



# Use of Weather and Climate Forecast Information in the California-Nevada River Forecast Center

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## Mission of NWS Hydrologic Services Program

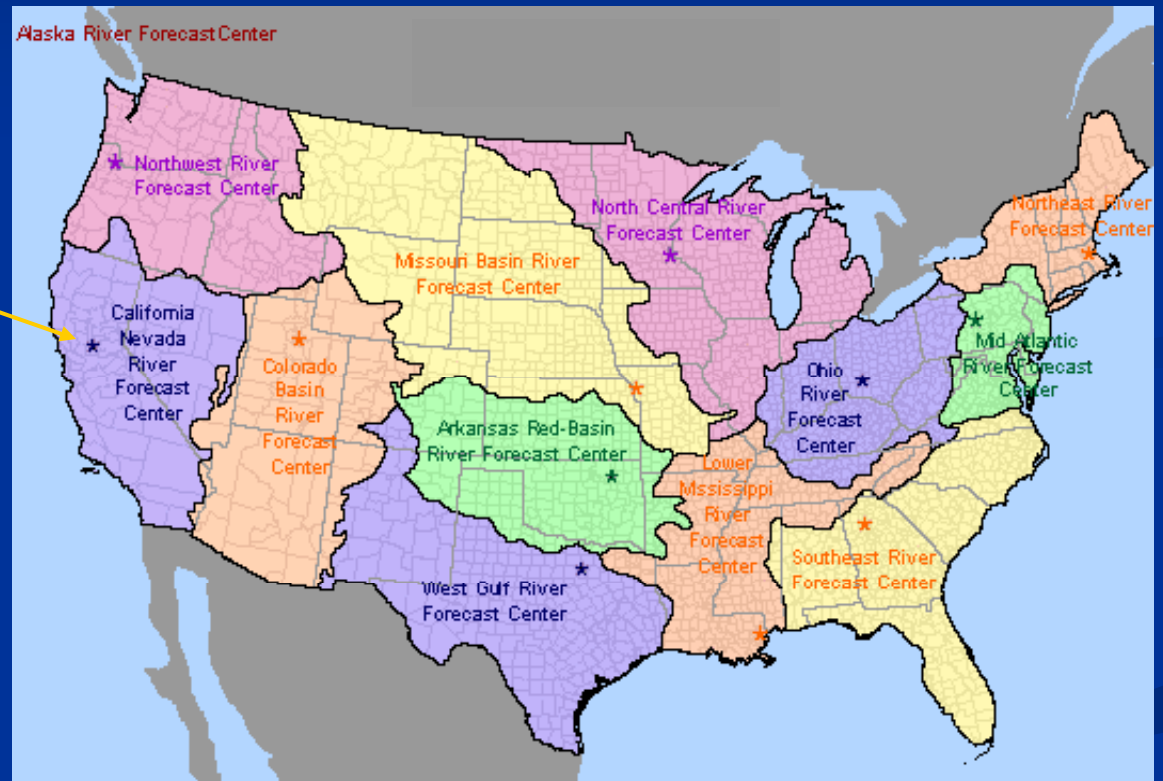
- Provide river and flood forecasts and warnings for the protection of lives and property.
- Provide basic hydrologic forecast information for the nation's environmental and economic well being.



# NWS River Forecast Centers

## CNRFC

- 245,000 sq. miles
- 182+ modeled basins
- 80+ flood forecast points
- 42+ reservoir inflows
- 50 water supply points
- Lots of people!





# CNRFC Hydrologic Products and Services

Short Range ... .. Long Range

Local Flood Warning Systems Support

Flash Flood Guidance

Headwater Guidance

Flood Forecast Guidance

Reservoir Inflow Forecasts

Spring Snow Melt Forecasts

Water Supply Volume



# CNRFC Hydrologic Modeling

Short Range ..... Long Range

## NWSRFS – OFS

6 hour time step, 5 day duration  
modular, deterministic

## NWSRFS - ESP.....

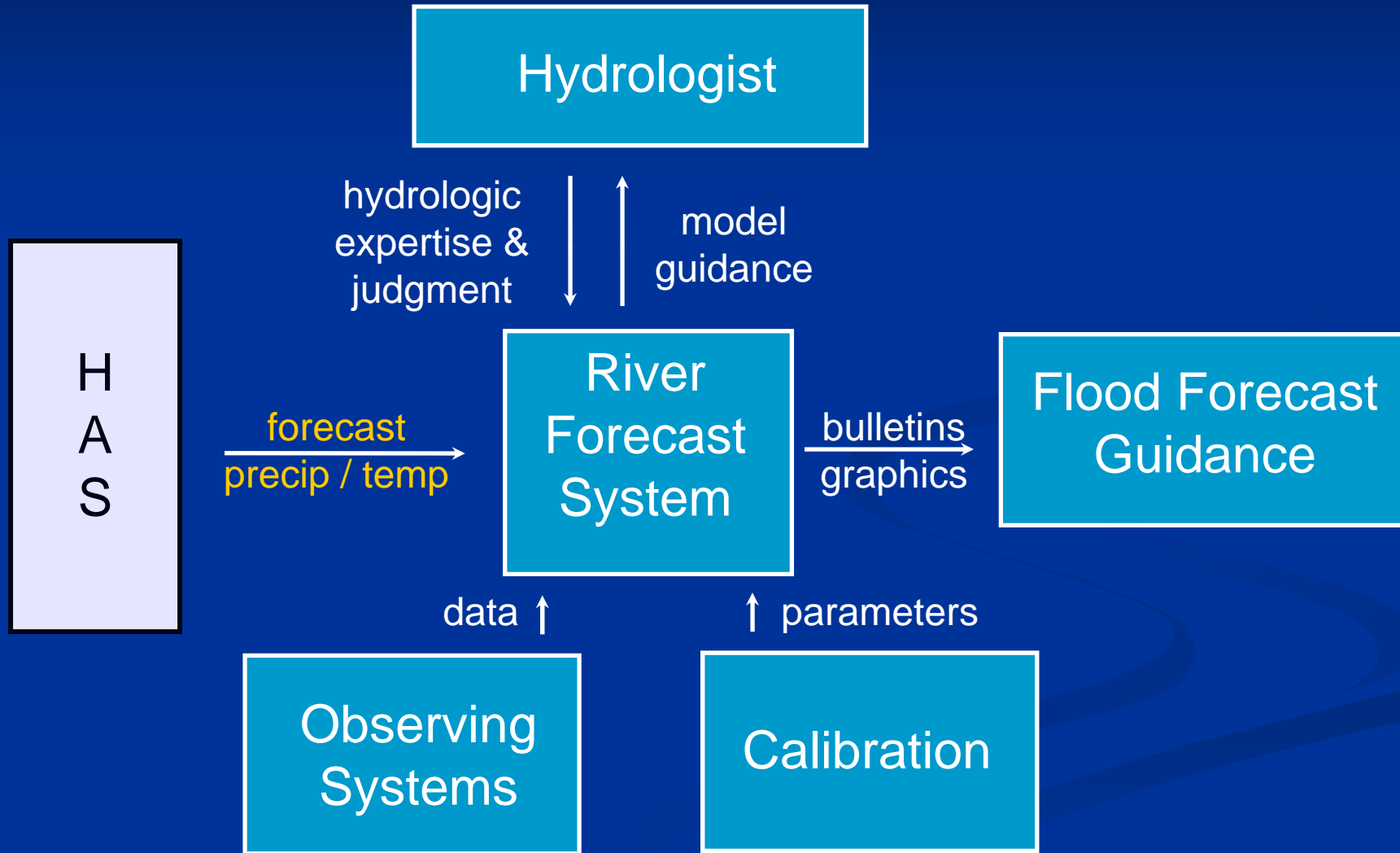
6 hour time step, ~ 1 year duration,  
ensemble-based, probabilistic

