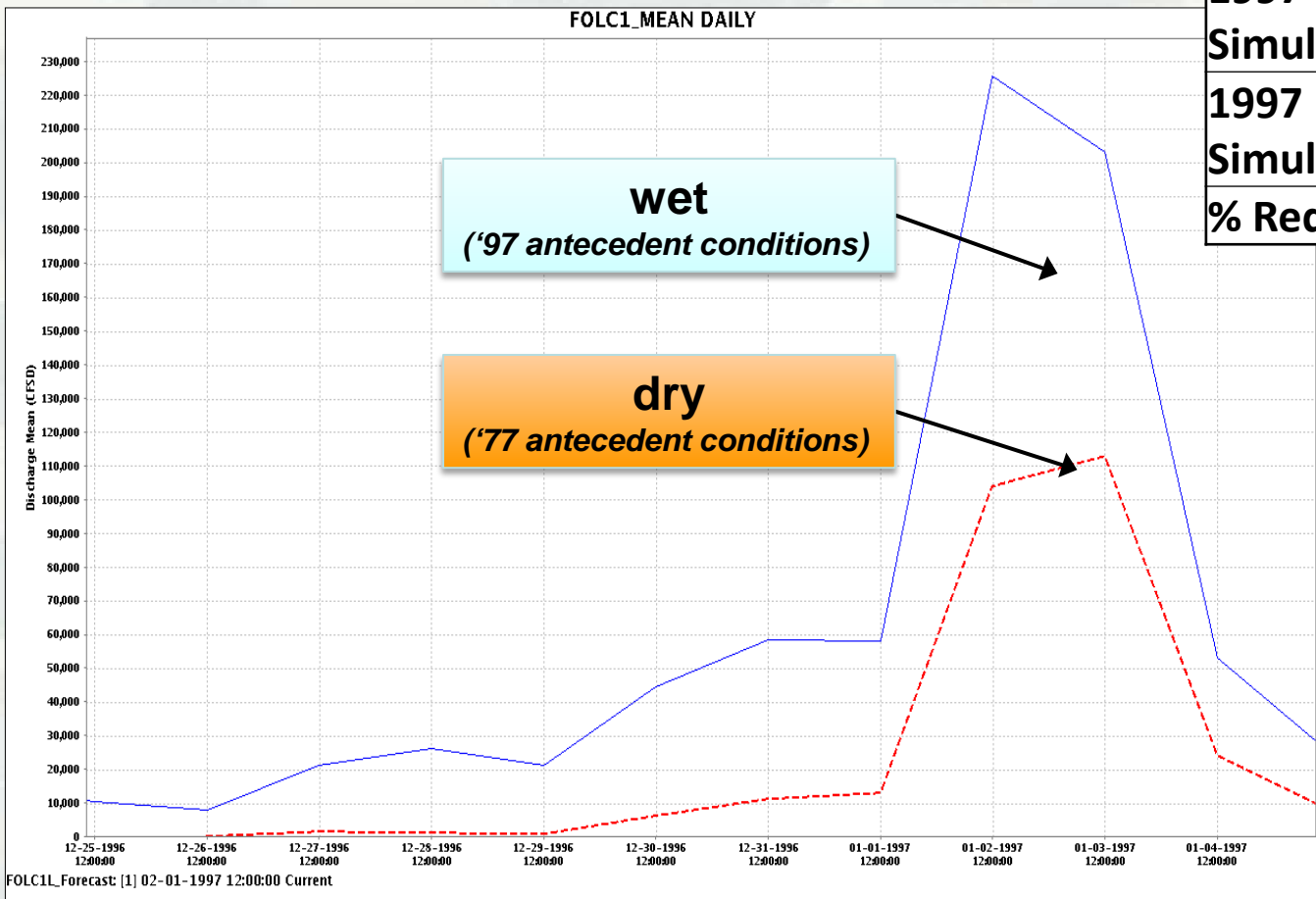


BASIN WETNESS INDEX (BWI) USING CNRFC MODELING



'97 EVENT INITIAL CONDITION COMPARISONS

Condition	Max 3-day flow (cfs)
1997 Historical Simulation	162,000
1997 Dry Simulation	80,000
% Reduction	51%

