



Hydrologic Forecasting Capability and Gaps

**Alan Haynes
Hydrologist in Charge**

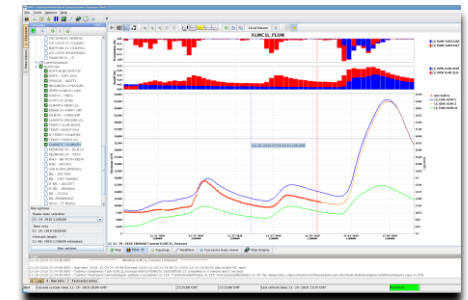
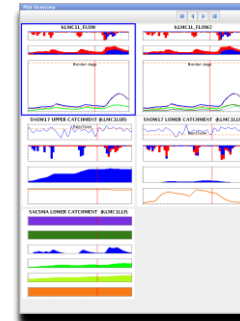
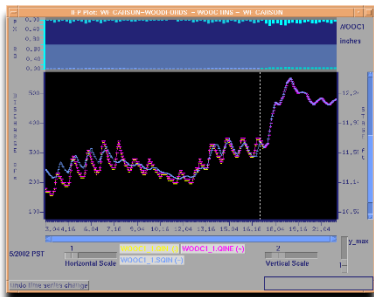
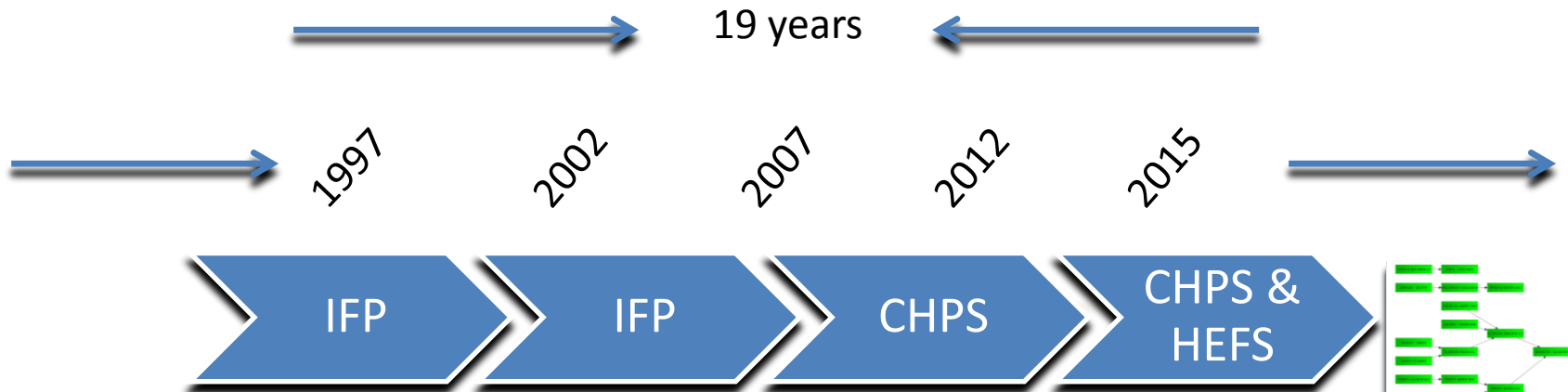
NOAA/NWS – California Nevada River Forecast Center

August 2019

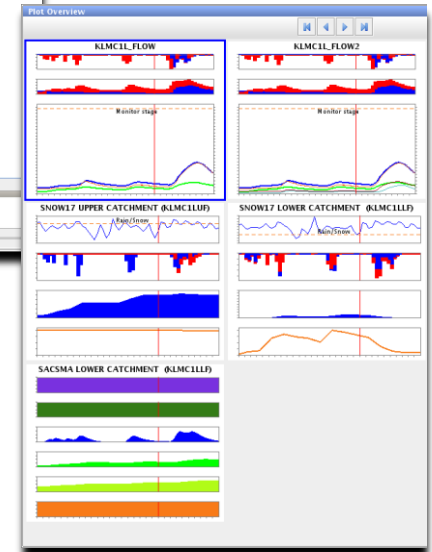
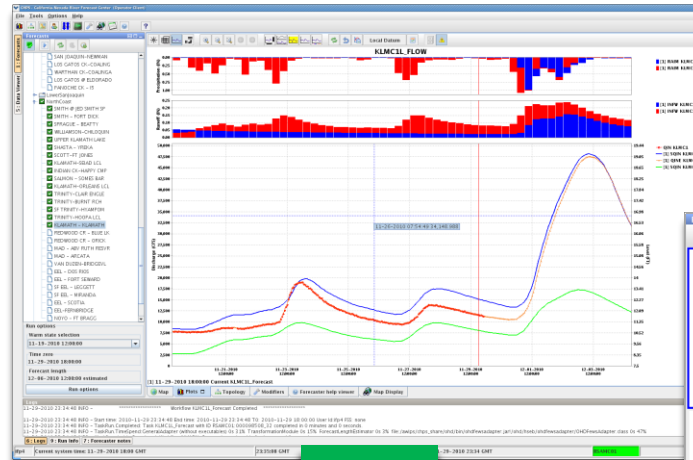
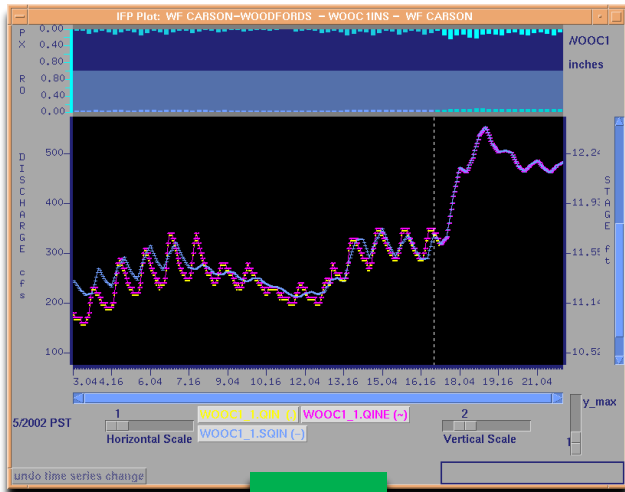
Biggest Gaps in Hydrologic Forecasting Capability Based on User Needs

- **Skillful long-lead forecasts**
 - Hydrologic forecasting skill for floods is highly dependent on meteorological forecast skill which drops off considerably after just a few days and disappears after 2 weeks
 - Probabilistic hydrologic forecast skill for seasonal forecasts is dependent on knowledge of snowpack
- **Rapid-onset flooding**
 - NWS legacy hydrologic forecasts are not designed to handle rapid-onset flooding
 - Hydrologic model time-step is six hours and skillful hourly and sub-hourly forcings don't exist
 - National Water Model is a potential solution, but it needs skillful hourly and sub-hourly forcings
- **Lack of extensive validation for probabilistic hydrologic forecasts**
 - Developing validation information for probabilistic hydrologic forecasts is resource-intensive and therefore limited
- **High uncertainty in forecasting land-falling atmospheric rivers**
 - Land-falling atmospheric rivers are narrow and subject to modulation by small-scale atmospheric phenomena such as frontal waves which result in spatial and temporal errors

