



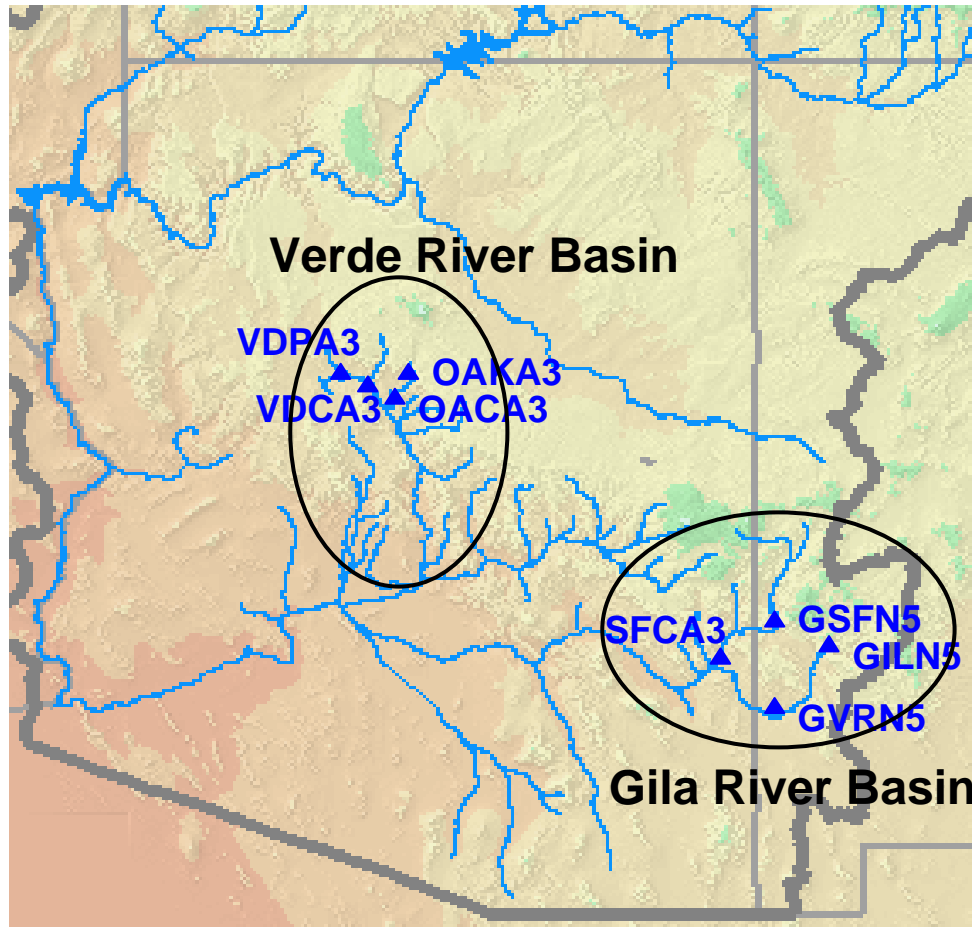
# **Gila and Verde Basins February 10-13, 2005**

National Verification Team Case Study  
March 25, 2008

Lisa Holts and Brenda Alcorn  
Colorado Basin River Forecast Center



# Case Studies in Two Basins



- Two headwater and two downstream forecast points in each basin
- Segments calibrated and run on one hour time step
- MAPX input from MPE
- One of first events for these hourly calibrations



# Event Summary



- Precipitation Begins – February 10, 2005 21z
- Precipitation Ends – February 13, 2005 5z
- Verde River (storm total MAPs ~2.0-3.0 in)
  - VDPA3 (H) peak: 2/13 01z – 10.5 ft 8,140 cfs (flood 13.0 ft)
  - VDCA3 (L) peak: 2/12 12z – 17.9 ft 27,000 cfs (flood 14.0 ft)\*\*
  - OAKA3 (H) peak: 2/12 09z – 11.0 ft 9,100 cfs (flood 14.0 ft)
  - OACA3 (L) peak: 2/12 13z – 13.7 ft 12,300 cfs (flood 9.0 ft)\*\*
- Gila River (storm total MAPs ~1.5-2.5 in)
  - GILN5 (H) peak: 2/12 23z – 12.3 ft 19,800 cfs (flood 11.0 ft)\*\*
  - GVRN5 (L) peak: 2/13 05z – 21.4 ft 35,300 cfs (flood 15.0 ft)\*\*
  - GSFN5 (H) peak: 2/12 21z – 12.6 ft 13,500 cfs (flood 15.0 ft)
  - SFCA3 (L) peak: 2/12 20z – 23.4 ft 18,300 cfs (flood 22.0 ft)\*\*

\*\* went above flood during event



# WR Case Study



- Use 'ofs\_spin' to create a pure model simulation time series to use as a control
  - Start from a set of fs5files from November 2004 and run through February 2005.
  - No mods included for entire run.
  - Feed only observed precipitation, temperature and freezing levels (no forecasts).