## Statistical

simple, efficient, inflexible  
seasonal duration

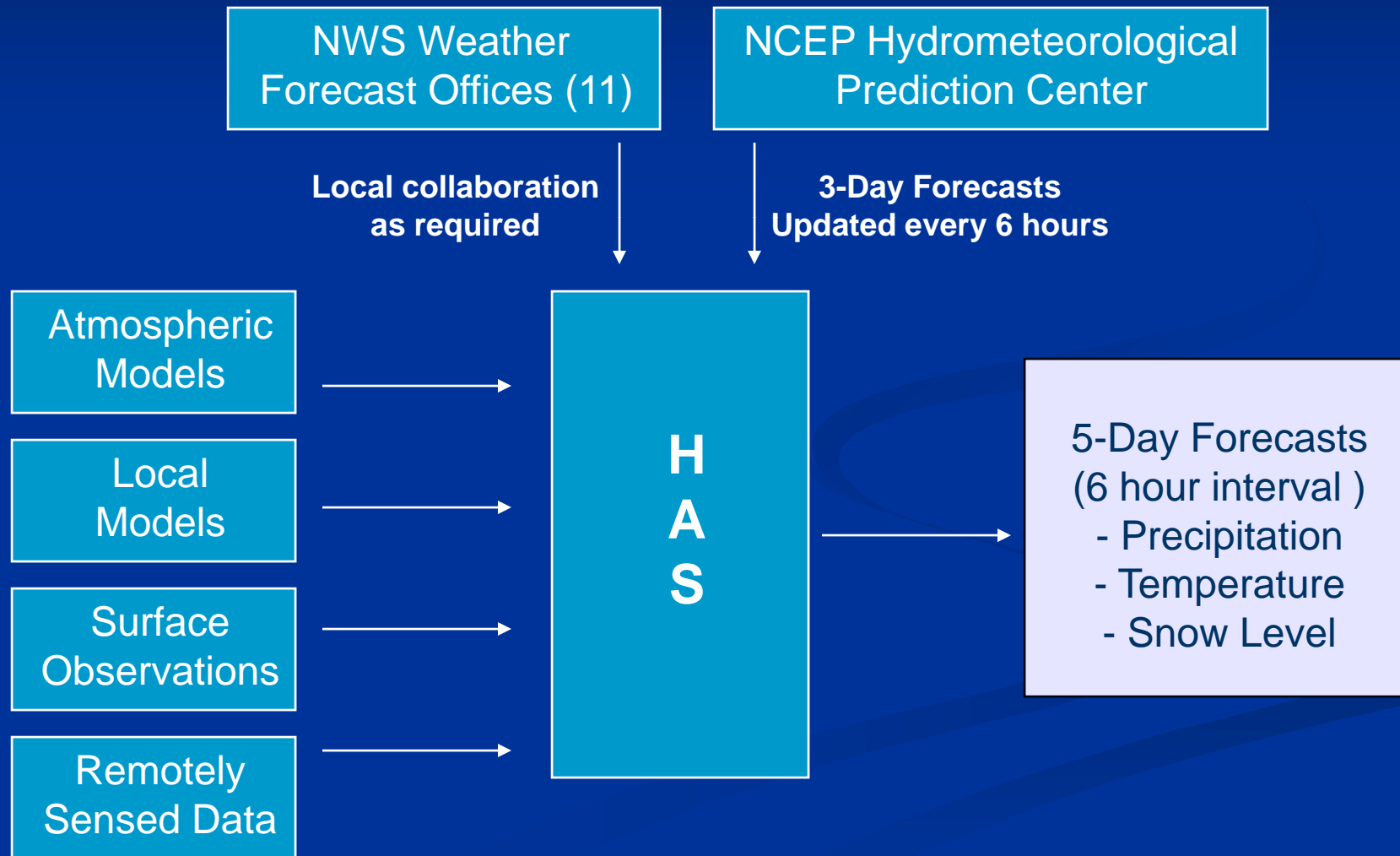


# Operational Flood Forecasting





# Operational HAS Function

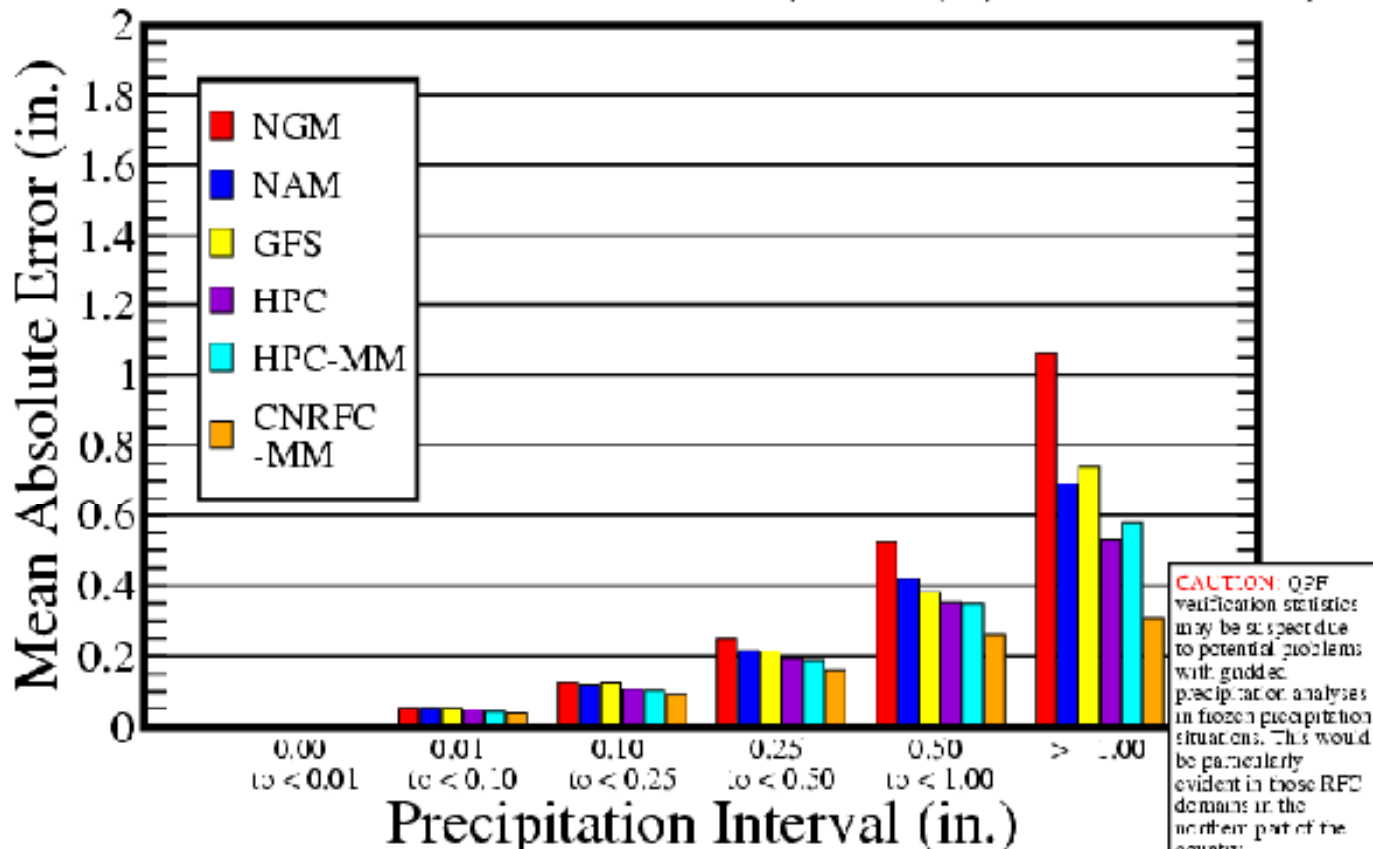




# Day 1 QPF Error (Feb05)

## California Nevada RFC - MAE

Feb2005 DAY1 06H GRD(32km) (OBS & FOR)



**CAUTION:** QPF verification statistics may be suspect due to