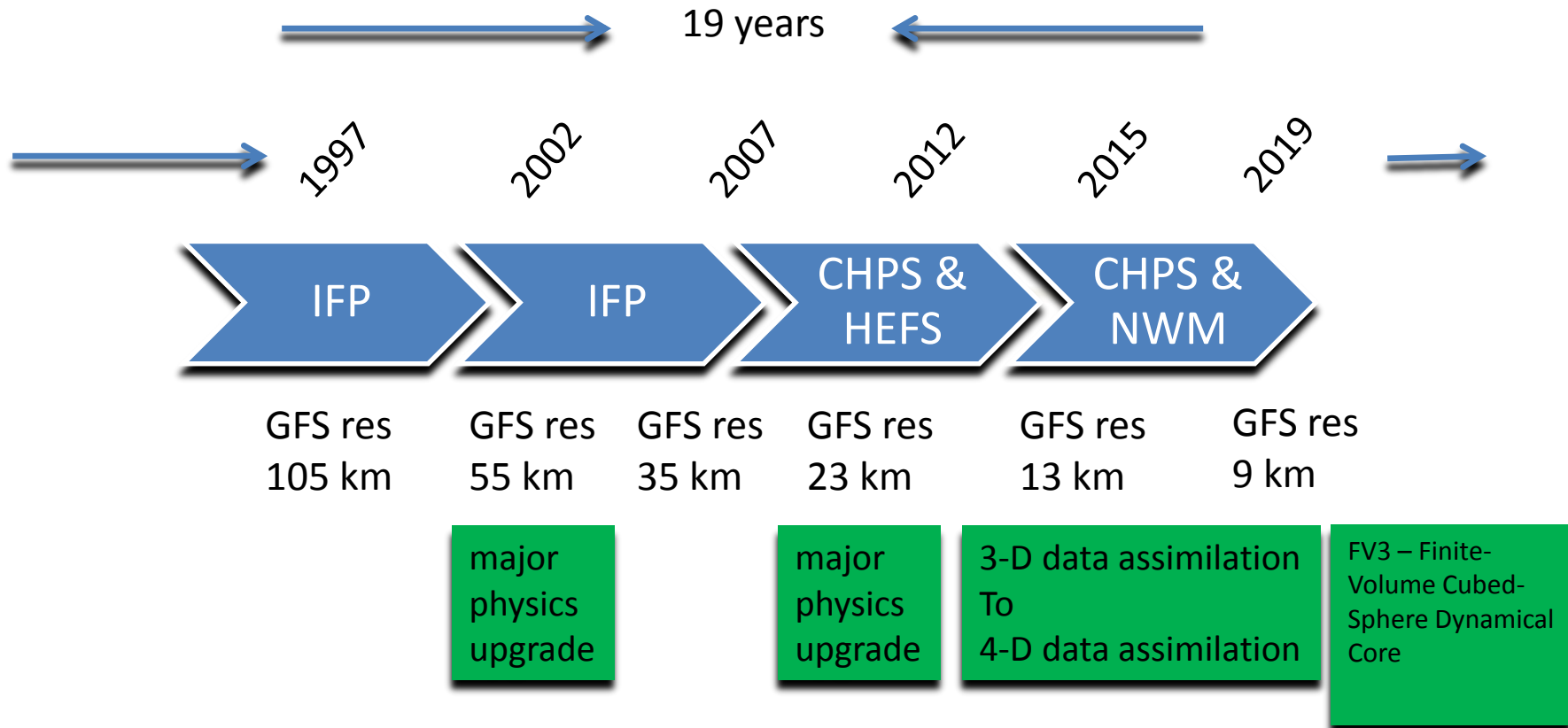
Evolution of Atmospheric & Hydrologic Modeling Capabilities