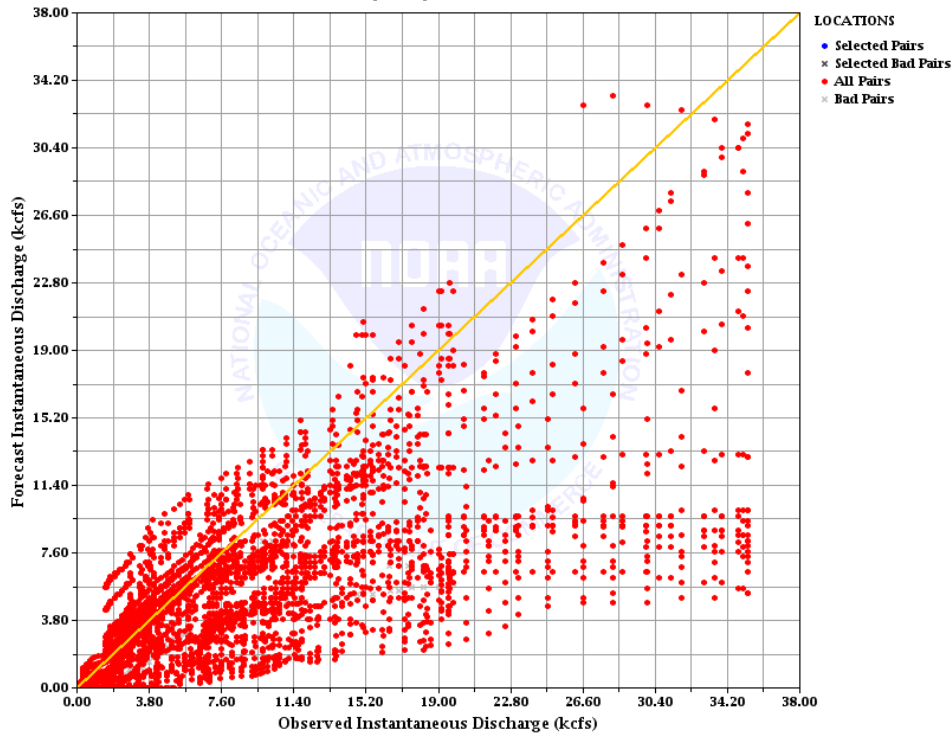


# Pure Model Flow Plots



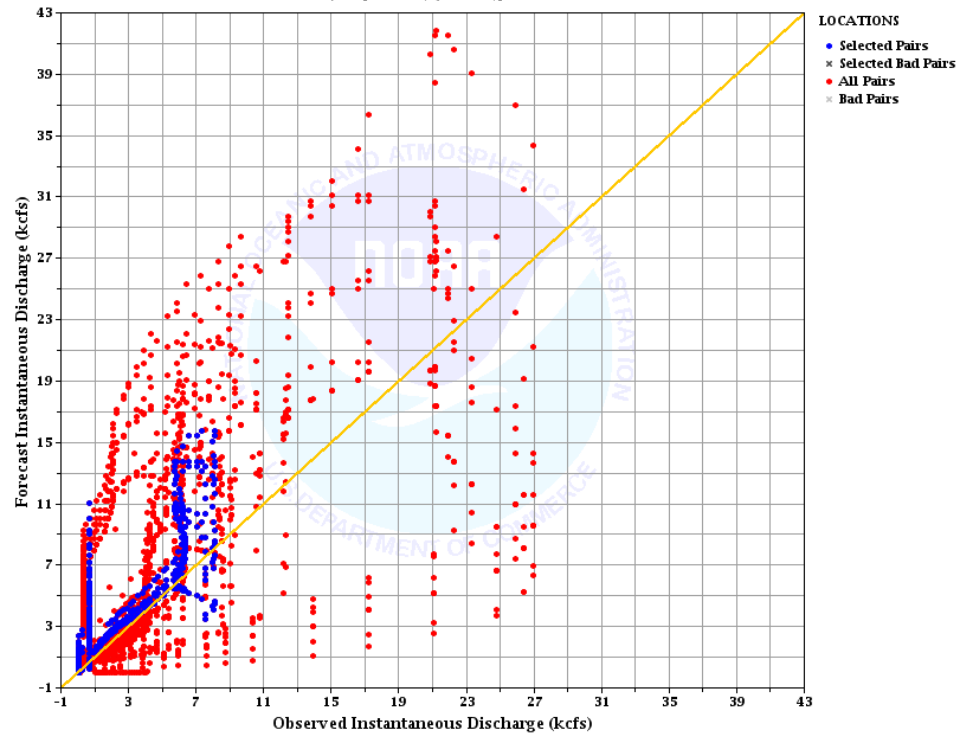
## GILA

Plot of Forecast-Observed Instantaneous Discharge Data Pairs for NONE  
Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
Lead times: 0 hours - 120 hours  
Selected Location: No Name Available [NONE]



## VERDE

Plot of Forecast-Observed Instantaneous Discharge Data Pairs for CBRFC  
Time Period: 2005-02-08 12:42:30 GMT - 2005-02-15 12:42:53 GMT  
Lead times: 0 hours - 72 hours  
Selected Location: Verde - Paulden, nr [VDPA3(QRIFZZZ)]