potential problems with ground precipitation analyses in frozen precipitation situations. This would be particularly evident in those RFC domains in the northern part of the country.

Created by the NFVU on Thu 10 Mar 2005 01:38:44 PM EST

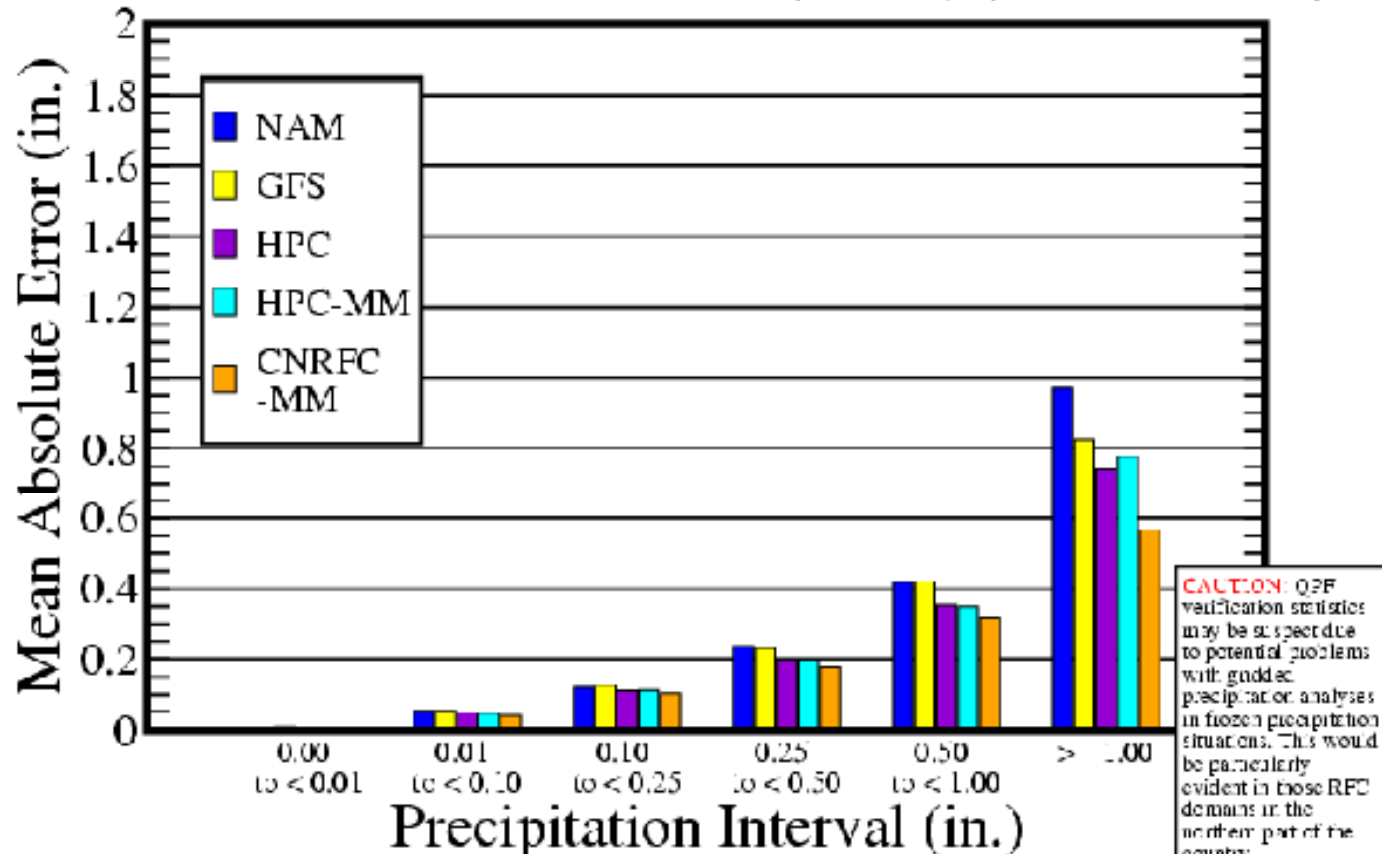




# Day 2 QPF Error (Feb05)

## California Nevada RFC - MAE

Feb2005 DAY2 06H GRD(32km) (OBS & FOR)