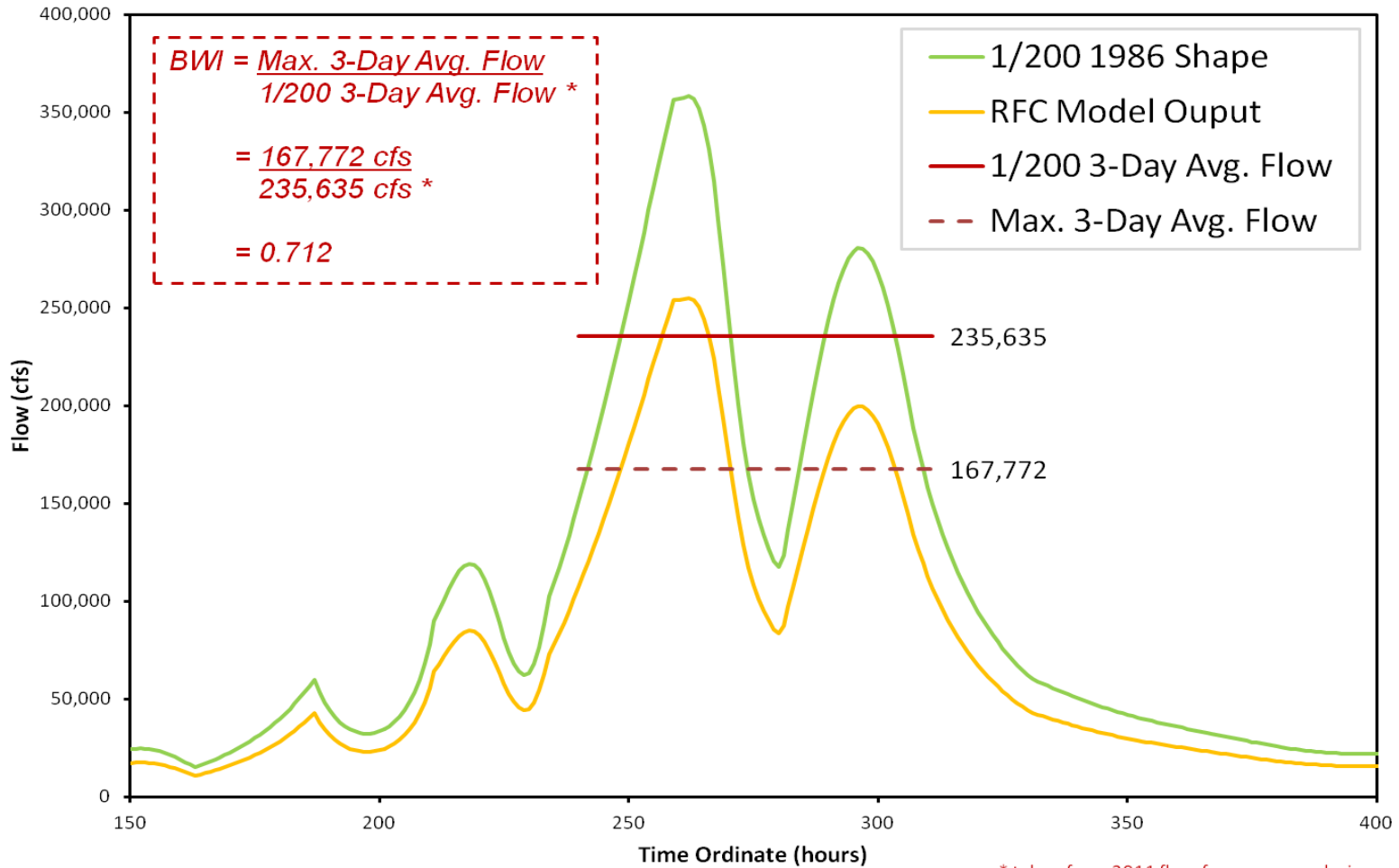


CNRFC MODEL-BASED BWI

- Drop 1/200 year precipitation on basin every day
- Compare how the current day's 3-day volume compares to the “wet” 1/200 year
- This ratio will be the basin wetness indicator

CNRFC MODEL-BASED BWI

CALCULATION OF THE RFC MODEL-BASED INDEX



$$BWI = \frac{\text{Max. 3-Day Avg. Flow}}{\text{1/200 3-Day Avg. Flow}^*}$$
$$= \frac{167,772 \text{ cfs}}{235,635 \text{ cfs}^*}$$
$$= 0.712$$

- 1/200 1986 Shape
- RFC Model Output
- 1/200 3-Day Avg. Flow
- Max. 3-Day Avg. Flow

* taken from 2011 flow frequency analysis



CNRFC MODEL-BASED BWI 1/200 PRECIPITATION DESIGN

- Take max 5 days of 1986 mean aerial precipitation and scale up iteratively until max 3-day volume matches 1/200 value from flow frequency curve
- “Wet” condition is assumed to be conditions in 1986 prior to the maximum 5 days of rain
- This was also done for the 1997 event
- 1986 was chosen as THE 1/200 year event for basin wetness because it proved to be a better ‘naturally’ balanced pattern