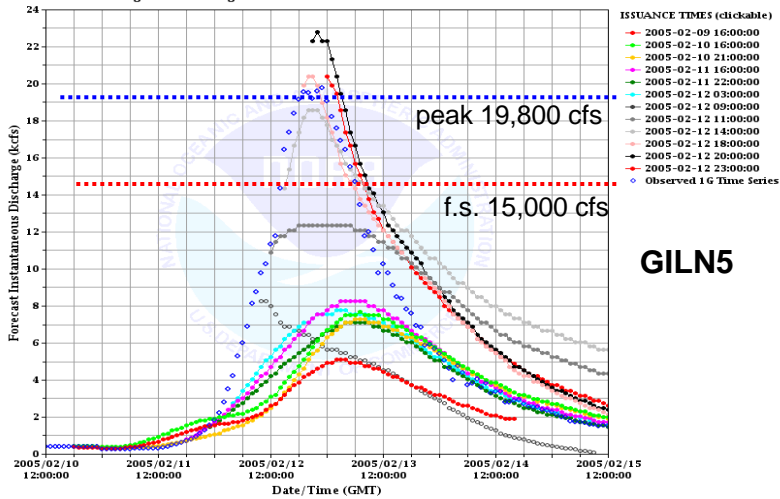




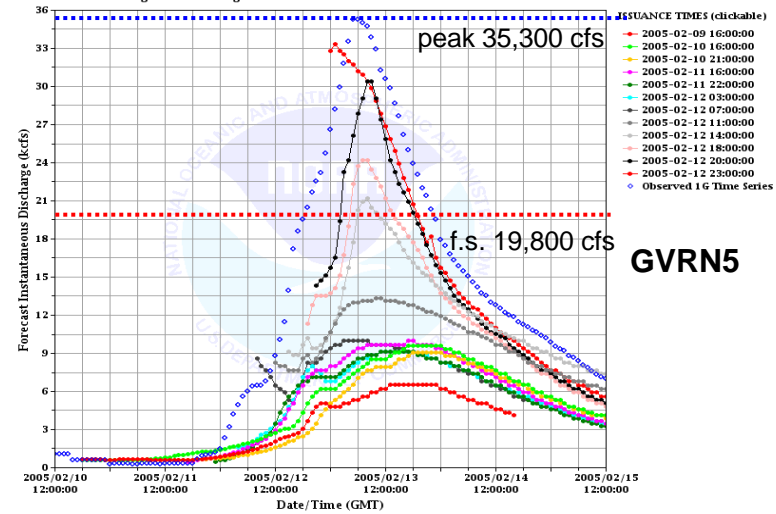
# Flow Time Series



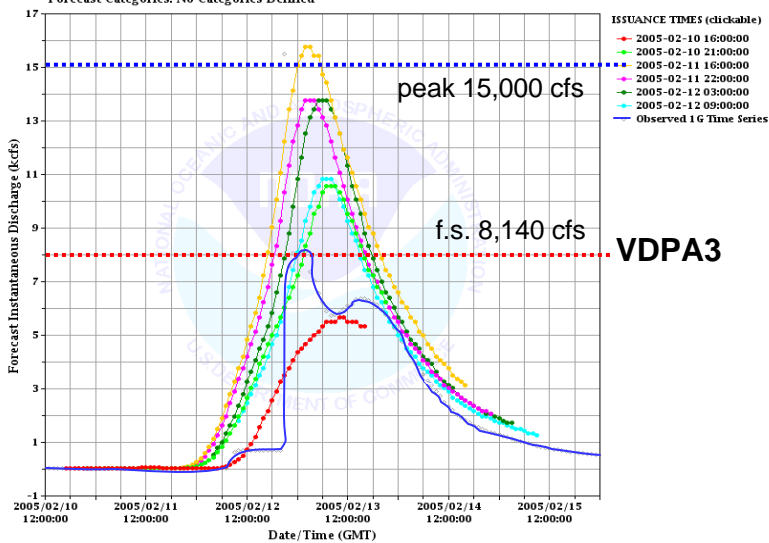
Plot of Forecast and Observed Instantaneous Discharge Time Series for CBRFC  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Location: Gila - Gila, nr [GILN5(QRIFZZZ)]  
 Forecast Categories: No Categories Defined



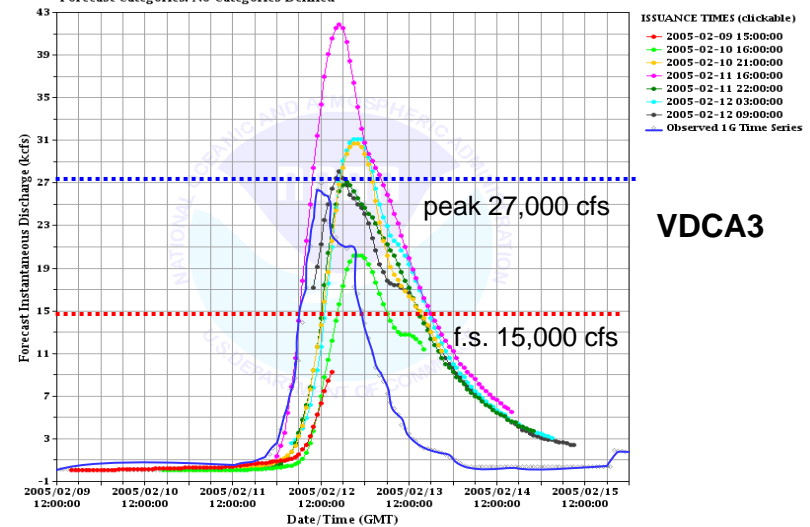
Plot of Forecast and Observed Instantaneous Discharge Time Series for CBRFC  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Location: Gila - Virden, nr, Blue Ck, blo [GVRN5(QRIFZZZ)]  
 Forecast Categories: No Categories Defined