Created by the NFWU on Thu 10 Mar 2005 01:43:21 PM EST

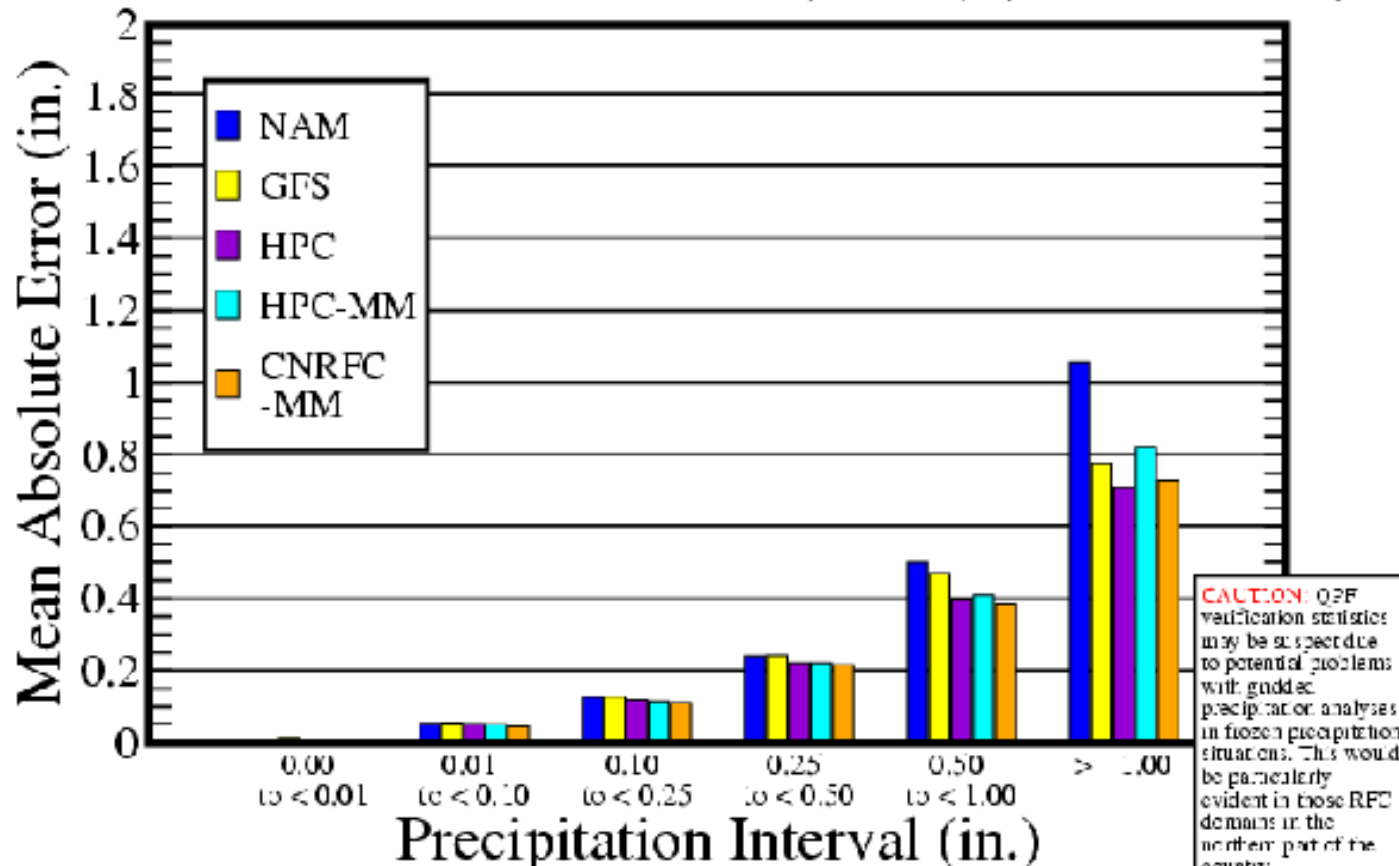
**CAUTION:** QPF verification statistics may be biased due to potential problems with ground precipitation analysis in frozen precipitation situations. This would be particularly evident in those RFC domains in the northern part of the country.



# Day 3 QPF Error (Feb05)

## California Nevada RFC - MAE

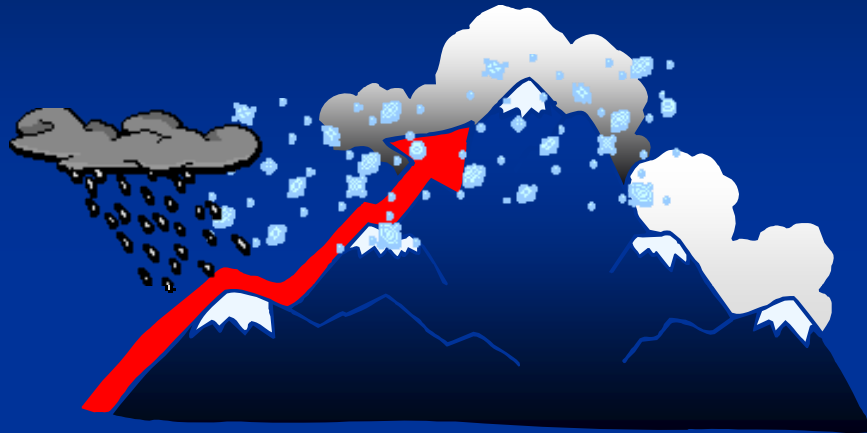
Feb2005 DAY3 06H GRD(32km) (OBS & FOR)