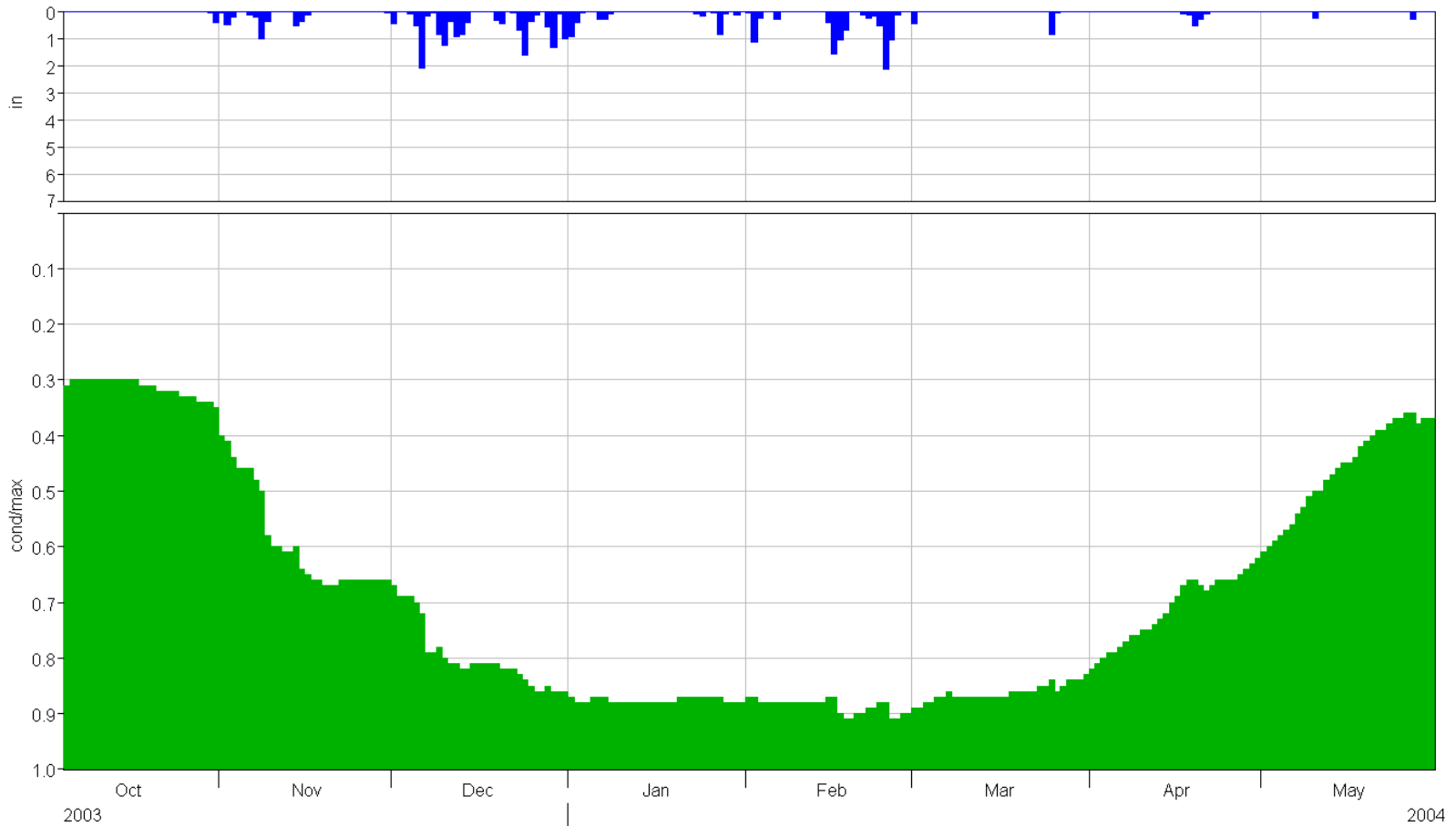
CNRFC MODEL-BASED BWI PERIOD OF RECORD SIMULATION

- Generate a period of record simulation in the CNRFC model (1948-2010) using historical precipitation and temperature
- Save off the basin conditions for every day in that period of record
- Result = over 20,000 different basin conditions
- Then drop the 1/200 event on every single one of these basin conditions