Plot of Forecast and Observed Instantaneous Discharge Time Series for CBRFC  
 Time Period: 2005-02-08 12:42:30 GMT - 2005-02-15 12:42:53 GMT  
 Lead times: 0 hours - 72 hours  
 Location: Verde - Paulden, nr [VDPA3(QRIFZZZ)]  
 Forecast Categories: No Categories Defined



Plot of Forecast and Observed Instantaneous Discharge Time Series for CBRFC  
 Time Period: 2005-02-08 12:42:30 GMT - 2005-02-15 12:42:53 GMT  
 Lead times: 0 hours - 72 hours  
 Location: Verde - Clarkdale [VDCA3(QRIFZZZ)]  
 Forecast Categories: No Categories Defined





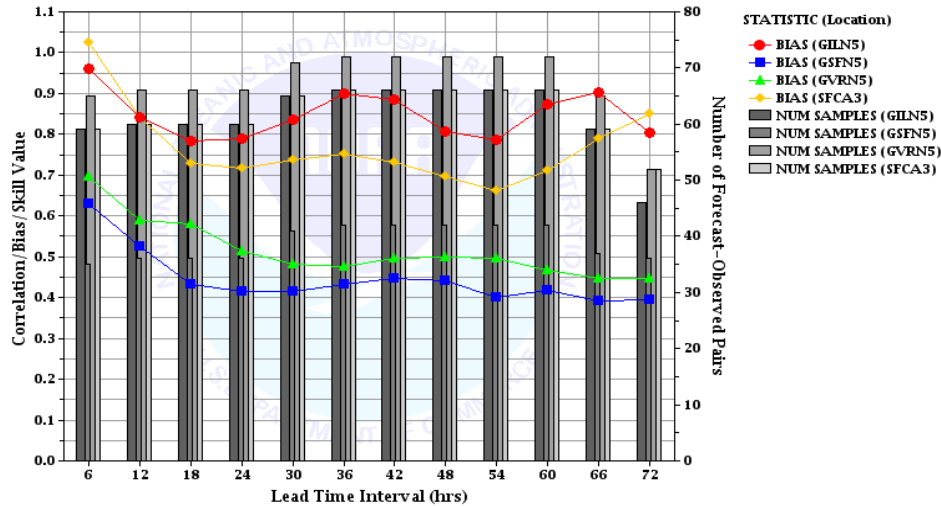
# Gila Bias by Lead Time



## Full Time Series

2/10 18Z – 2/15 12Z

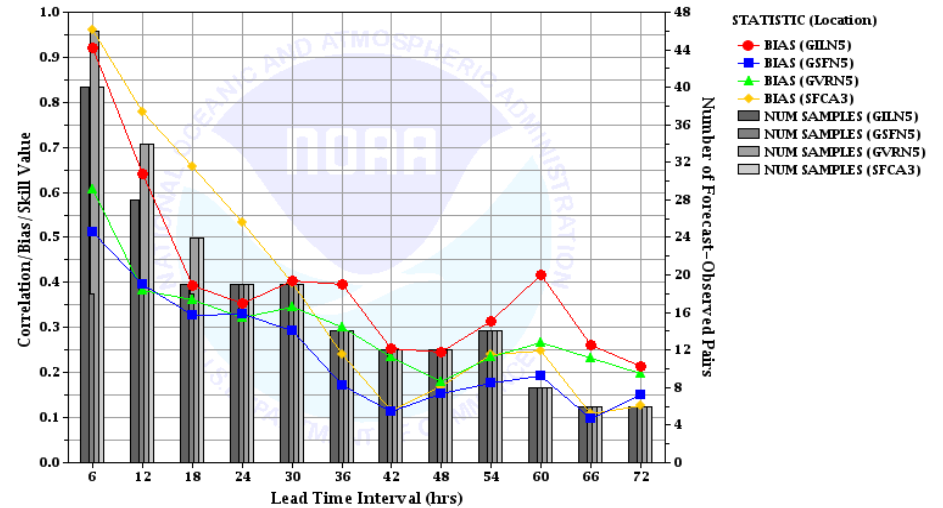
Plot of Instantaneous Discharge Correlation, Bias, and/or Skill against Leadtime Interval for CBRFC Compared Over Location  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 72 hours  
 Locations: GILN5, G5FN5, GVRN5, SFCA3



## Rising Limb

2/11 18Z – 2/13 00Z

Plot of Instantaneous Discharge Correlation, Bias, and/or Skill against Leadtime Interval for CBRFC Compared Over Location  
 Time Period: 2005-02-11 18:00:00 GMT - 2005-02-13 00:00:00 GMT  
 Lead times: 0 hours - 72 hours  
 Locations: GILN5, G5FN5, GVRN5, SFCA3