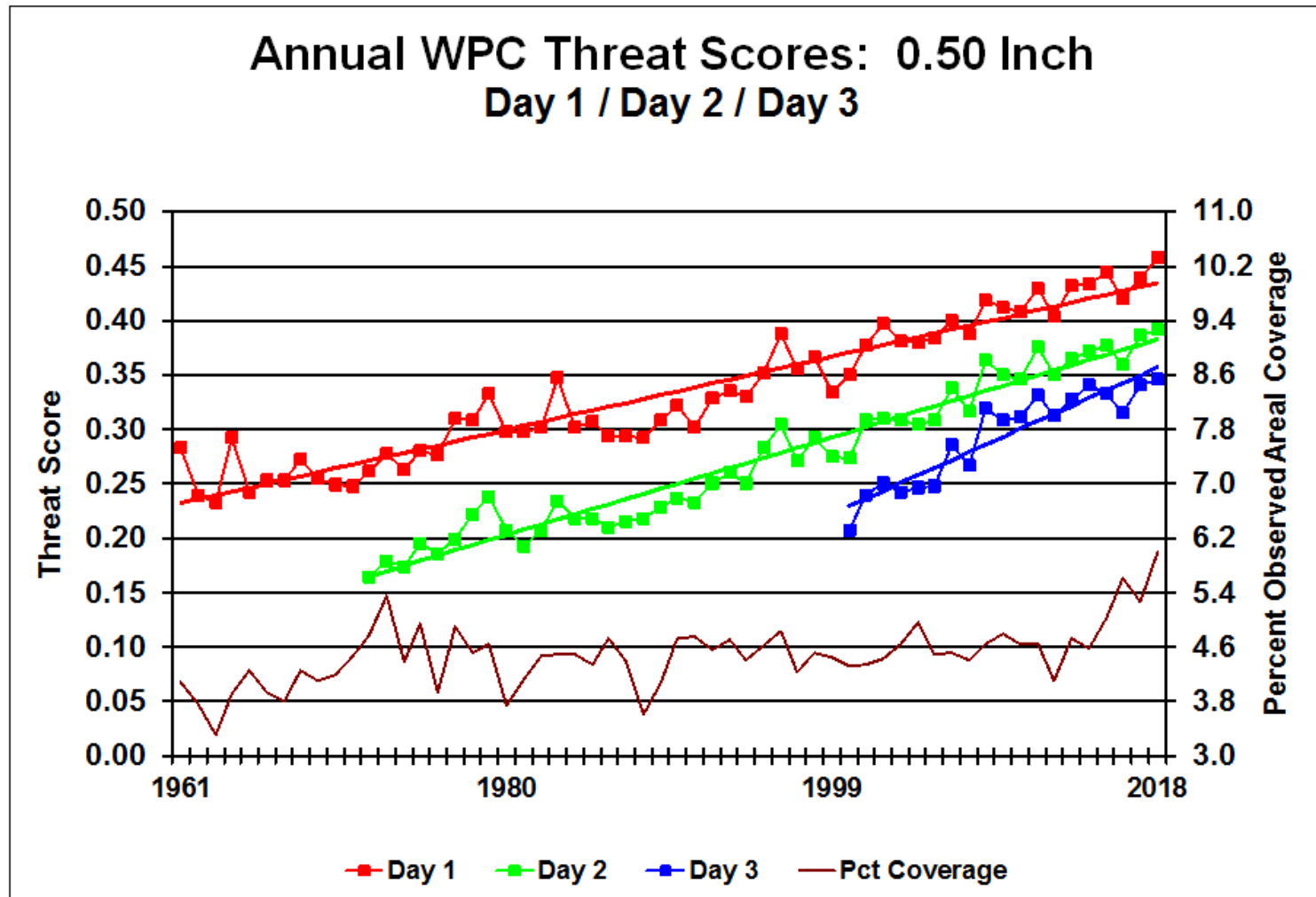
Hydrologic Modeling Visualization



Evolution of Atmospheric & Hydrologic Modeling Capabilities

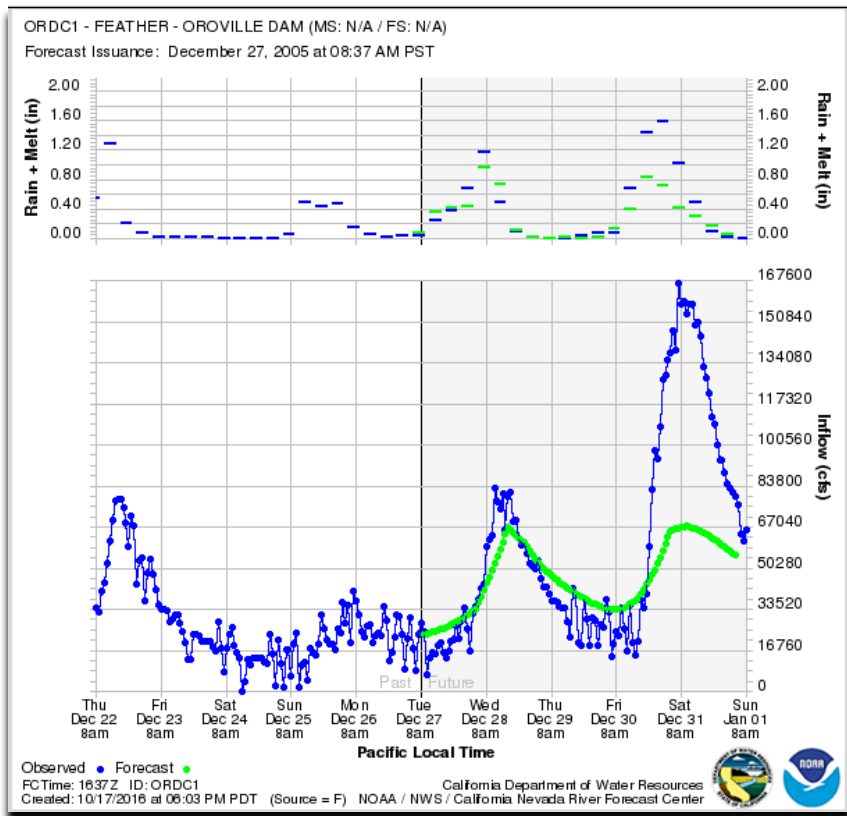


Long-Term Trends in Precipitation Forecast Skill (national scale)