CNRFC MODEL-BASED BWI

WATER YEAR 2004

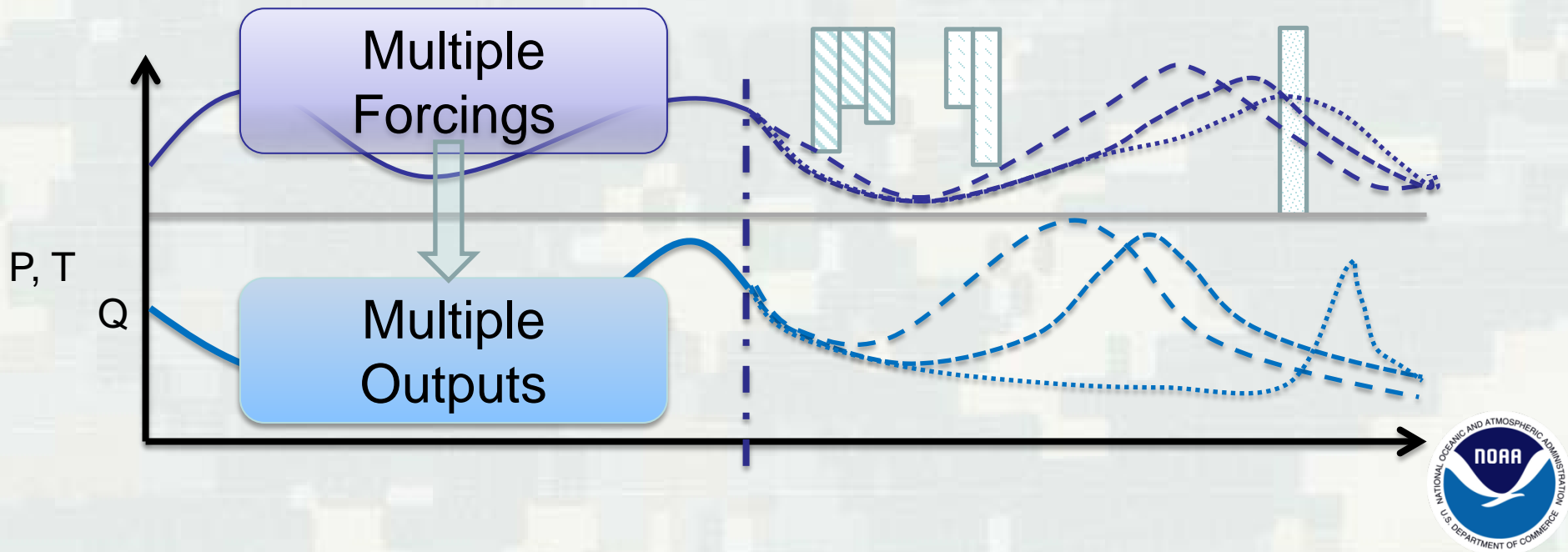


ENSEMBLE FORECASTING & HINDCASTING

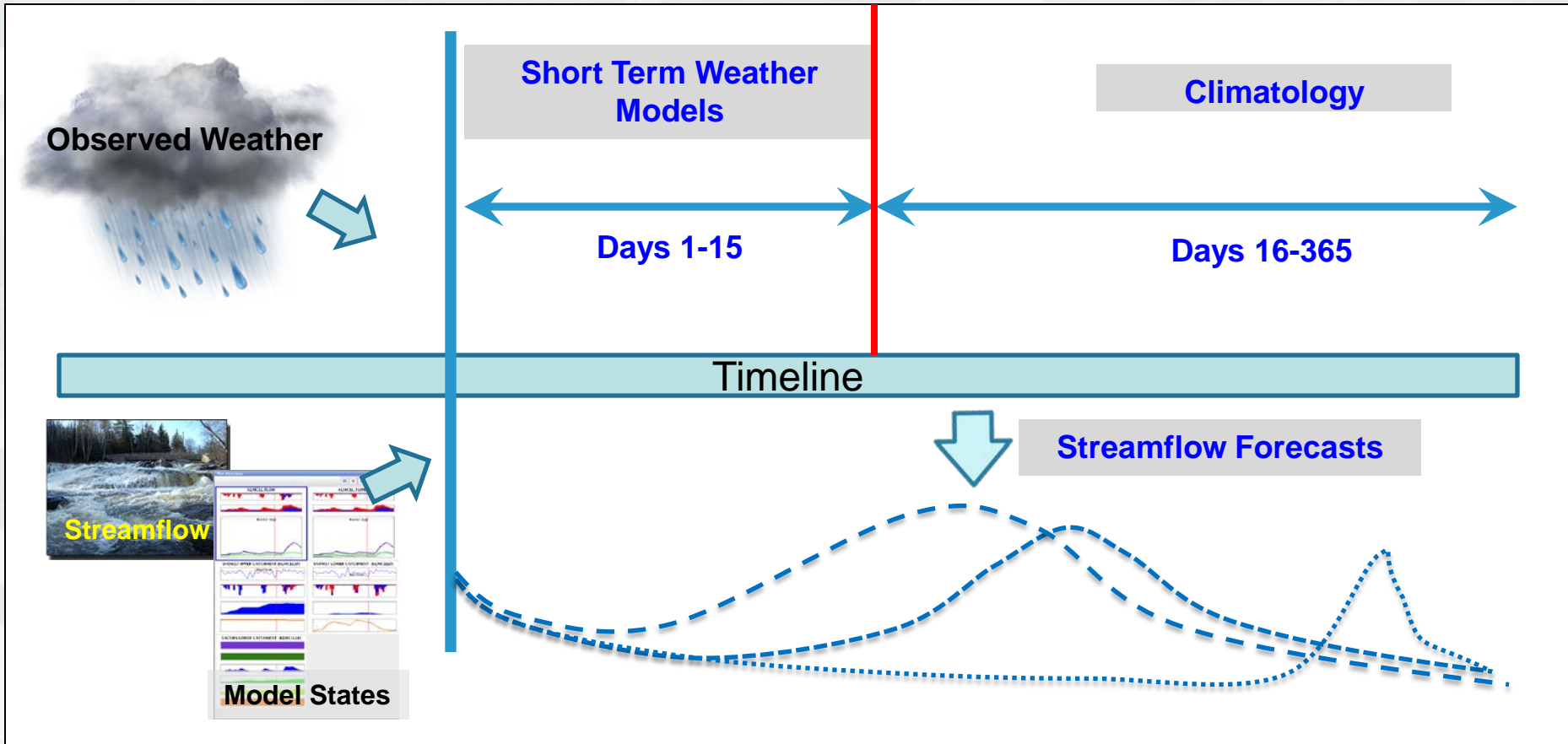


WHAT IS ENSEMBLE FORECASTING?