# National Case Study



- Use 'ofs\_spin' to create a raw model forecast and simulation time series to use as a control
  - Start from a set of fs5files from February 7, 2005 and run through February 18, 2005
  - No mods included from starting point on.
  - Forecasts created by feeding
    - Observed temperatures and freezing level
    - Forecast precipitation
  - Final simulation created by feeding
    - Observed temperatures and freezing level
    - Observed precipitation





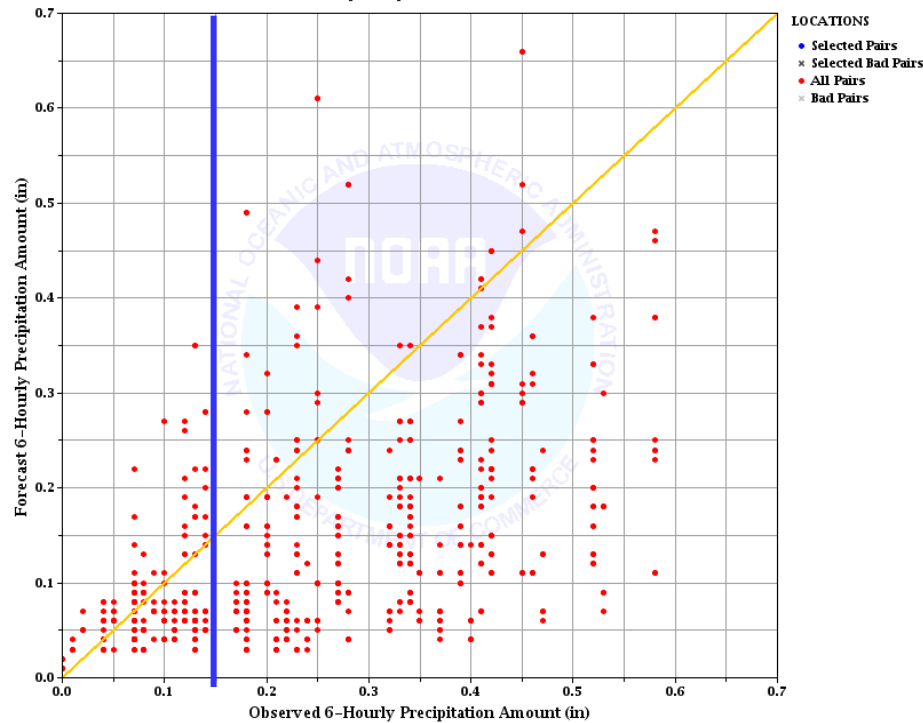
# MAP Scatter Plots



## GILA

**GILN5(L,M,U), GVRN5(L,U),  
GSFN5(L,M,U), SFCA3(L,M,U)**

Plot of Forecast-Observed 6-Hourly Precipitation Amount Data Pairs for NONE  
Time Period: 2005-02-10 18:00:00 GMT - 2005-02-13 00:00:00 GMT  
Lead times: 0 hours - 72 hours  
Selected Location: No Name Available [NONE]

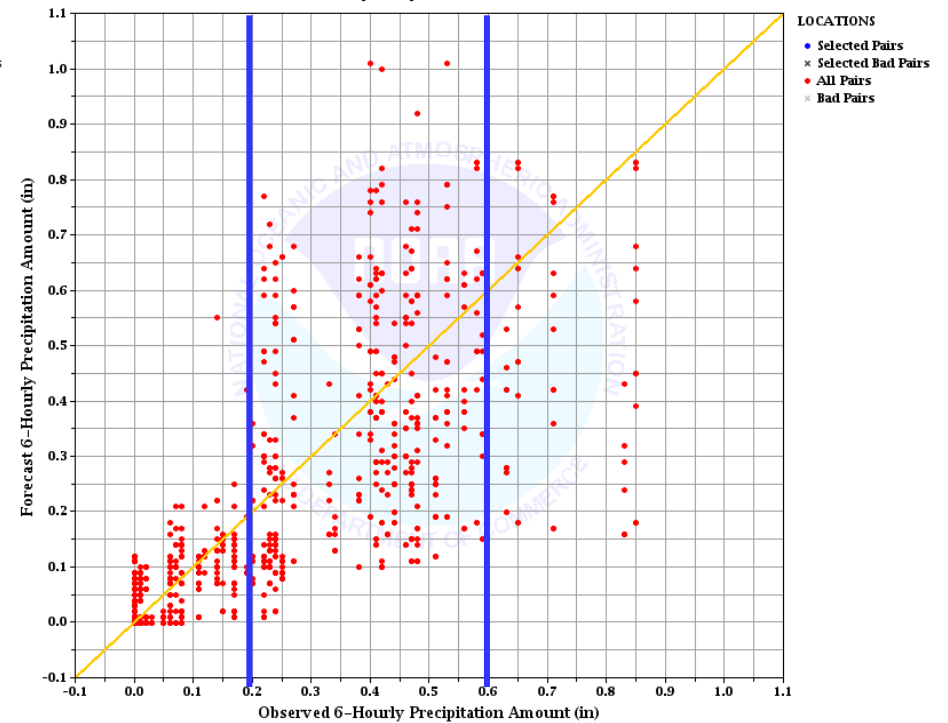


- Mostly under-forecast, especially for values above ~0.15 inches

## VERDE

**VDPA3(L,M,U), VDCA3(L,M,U),  
OAKA3(L,M,U), OACA3(L,U)**

Plot of Forecast-Observed 6-Hourly Precipitation Amount Data Pairs for NONE  
Time Period: 2005-02-08 12:42:30 GMT - 2005-02-15 12:42:53 GMT  
Lead times: 0 hours - 72 hours  
Selected Location: No Name Available [NONE]