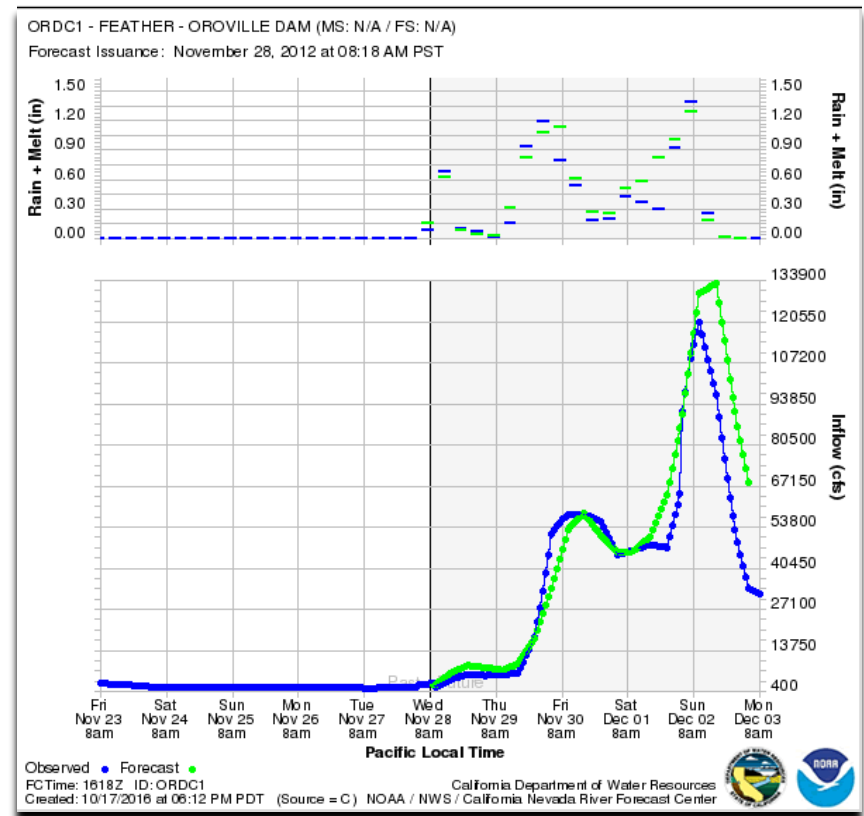


Lake Oroville Inflow

Late December 2005 vs Early December 2012



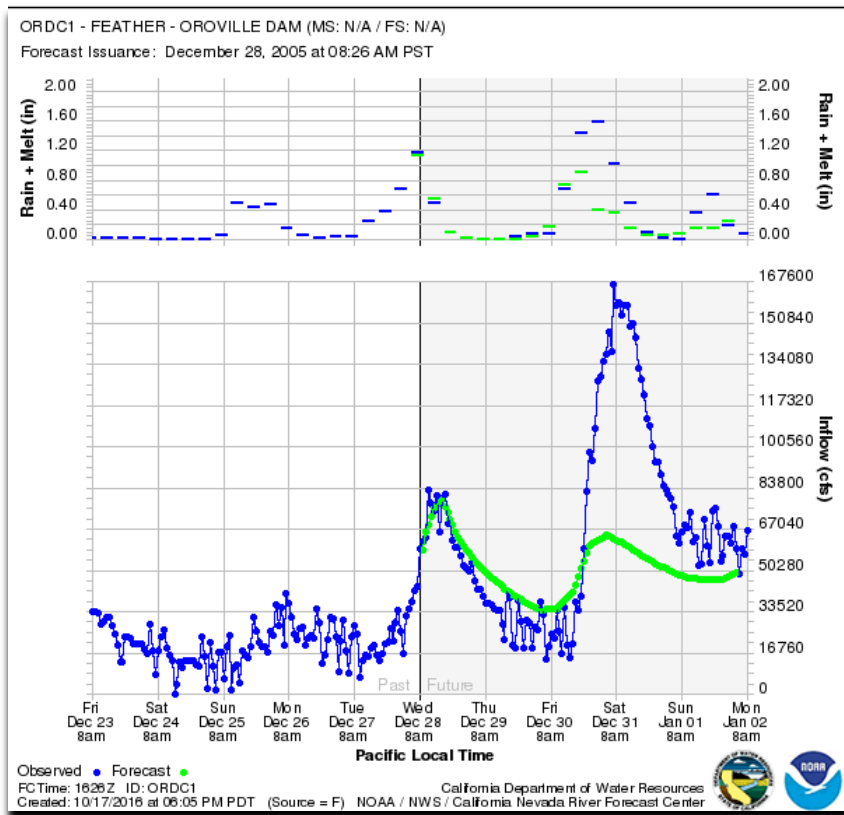
Dec 27th 2005



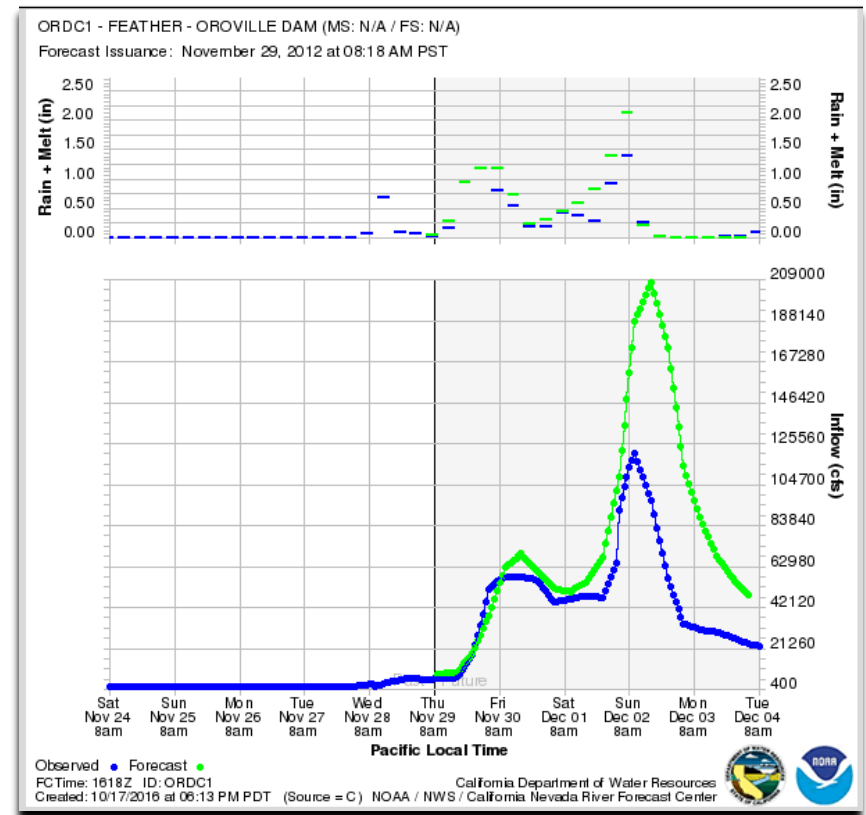
Nov 28th 2012

Lake Oroville Inflow

Late December 2005 vs Early December 2012



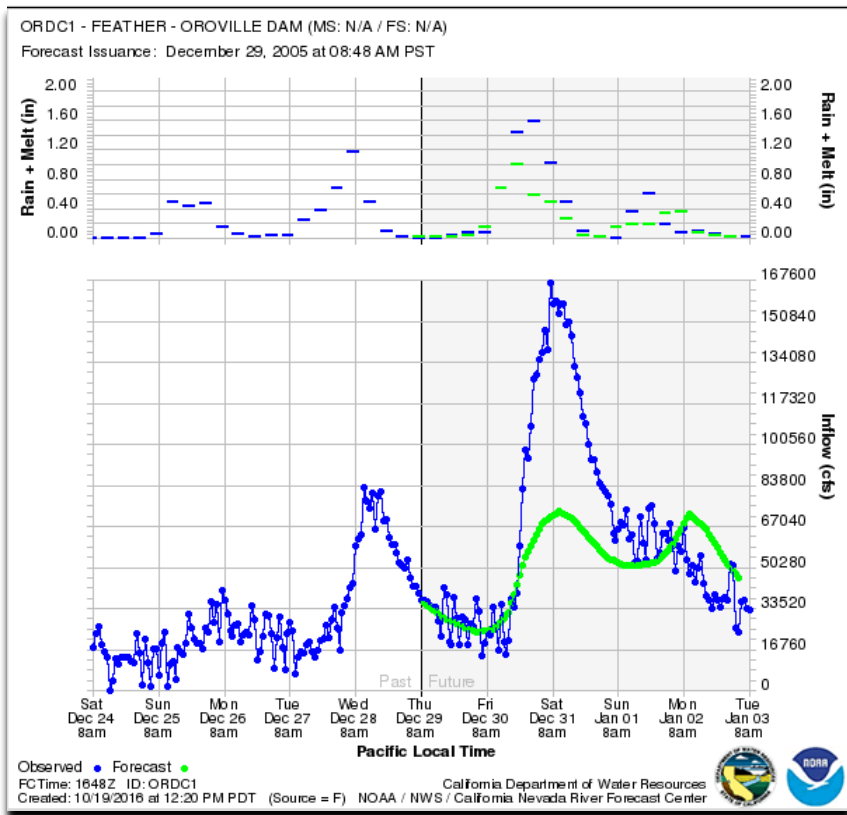
Dec 28th 2005



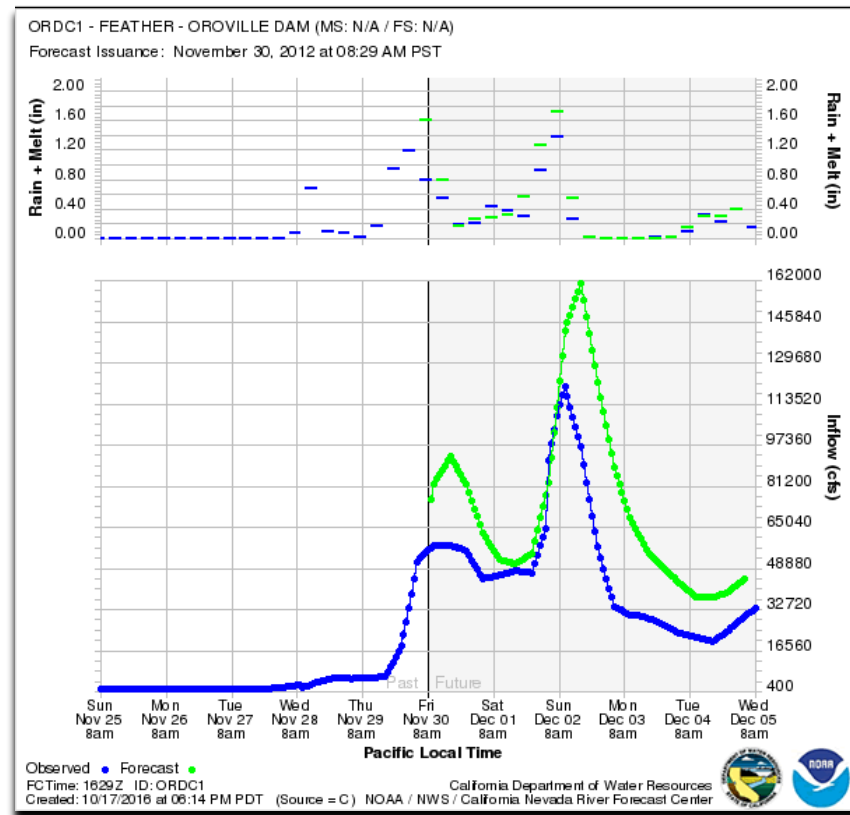
Nov 29th 2012

Lake Oroville Inflow

Late December 2005 vs Early December 2012



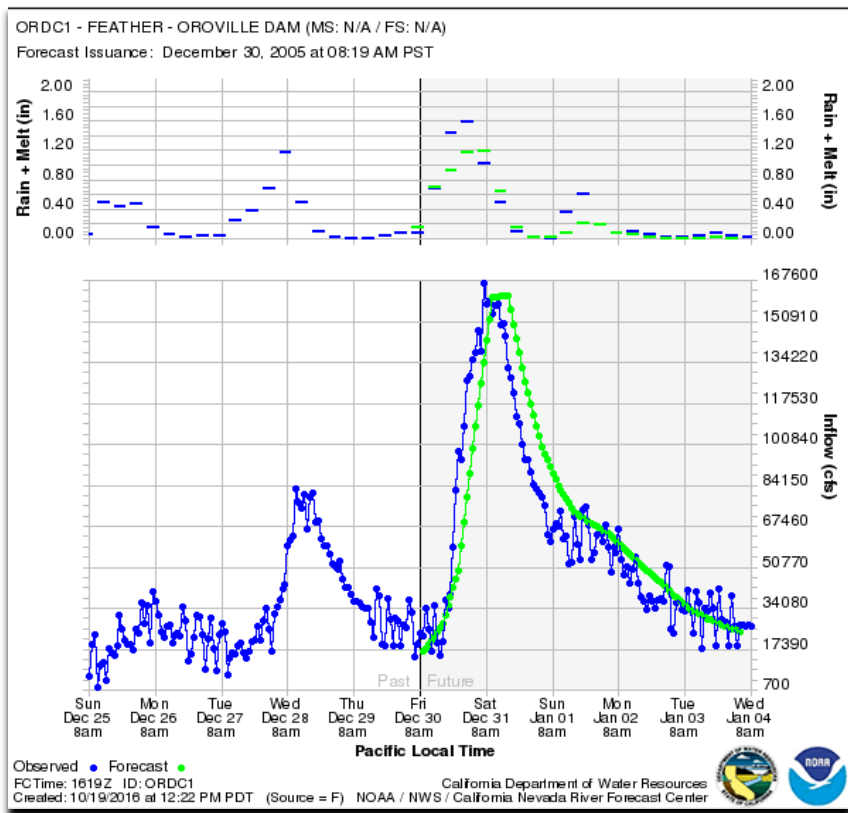