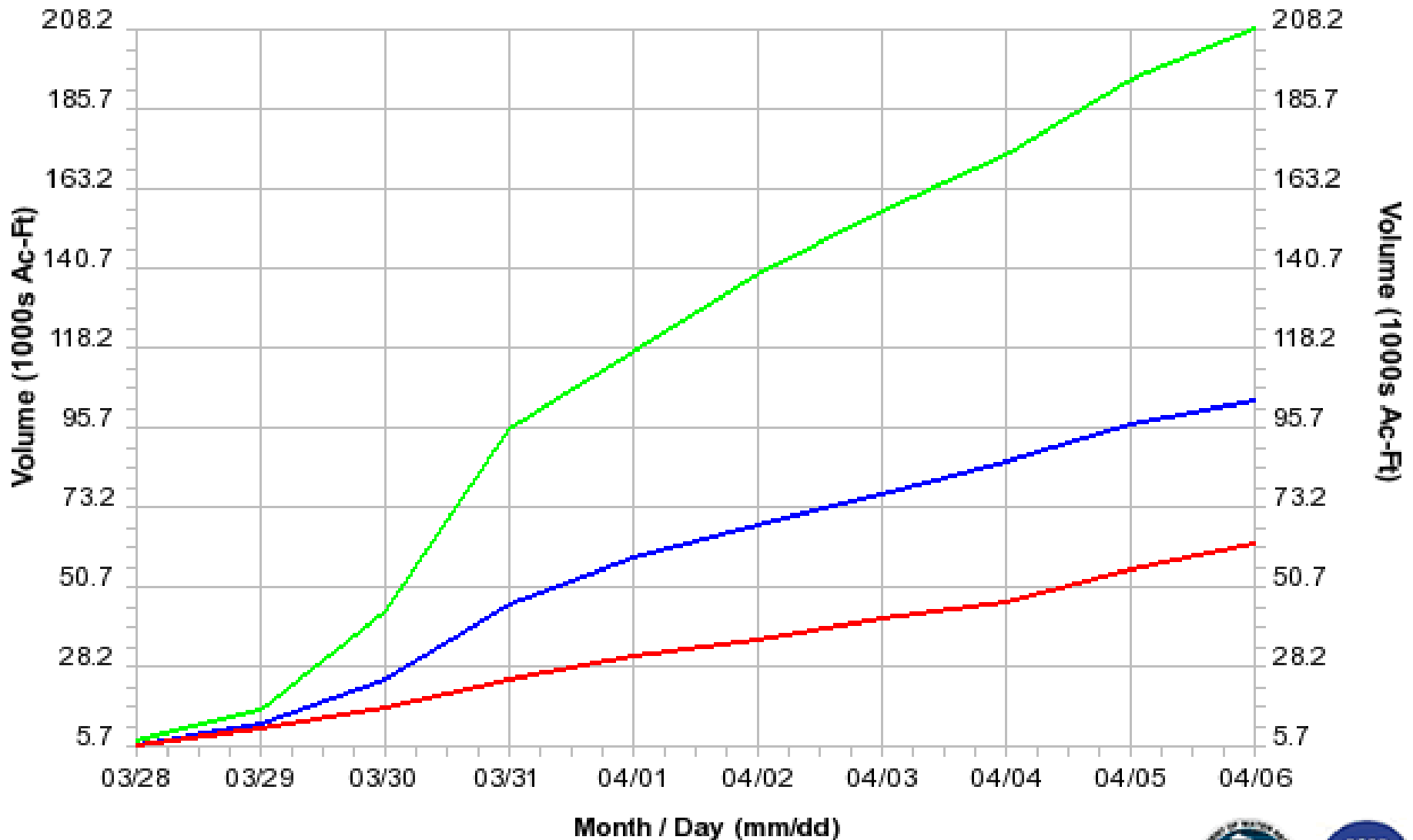
- Multiple precipitation and temperature forcings
- Results in multiple streamflow forecasts



EMSEMBLE RIVER FORECASTS



PROBABILISTIC INFLOW VOLUME FORECAST



10% (Max) — 50% (Prob) — 90% (Min) —
Generated 03/27/2014 at 09:22 AM PDT (ID = FOLC1)

California Department of Water Resources
NWS / California Nevada River Forecast Center



HINDCASTING

Hindcast:

Ensemble forecast performed for historical time period using current forecasting methodology

Value of Hindcasts:

Provide a large sample for verification

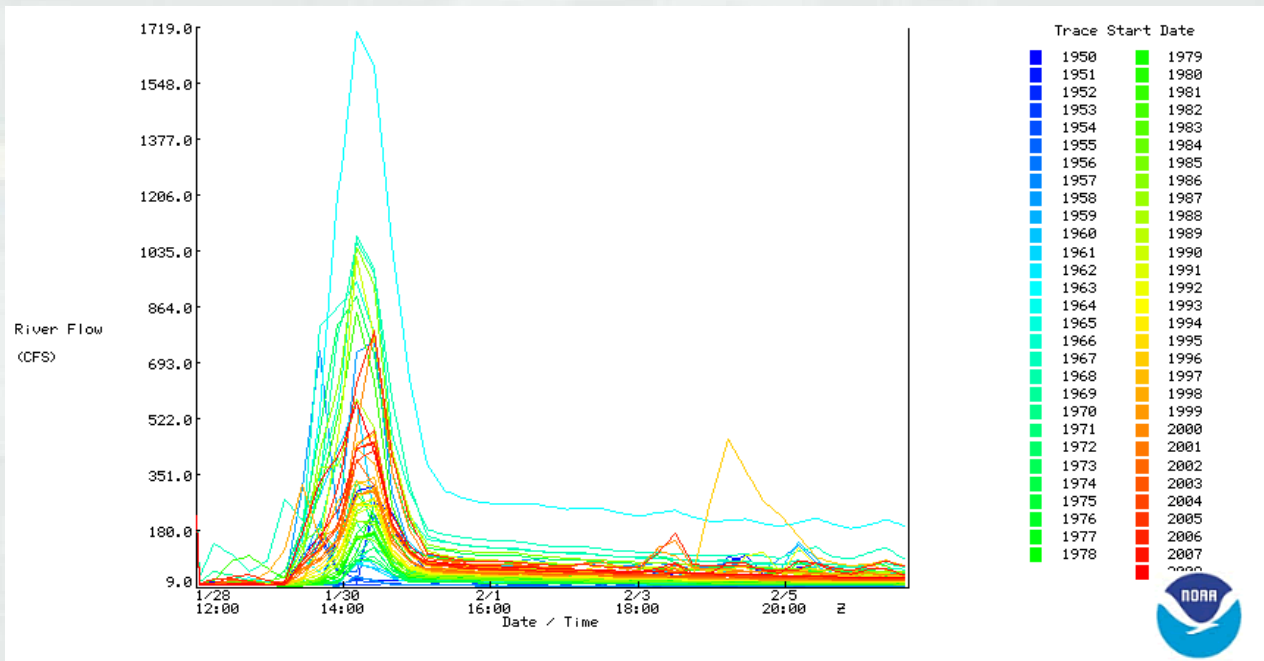
Provide a consistent sample for verification