Created by the NFVU on Thu 10 Mar 2005 01:44:29 PM EST



# Rhea Orographic Aid (Days 4-6)



- Objective tool
- Outputs 6-hour orographic QPF
- Input - NCEP gridded datasets from AWIPS
  - Eta and GFS
- Performed well during large-scale rain events in California (1986, 1997)
- Mesoscale resolution

## Sample output...

```

==< SHASTA ABOVE SHASTA DAM - SHDC1
>=====
      STRDA  BEG-END  QPF  SLVL  FRZGLVL  700DIR  WIND&RH WK SSE-NNW PRDIF
6       19  16-22   .00  35     5.1   253-299  WIND&RH WK SSE-NNW PRDIF
12      19  22- 4   .04  28     4.3   299-257  WIND&RH WK SSE-NNW PRDIF

18      20  4-10   .13  26     4.1   257-228  RH ONLY NORMAL PGRAD
24      20  10-16  .17  27     4.3   228-210  RH ONLY NORMAL PGRAD
30      20  16-22  .09  28     4.4   210-109  WIND&RH WK SSE-NNW PRDIF
36      20  22- 4   .00*  30     4.6   109- 49  WIND&RH WK SSE-NNW PRDIF
MODIFIED TOTS 04-04   .38  MOD-FAC = .85  * = 700mbWD >344 or <155 DEG
42      21  4-10   .00*  38     5.4   49- 15  WIND&RH WK SSE-NNW PRDIF
48      21  10-16  .00*  51     6.6   15- 14  WIND&RH WK SSE-NNW PRDIF
54      21  16-22  .00*  57     7.3   14- 7   WIND&RH WK SSE-NNW PRDIF
60      21  22- 4   .00  56     7.1   7-303  WIND&RH WK SSE-NNW PRDIF
MODIFIED TOTS 04-04   .00  MOD-FAC = .85  * = 700mbWD >344 or <155 DEG

```



# Rhea Orographic Aid Performance

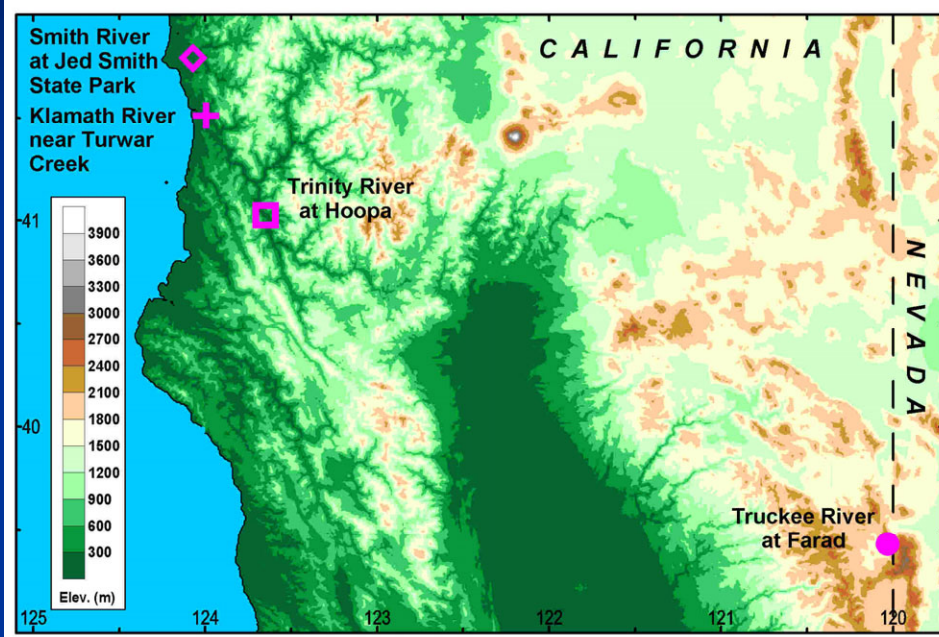
## New Year's Flood 1997 – Feather River Basin

Feather River Basin - Dec/Jan 1996-97 Flood Event

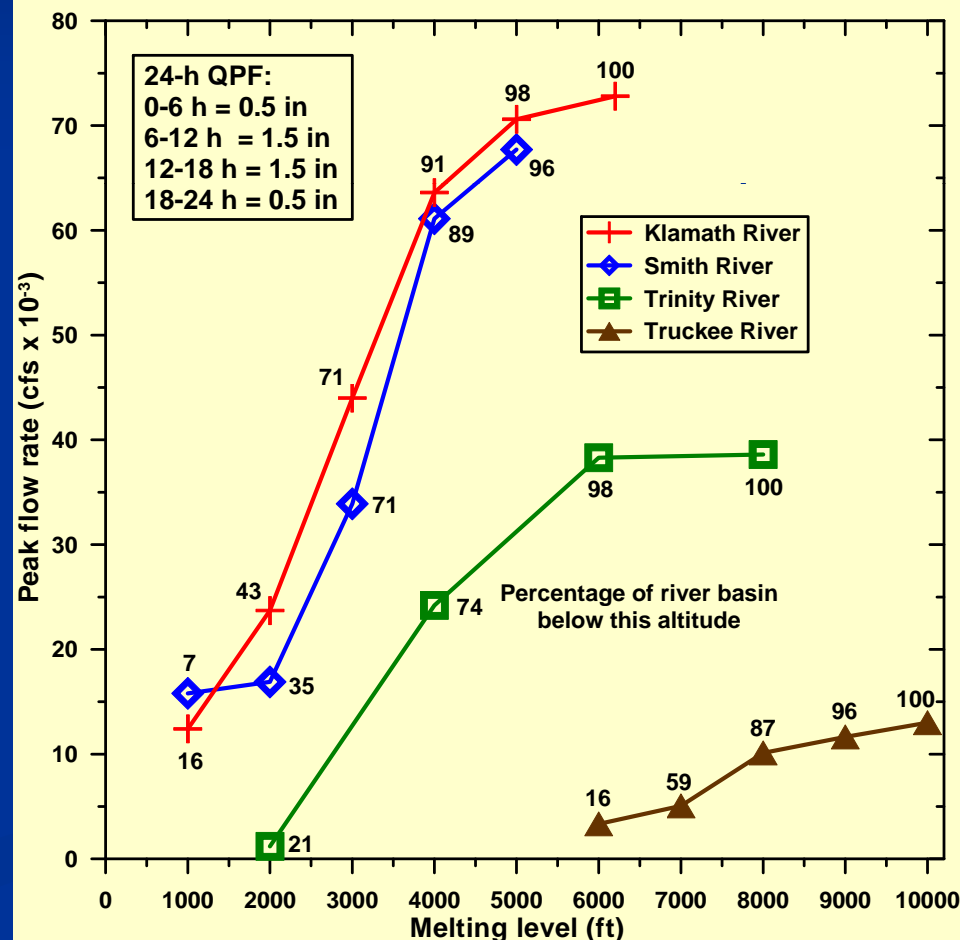
MRF Model 00 UTC	Dec 24-25	Dec 25-26	Dec 26-27	Dec 27-28	Dec 28-29	Dec 29-30	Dec 30-31	Dec 31 -Jan 01	Jan 01-02	Jan 02-03	Total Orog	Total Obsvd
12/24/96	0.0	0.2	2.1	1.0	>.3						>3.6	5.6
12/25/96		0.2	2.2	1.8	4.3	>4.6					>13.1	8.3
12/26/96			2.6	1.4	4.0	4.2	>2.1				>14.3	13.9
12/27/96				1.4	3.4	4.2	5.4	>2.2			>16.6	15.5
12/28/96					3.2	3.8	4.4	3.2	>4.3		>18.9	20.8
12/29/96						4.2	4.1	5.8	4.7	>2.7	>21.5	21.2
12/30/96							3.5	6.2	5.4	1.3	16.4	18.5
12/31/96								5.4	6.2	3.3	14.9	12.8
01/01/96									6.3	4.2	10.5	8.0
01/02/96										3.1	3.1	1.3
Observed	0.0	0.1	3.2	1.4	0.9	2.7	5.7	4.8	6.7	1.3	--	--
00 UTC Eta Model 12-36 Hour QPF												
12-36hr	0.0	0.4	2.4	*	2.8	4.1	4.3	3.7	5.7	3.4	26.8	--
Observed	0.0	0.1	3.2	1.4	0.9	2.7	5.7	4.8	6.7	1.3	--	26.8