Dec 29th 2005



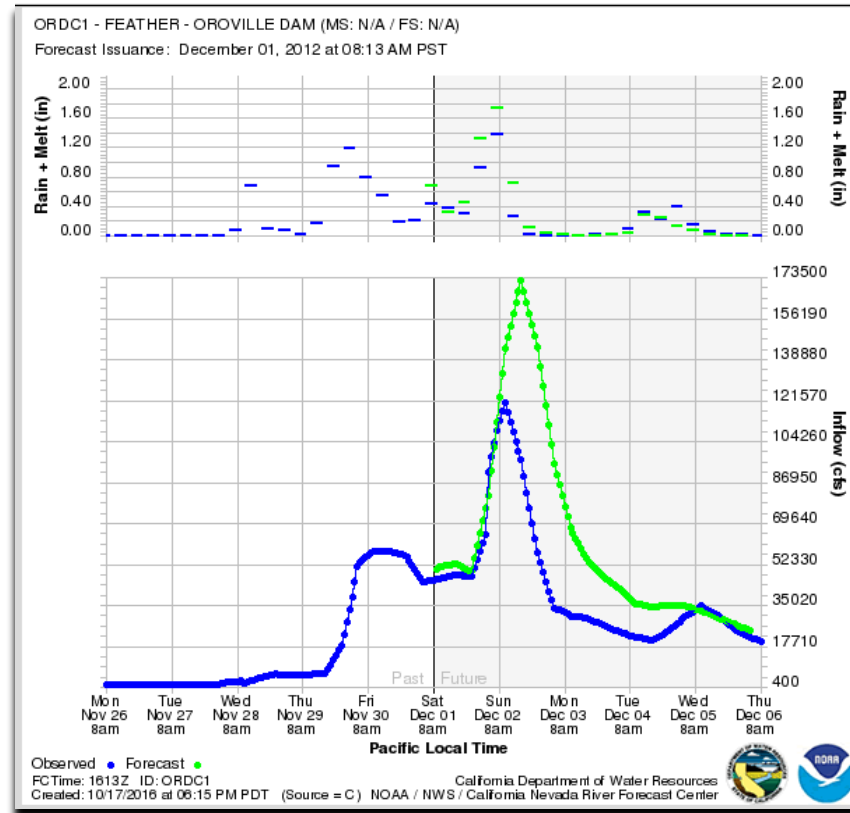
Nov 30th 2012

Lake Oroville Inflow

Late December 2005 vs Early December 2012



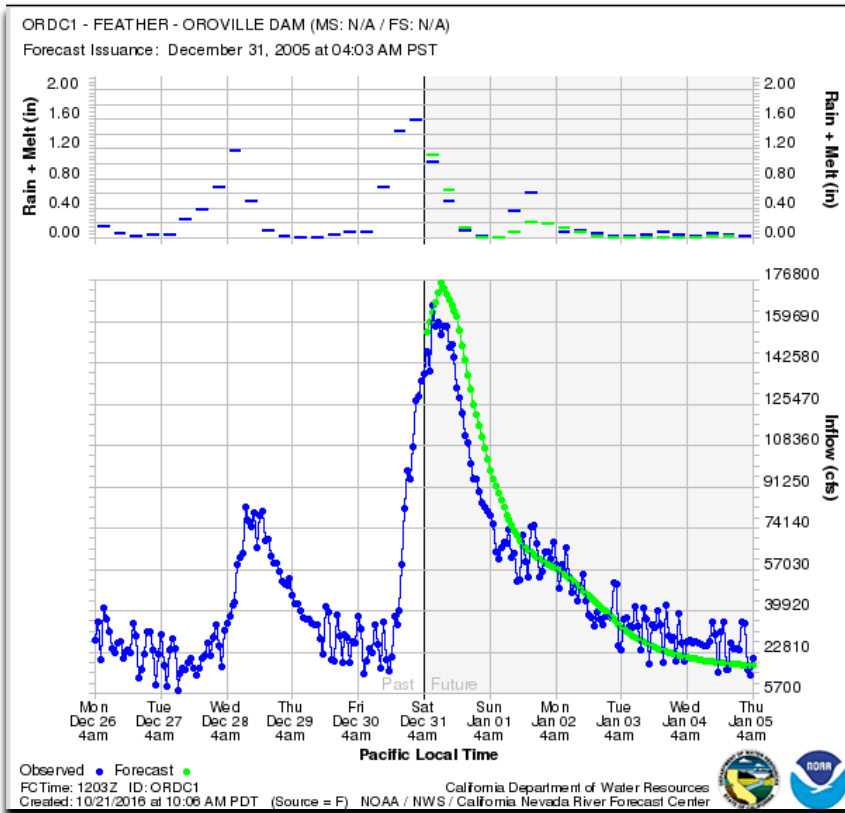
Dec 30th 2005



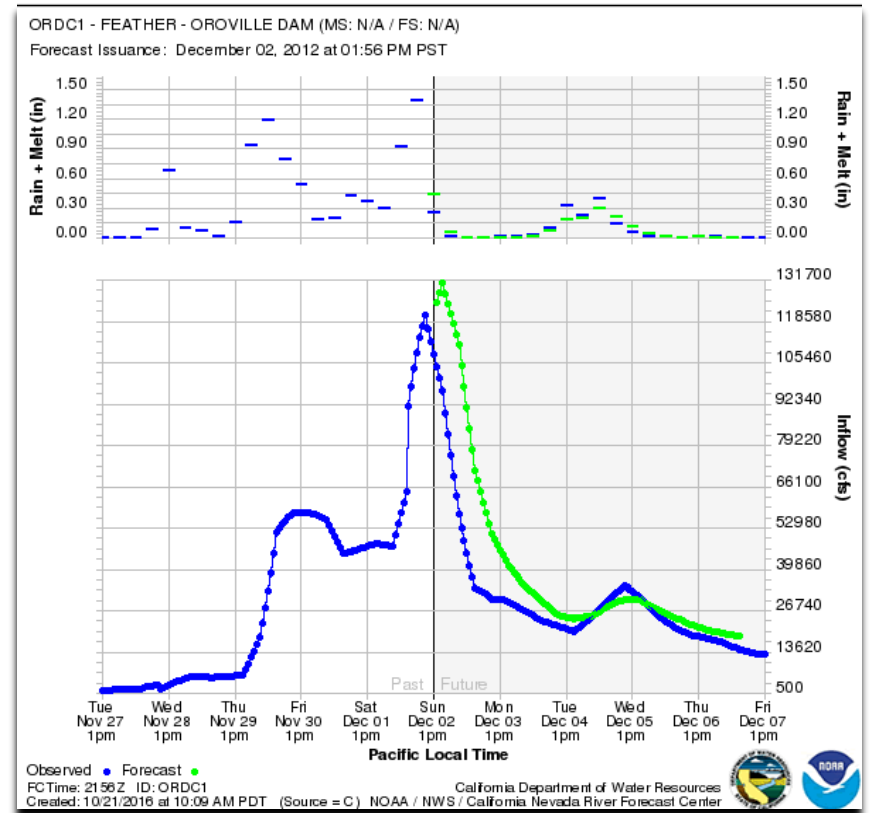
Dec 1st 2012

Lake Oroville Inflow

Late December 2005 vs Early December 2012



Dec 31th 2005



Dec 2nd 2012

Other Modeling Gaps & Challenges

- No estuary model connecting rivers with the ocean
- Dependence on rating curves