Bottom Line: demonstrate forecast quality/reliability

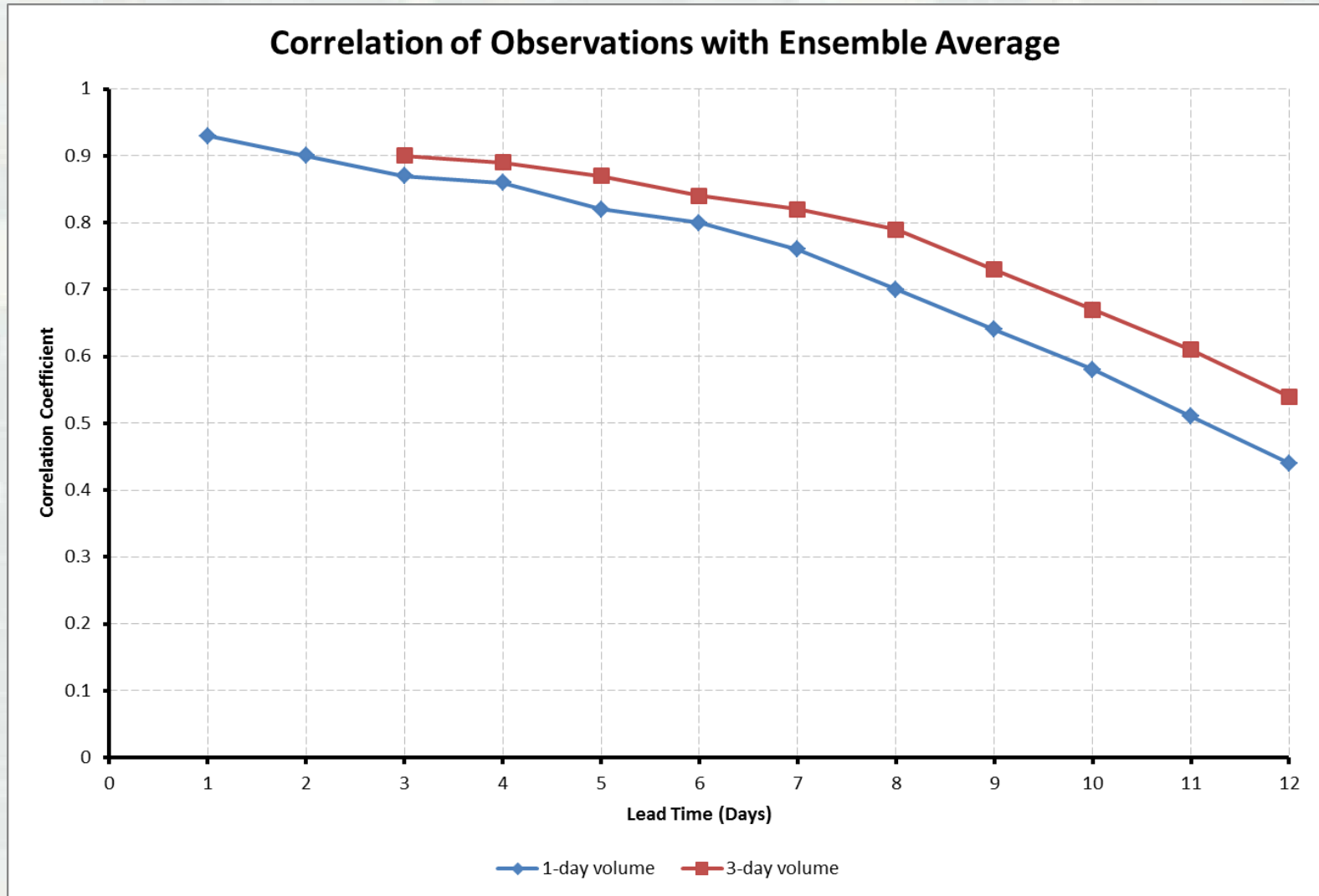


HINDCAST FINAL PRODUCTS

- Hourly ensemble inflow forecasts to Folsom
 - ▶ 61 traces per day
- Daily forecasts for 1985-2010