# The melting level strongly influences runoff In mountainous watersheds



**CNRFC River Forecasting System**  
The sensitivity of watershed runoff to changes in melting level for a given 24-h QPF



River/Basin	Area (mi <sup>2</sup> )	Precip. (in)
Klamath	772	70
Smith	614	103
Trinity	650	63
Truckee	204	41

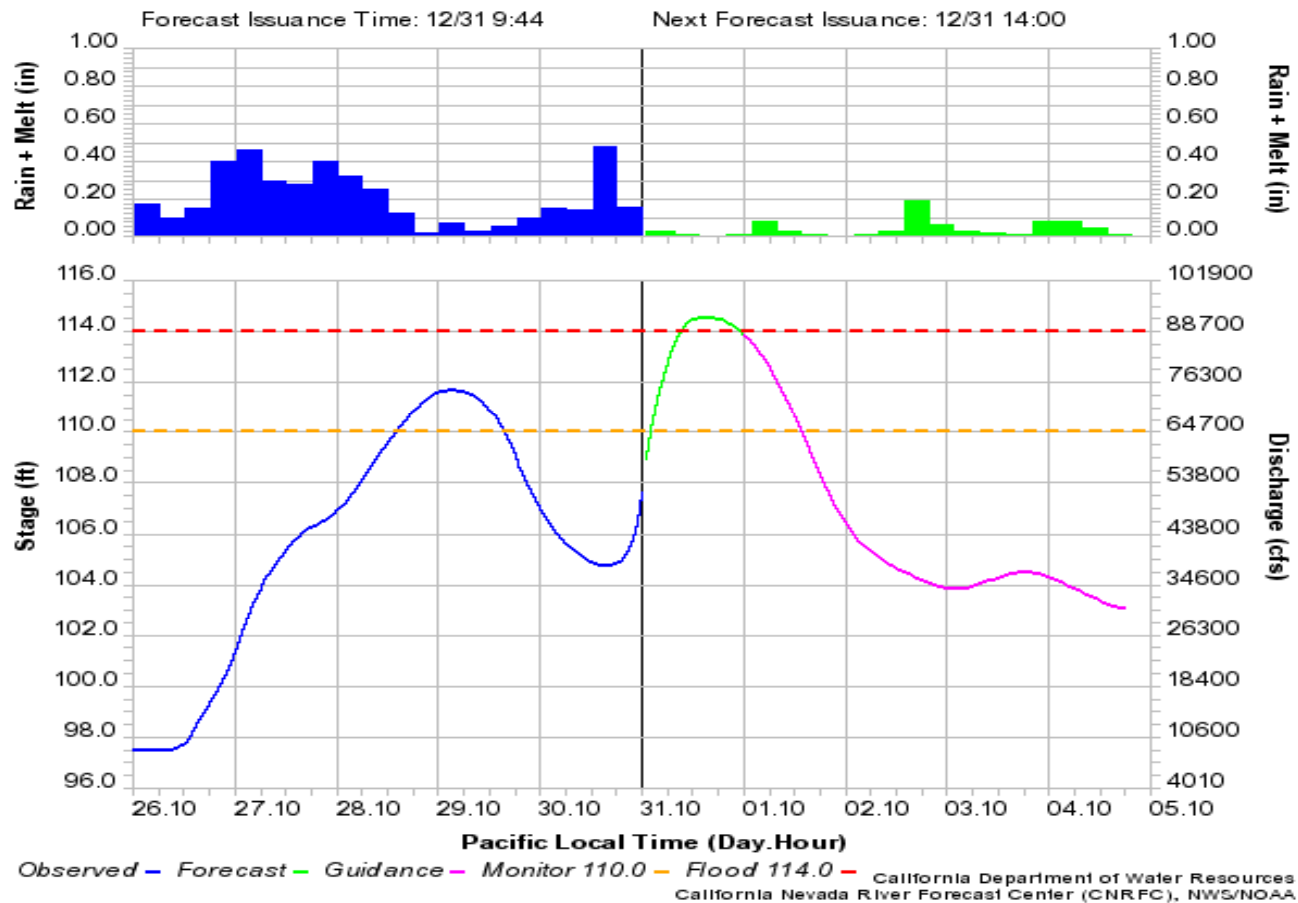
White et al., *JTech*, 2002





# Flood Forecast Guidance

## ORFC1 - SACRAMENTO RIVER - Ord Ferry

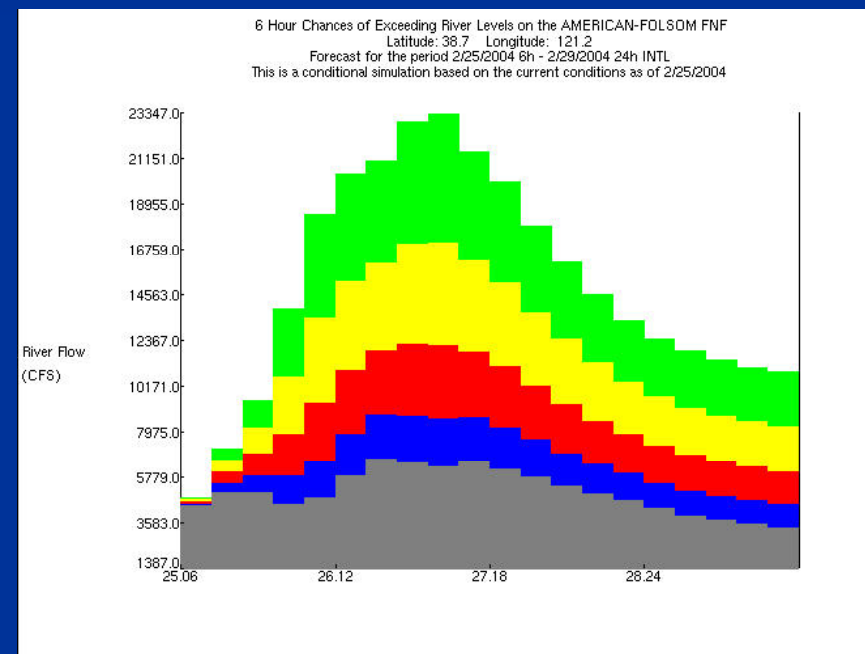
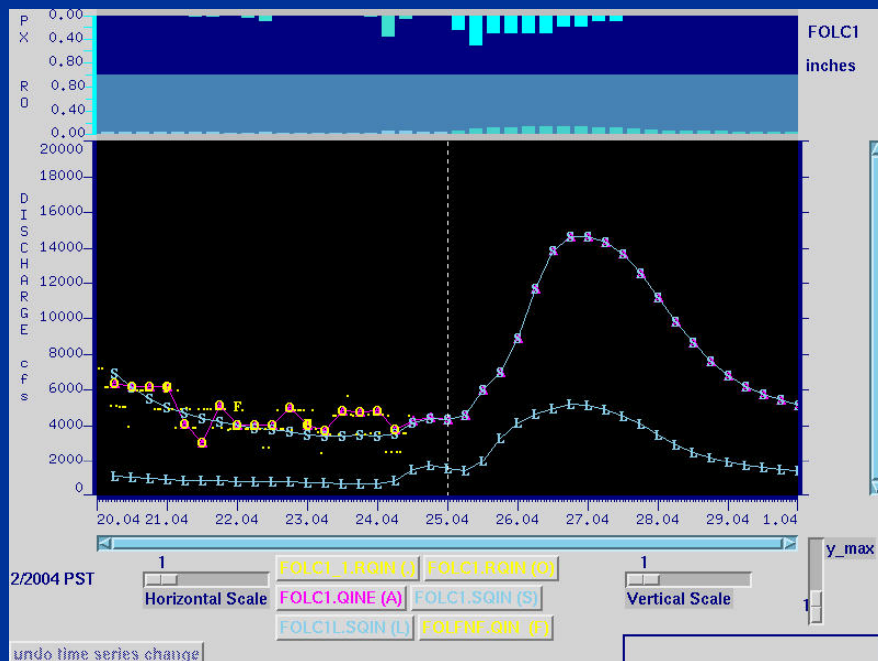