- Maintaining functional systems in an environment of continuously updated security measures

Ensemble Forecasts for Lake Oroville 10-Day Traces

FEATHER RIVER - LAKE OROVILLE (ORDC1)

Latitude: 39.53° N

Longitude: 121.52° W

Location: Butte County in California

Elevation: 922 Feet

River Group: Lower Sacramento

Issuance Time:

Oct 21 2016 at 7:24 AM PDT

10-Day Traces Plot

CSV Ensemble File Download: [ORDC1](#)

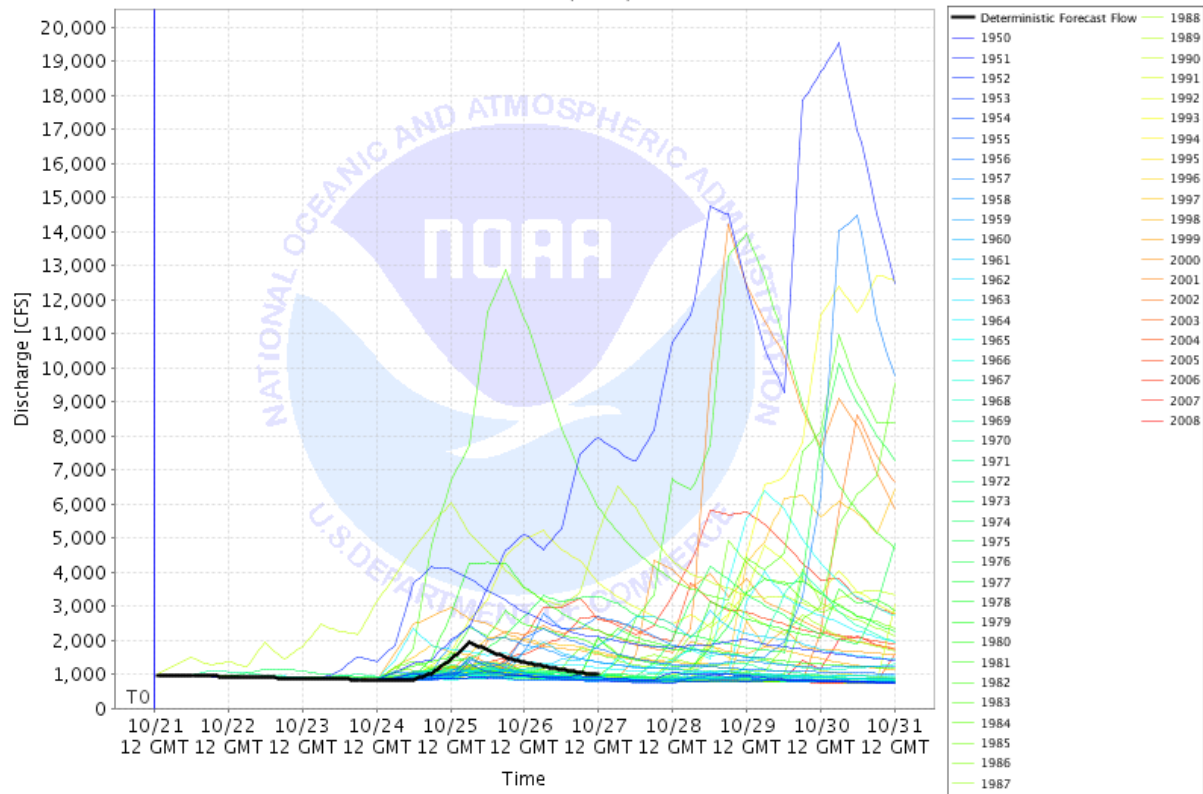
MEFP-based Traces with Deterministic Forecast for FEATHER - OROVILLE DAM