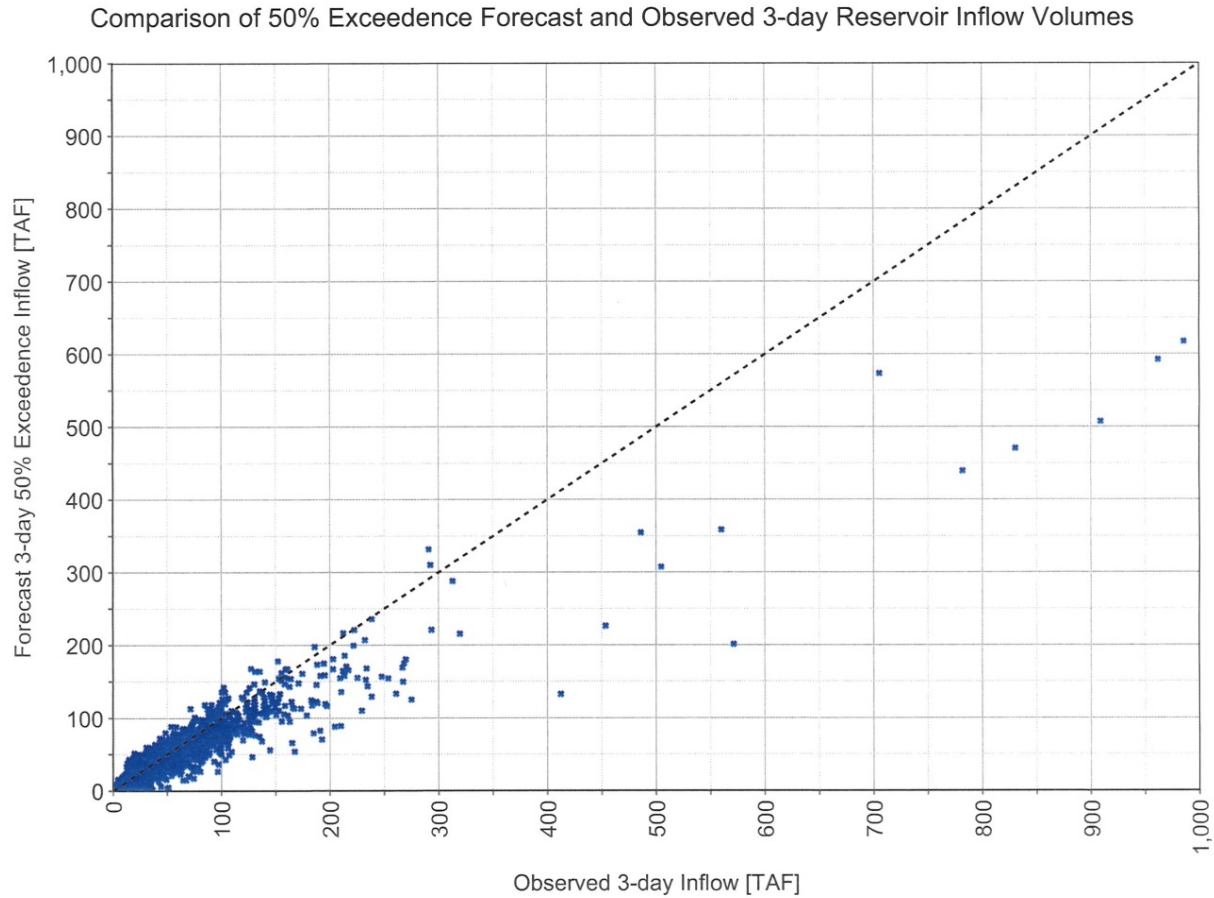
HINDCAST VERIFICATION OF RESULTS



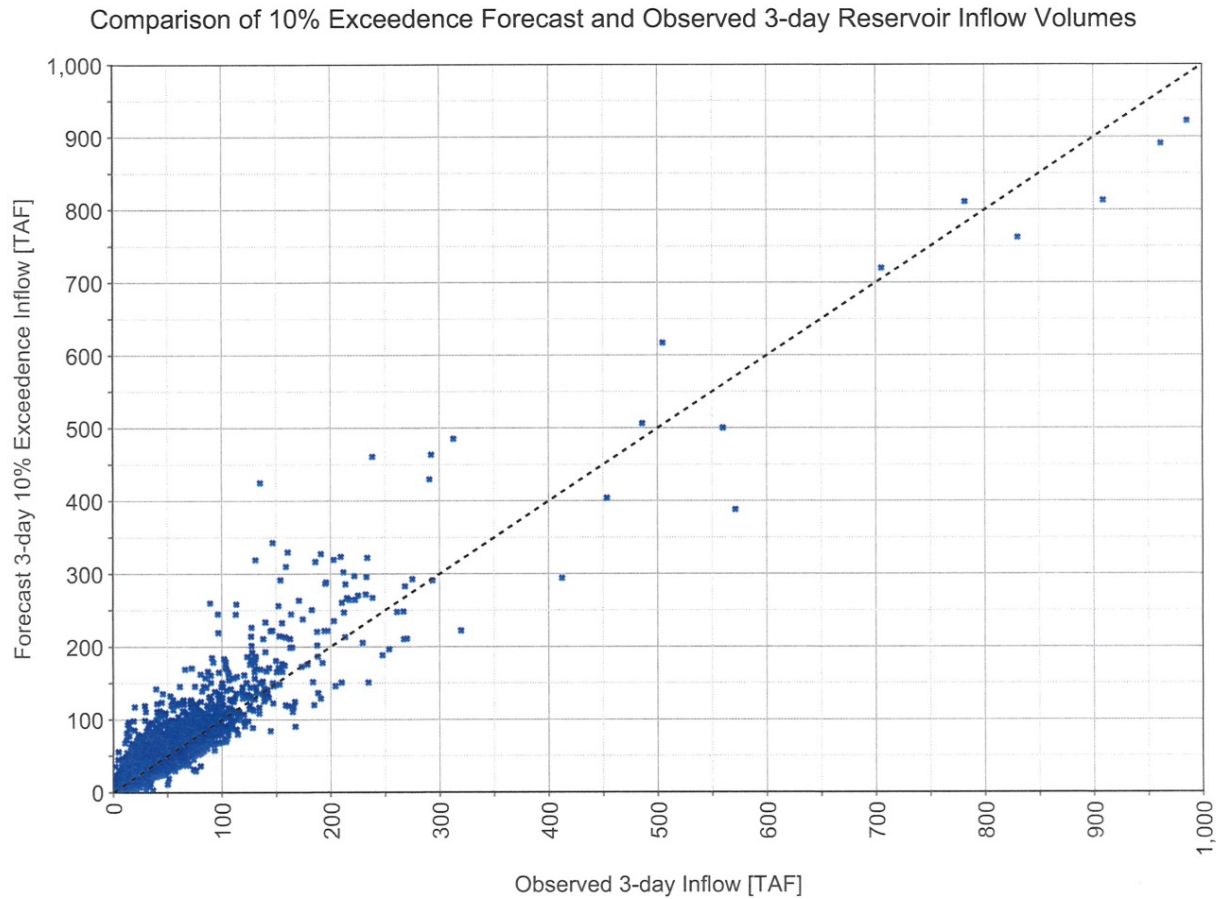
Note – These results are for winter (Dec-Feb)