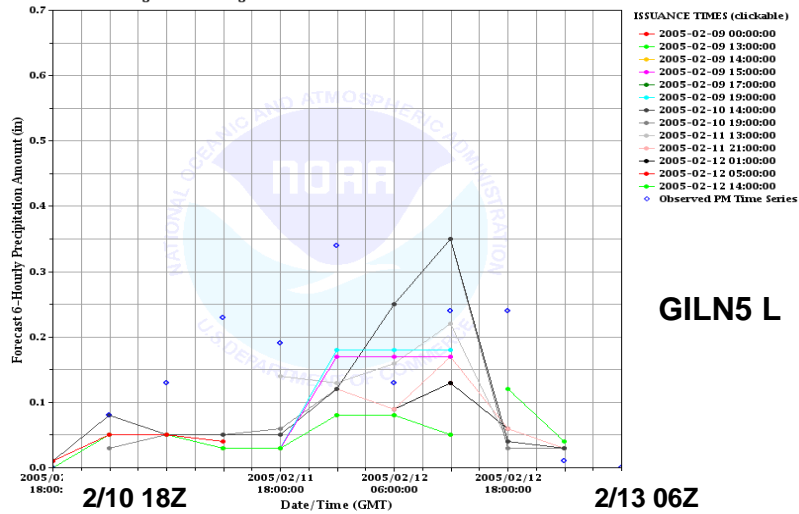
- Much better spread
- Under and Over forecasting



# Gila MAP Time Series

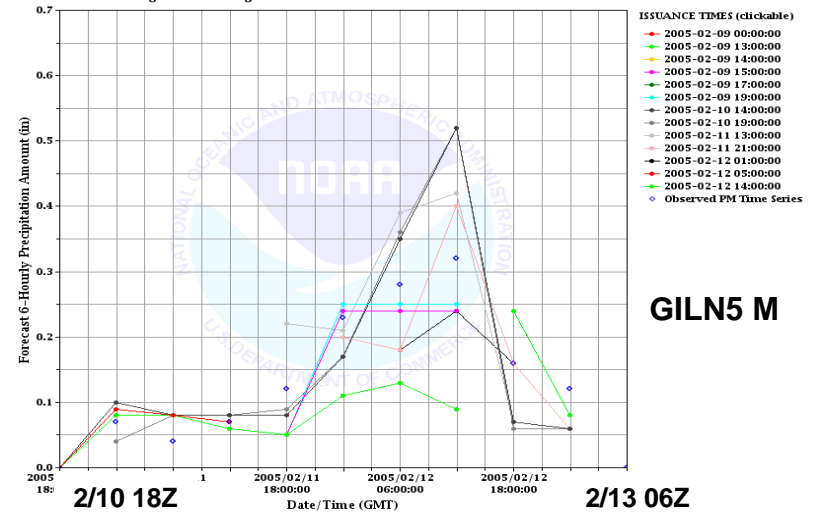


Plot of Forecast and Observed 6-Hourly Precipitation Amount Time Series for CBRFC  
Time Period: 2005-02-10 18:00:00 GMT - 2005-02-13 00:00:00 GMT  
Lead times: 0 hours - 72 hours  
Location: Gila - Gila, nr [GILN5LLH(PPQFEZZ)]  
Forecast Categories: No Categories Defined



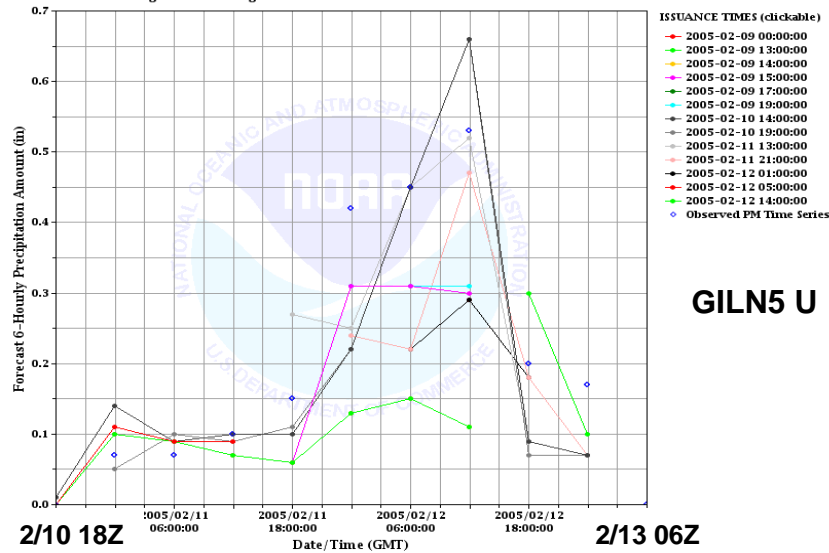
**GILN5 L**

Plot of Forecast and Observed 6-Hourly Precipitation Amount Time Series for CBRFC  
Time Period: 2005-02-10 18:00:00 GMT - 2005-02-13 00:00:00 GMT  
Lead times: 0 hours - 72 hours  
Location: San Francisco - Glenwood, nr [GSFN5LMH(PPQFEZZ)]  
Forecast Categories: No Categories Defined