Latitude: 39.533054 Longitude: -121.516945

Forecast for the period 10/21/2016 - 10/31/2016

This is a conditional simulation based on the current conditions as of 10/21/2016

(src=D)



Ensemble Forecasts for Lake Oroville 10-Day Volume

FEATHER RIVER - LAKE OROVILLE (ORDC1)

Latitude: 39.53° N

Longitude: 121.52° W

Location: Butte County in California

Elevation: 922 Feet

River Group: Lower Sacramento

Issuance Time:

Oct 21 2016 at 7:23 AM PDT

10-Day Accumulated Volume Plot

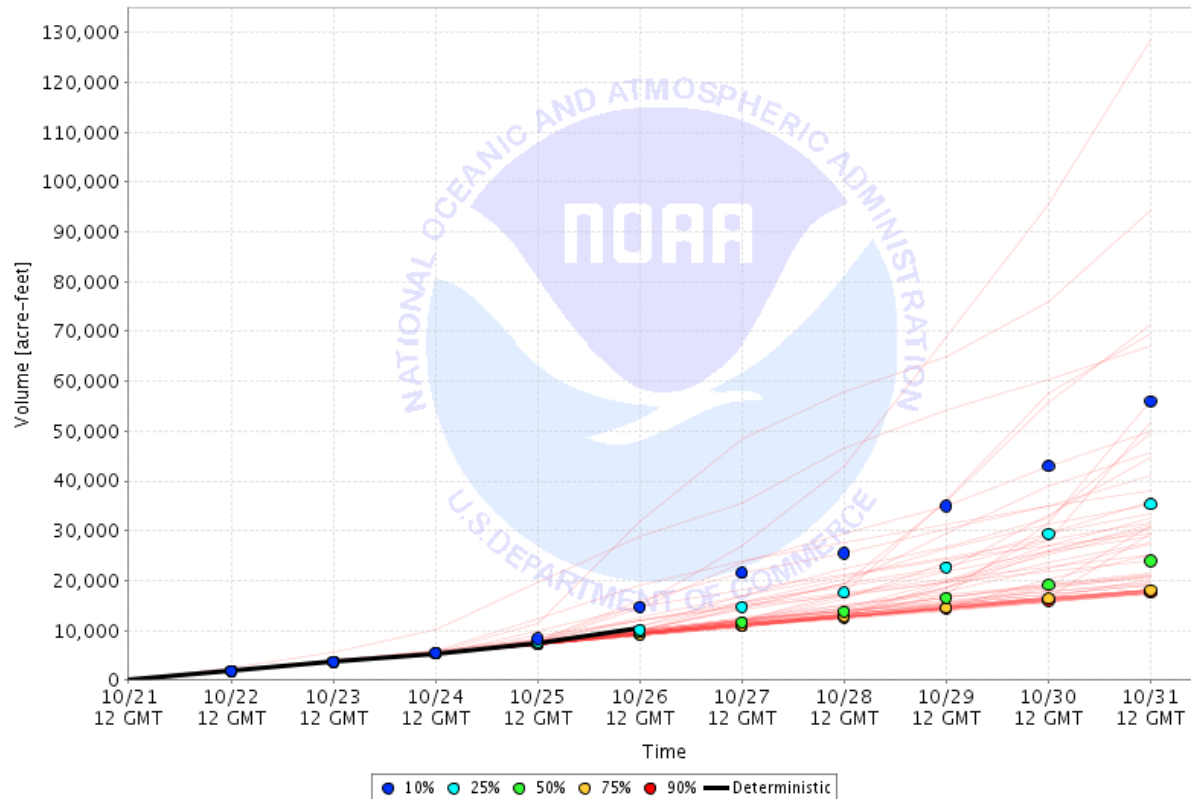
Volume Accumulation For FEATHER - OROVILLE DAM

Latitude: 39.533054 Longitude: -121.516945

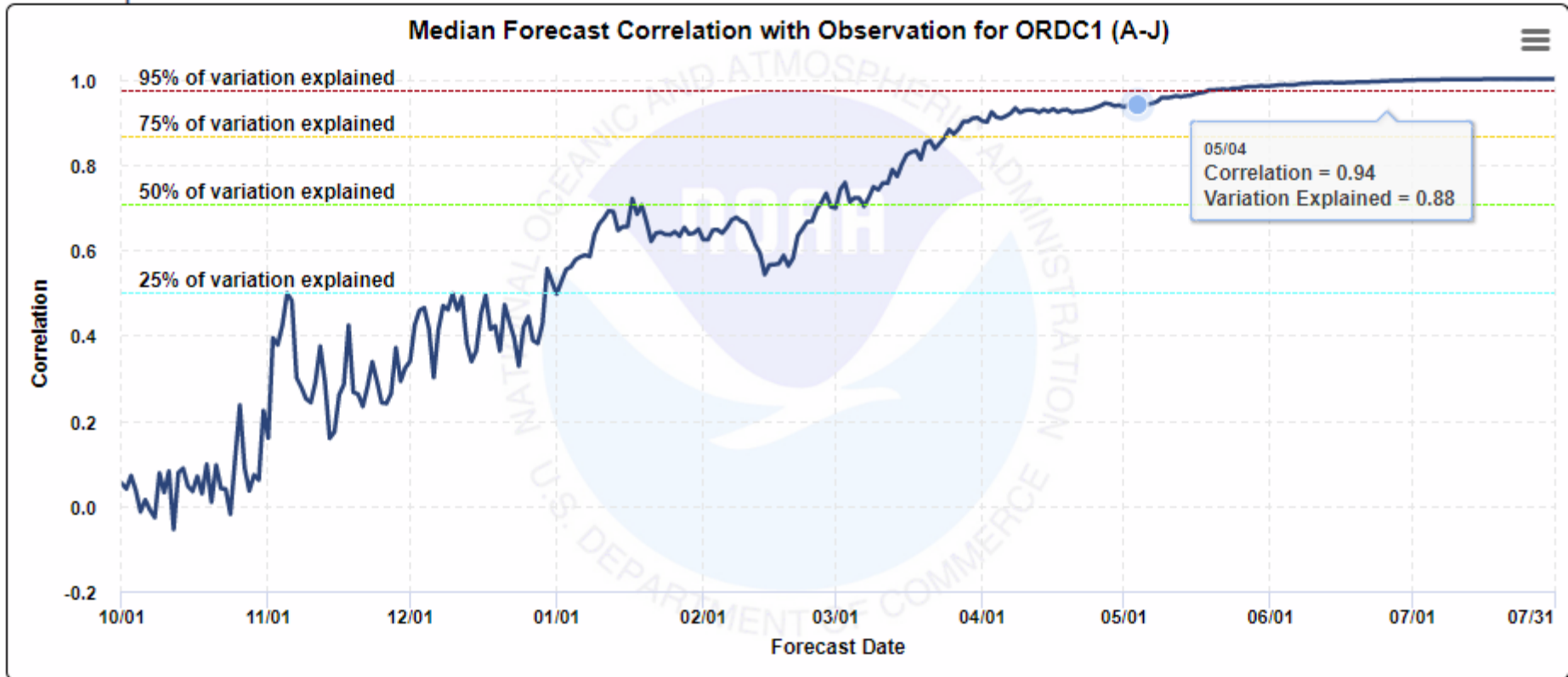
Forecast for the period 10/21/2016 - 10/31/2016