HINDCAST VERIFICATION OF RESULTS



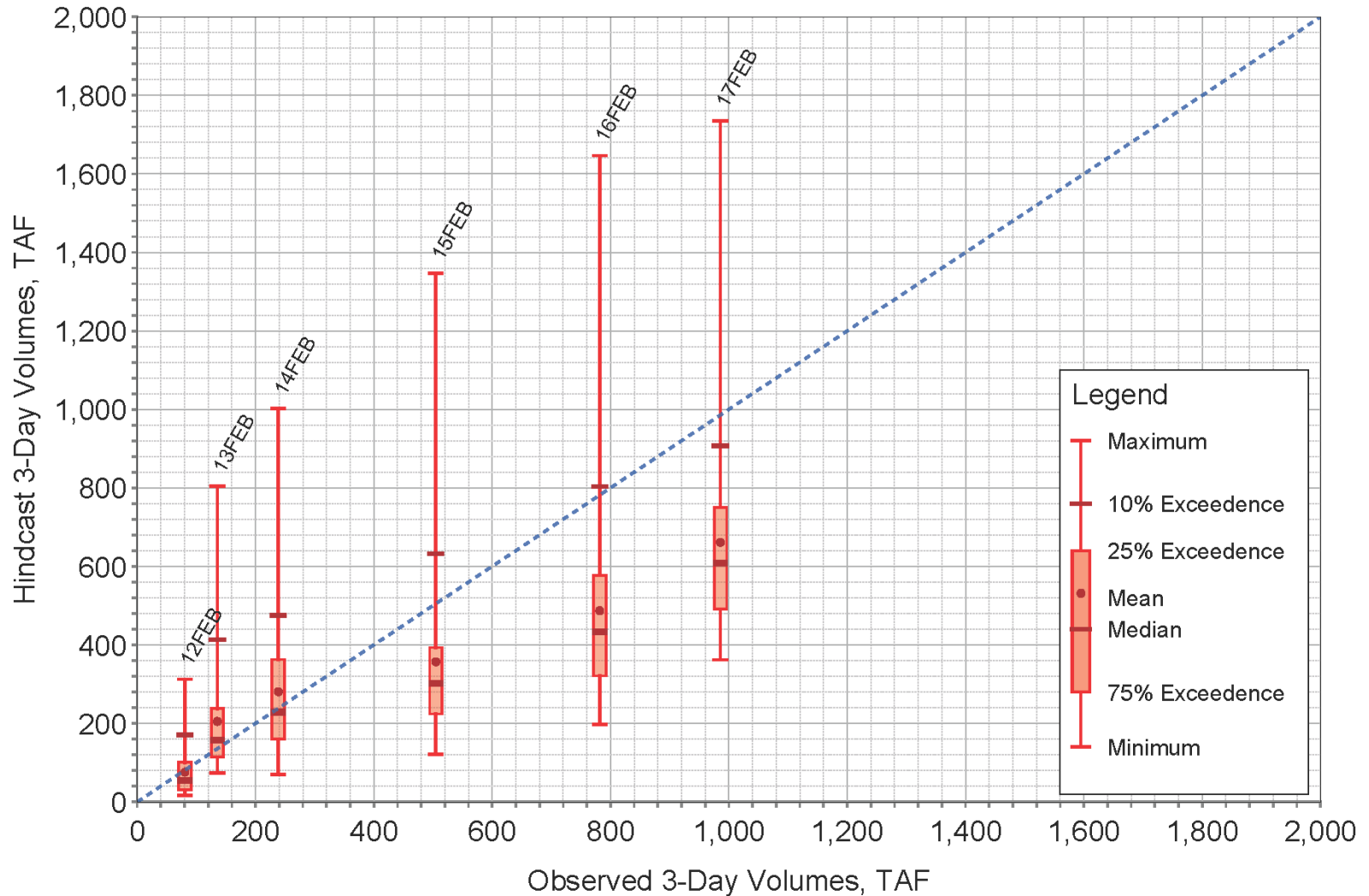
HINDCAST VERIFICATION OF RESULTS



1986 HINDCAST INFORMATION

Comparison of Observed and Hindcast 3-Day Volumes for 1986 Flood Event

Start Time: 12 February 1986, 24:00, End Time: 17 February 1986, 24:00



HINDCAST CONCLUSIONS

- Big events don't sneak up on us
- Apparent dry bias for larger events
- Release rules can be conditioned based on forecast biases/spread
- Limited sample set of large events is a challenge

ENSEMBLE FORECAST FUTURE DEVELOPMENT

- Extreme event improvements
- Incorporate hydrologic uncertainty (post-processing)
- Assess value of incorporating climate forecasts (beyond day 15)

QUESTIONS & COMMENTS



CLOSING REMARKS