**Monitor Stage:** 110 feet  
**Flood Stage:** 114 feet



# Ensemble Challenges

- Maintain coherence between deterministic and ensemble forecasts

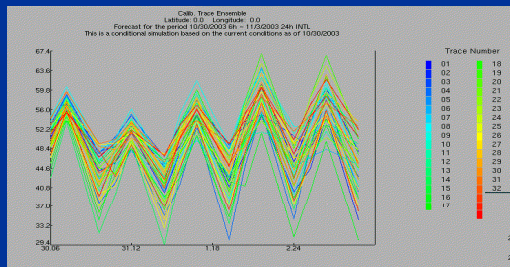




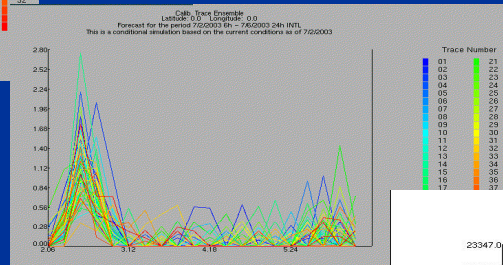


# 5-Day Ensemble Prototype

- **Status:**
  - Several RFCs collaborating with OHD on short-term prototype

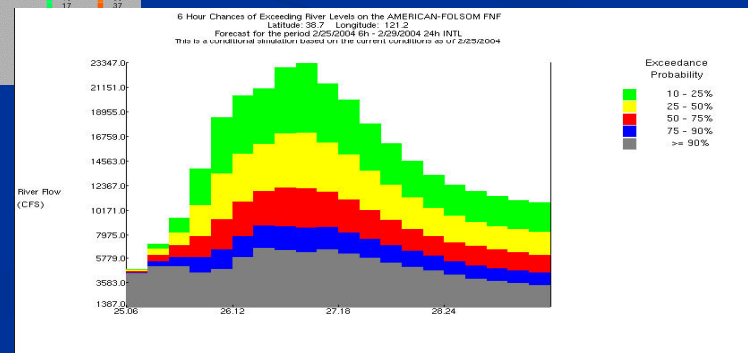


Forecast Temperature Ensembles



Forecast Precipitation Ensembles

Probablistic Reservoir Inflow





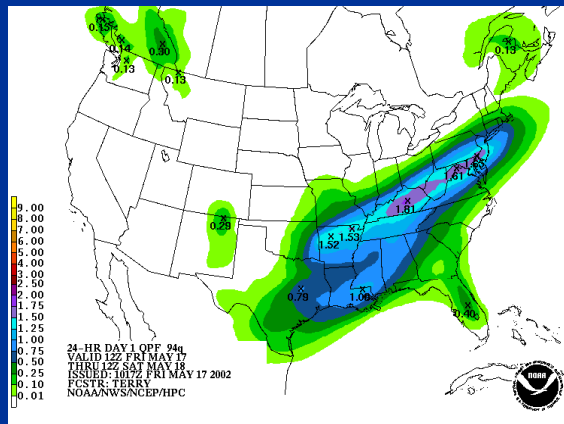
# ESP Use of Weather and Climate Forecasts