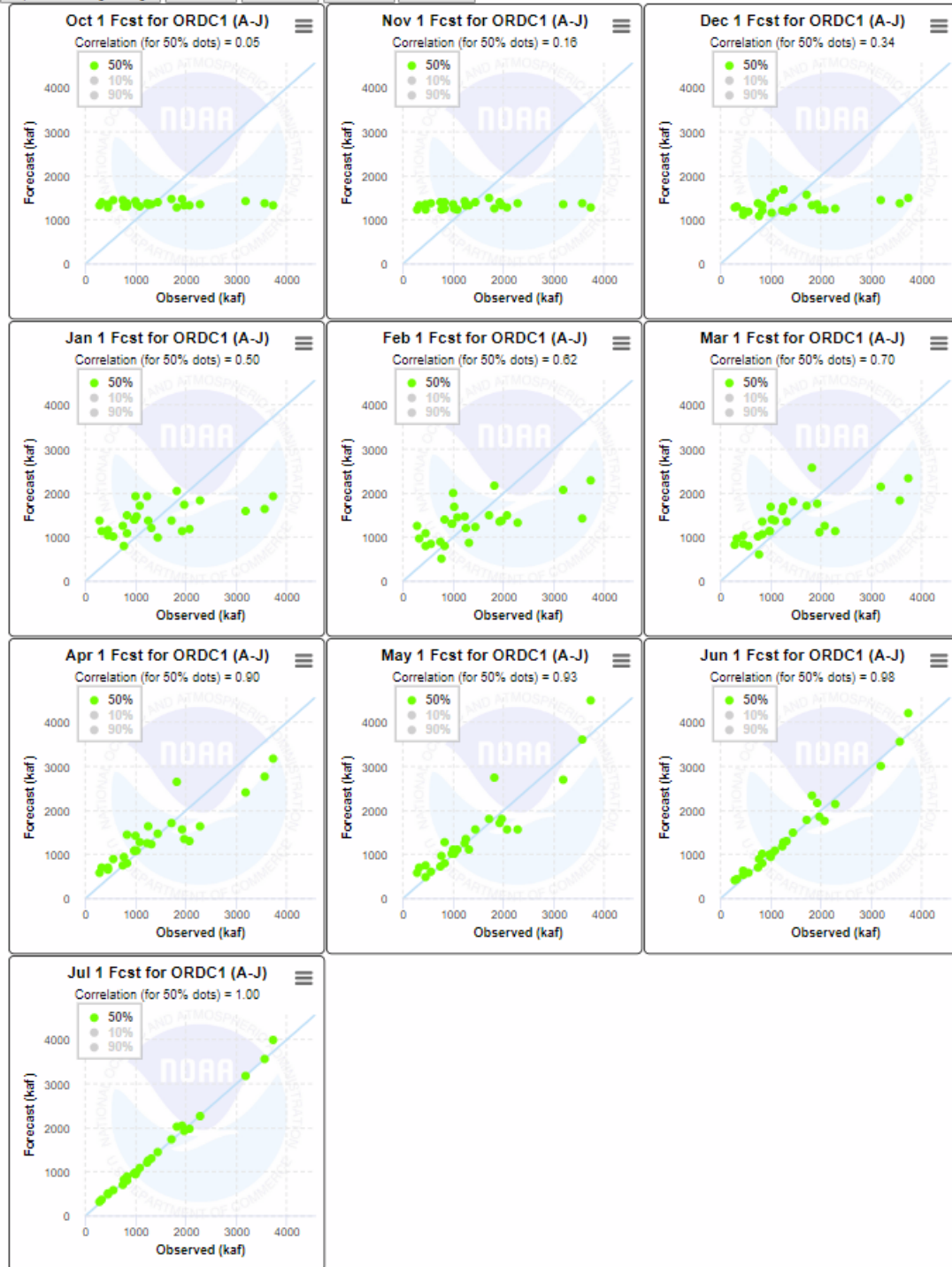
This is a conditional simulation based on the current conditions as of 10/21/2016

(src = D)



Verification





What Are We Doing About It?

- **Improving atmospheric river landfall forecasts**
 - Collaborating with CW3E who is working hard on this!
- **Observing networks & Data**
 - Evaluating gaging networks and adding sensors as appropriate given funding
 - Aerial Snow Surveys program
 - CA-funded network of vertically-pointed radars, atmospheric river observatories
 - Gap-filling radars in SF Bay area associated with AQPI
 - Collection of scheduled reservoir releases
- **Hydrologic Ensemble Forecast Service**
 - Investigating improvements in handling of extreme events
 - Providing support to projects such as Lake Mendocino FIRO
 - Collaborating with CW3E on investigating use of WestWRF precipitation
- **Long-lead or Sub-Seasonal to Seasonal Forecasts**
 - Engaged with the Climate Prediction Center (CPC) on improving week 3-4 forecasts
- **Rapid Onset Flooding (i.e., flash flooding)**
 - Potential use of National Water Model

What's Holding Us Back?

IT Security





California Nevada River Forecast Center



Alan S. Haynes

Hydrologist in Charge

National Oceanic & Atmospheric Administration
National Weather Service
3310 El Camino Ave., Suite 227
Sacramento, CA 95821-6373
www.cnrfc.noaa.gov

Tel: (916) 979-3056 x328
Fax: (916) 979-3067
Cell: (916) 202-9473
E-mail: alan.haynes@noaa.gov