**GILN5 M**

Plot of Forecast and Observed 6-Hourly Precipitation Amount Time Series for CBRFC  
Time Period: 2005-02-10 18:00:00 GMT - 2005-02-13 00:00:00 GMT  
Lead times: 0 hours - 72 hours  
Location: San Francisco - Glenwood, nr [GSFN5LUH(PPQFEZZ)]  
Forecast Categories: No Categories Defined



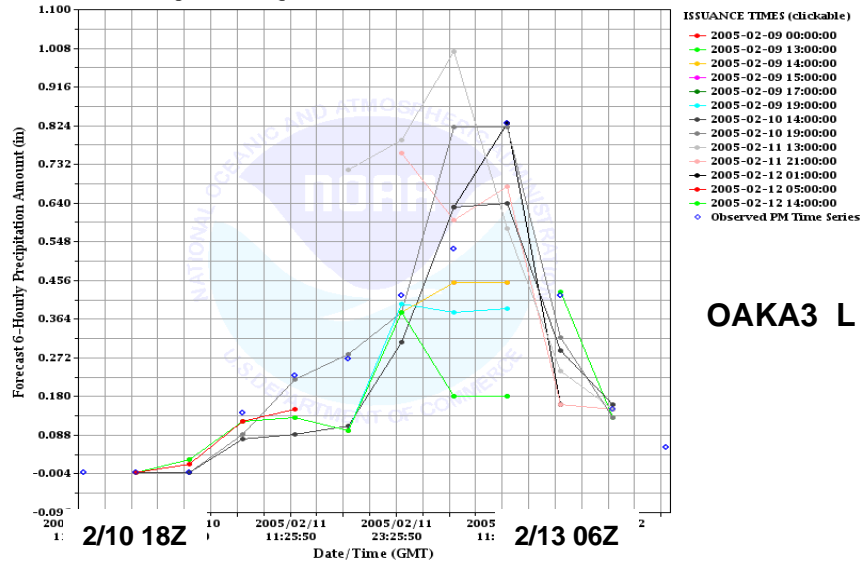
**GILN5 U**



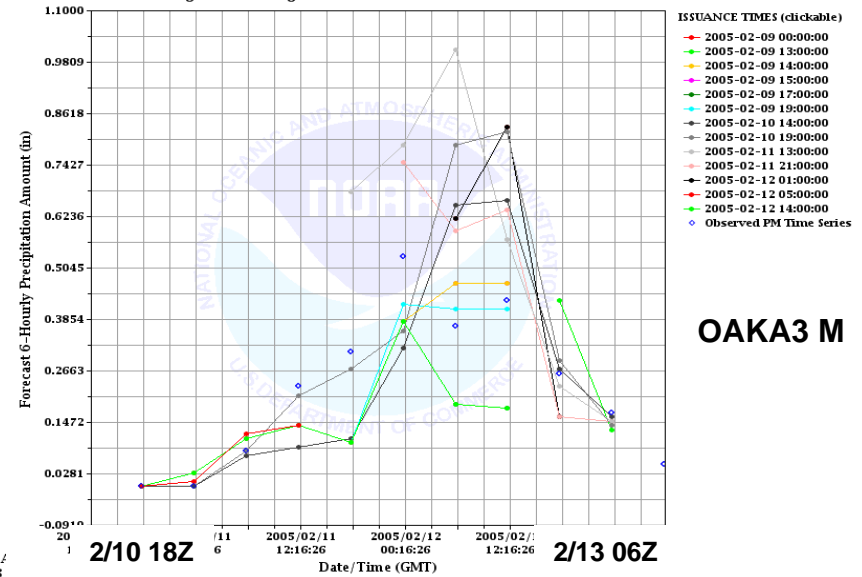
# Verde MAP Time Series



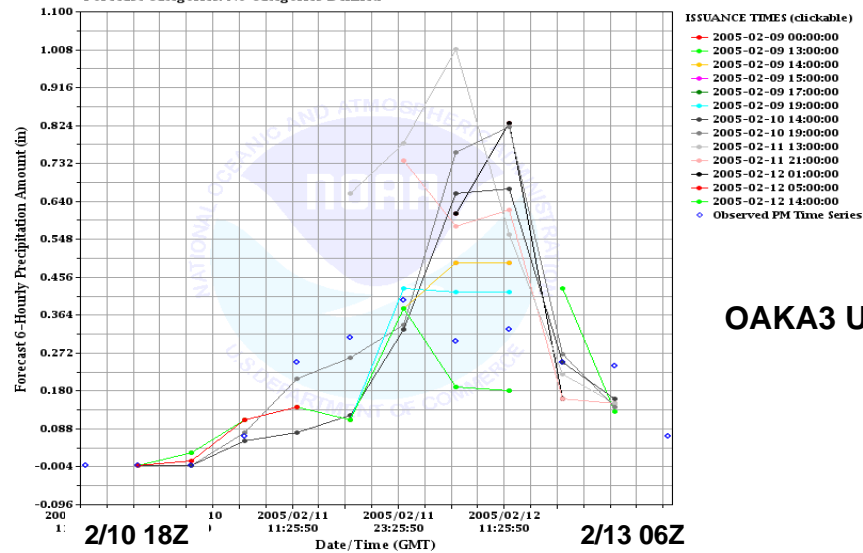
Plot of Forecast and Observed 6-Hourly Precipitation Amount Time Series for CBRFC  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-13 00:01:00 GMT  
 Lead times: 0 hours - 72 hours  