Historical  
MAT and MAP

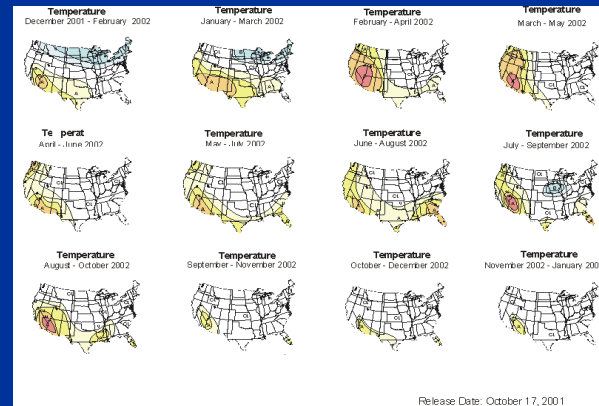
Adjustment  
System

Adjusted Historical  
MAP and MAT

## Weather Forecasts



## Climate Forecasts





# ESP Pre-Adjustment Technique

CPCPreAdj

Initial Parameters

Contributing Region:

Initial Date (m/d/y):

1-5 Day Forecast

Start Day:  Start Month:

Temp Min Anomaly (degF):

Temp Max Anomaly (degF):

Precipitation Total (inches):

6-10 Day Forecast

Start Day:  Start Month:

Temperature:

Precipitation:

Seasonal Forecast

Initial Period:

Period	Precipitation		Temperature	
	Category	Probability (%)	Category	Probability (%)
Apr 2005	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>
Apr - Jun (AMJ) 2005	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>
May - Jul (MJJ) 2005	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>
Jun - Aug (JJA) 2005	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>
Jul - Sep (JAS) 2005	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>
Aug - Oct (ASO) 2005	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>
Sep - Nov (SON) 2005	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>
Oct - Dec (OND) 2005	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>
Nov - Jan (NDJ) 2005	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>
Dec - Feb (DJF) 2005	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>
Jan - Mar (JFM) 2006	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>
Feb - Apr (FMA) 2006	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>
Mar - May (MAM) 2006	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>
Apr - Jun (AMJ) 2006	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>	<input type="text" value="climatology"/>	<input type="text" value="0.00"/>

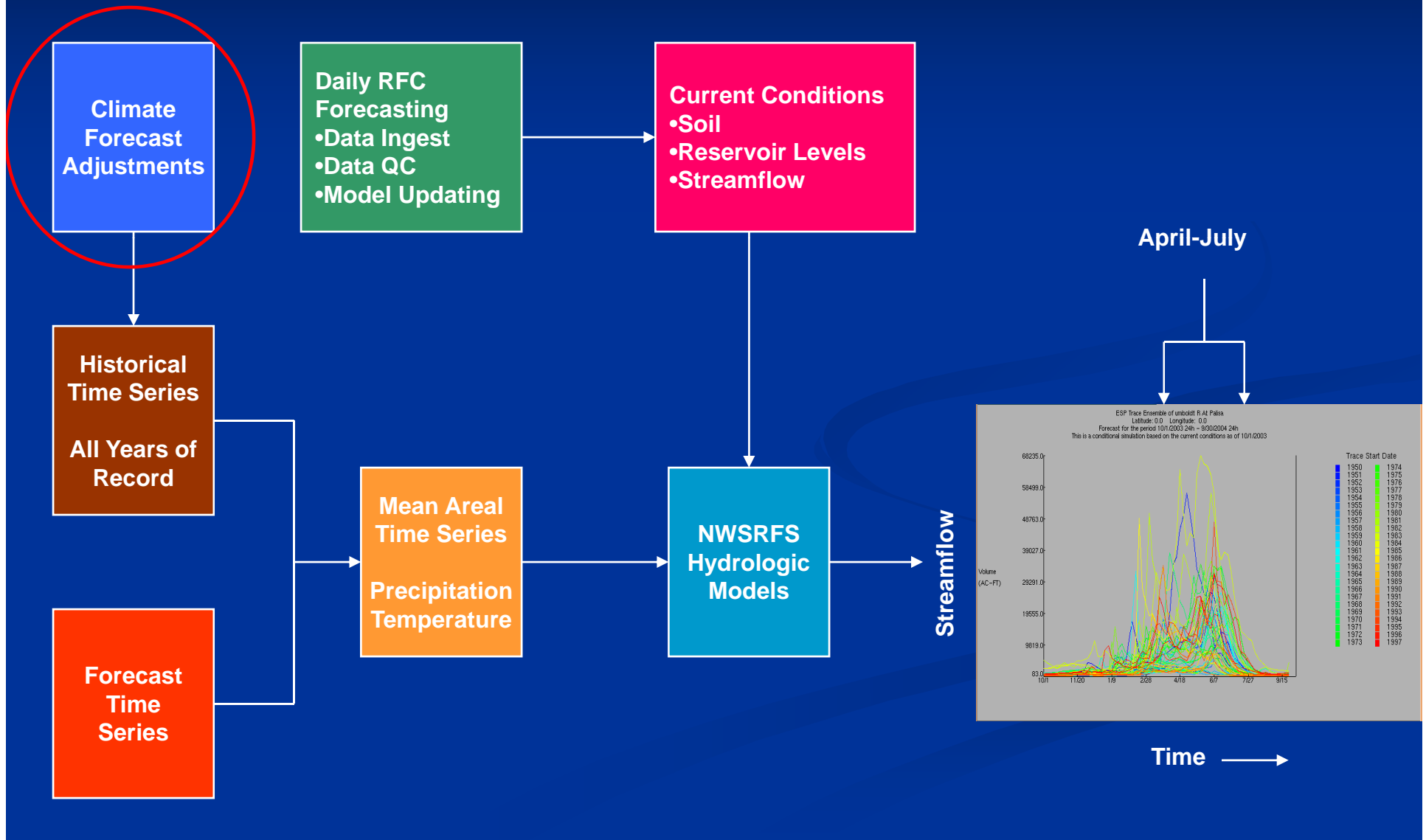
1-5 Day

Long-range

6-10 Day



# Ensemble Streamflow Prediction





Thank You