 Location: Oak Ck - Sedona [OAKA3HLH(PPOFEZZ)]  
 Forecast Categories: No Categories Defined



Plot of Forecast and Observed 6-Hourly Precipitation Amount Time Series for CBRFC  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-13 00:01:00 GMT  
 Lead times: 0 hours - 72 hours  
 Location: Oak Ck - Sedona [OAKA3HMH(PPOFEZZ)]  
 Forecast Categories: No Categories Defined



Time Period: 2005-02-10 18:00:00 GMT - 2005-02-13 00:01:00 GMT  
 Lead times: 0 hours - 72 hours  
 Location: Oak Ck - Sedona [OAKA3HUH(PPOFEZZ)]  
 Forecast Categories: No Categories Defined

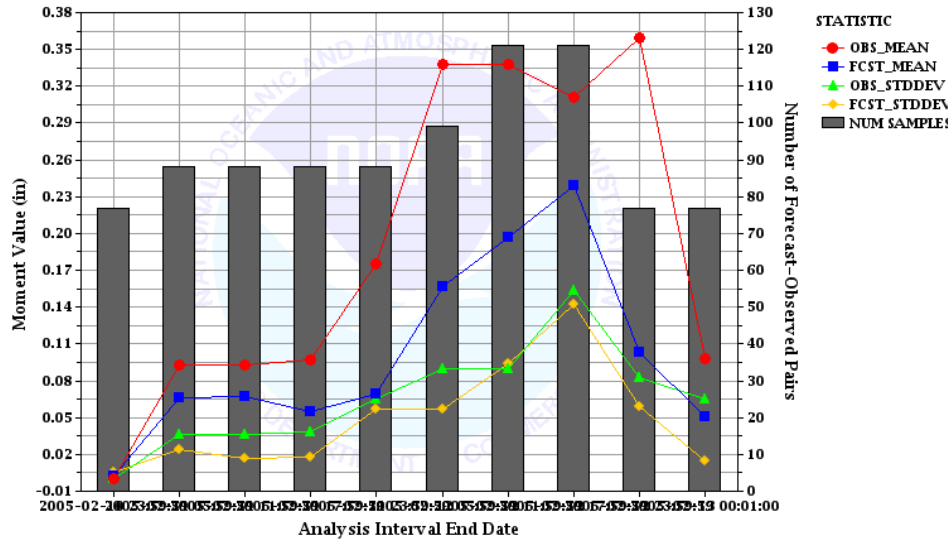




# MAP Stats

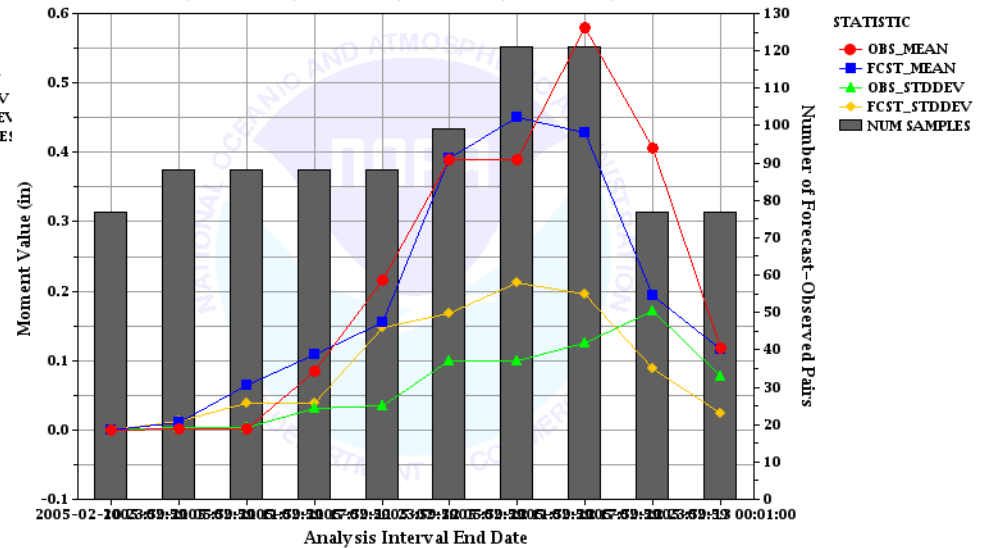


Plot of 6-Hourly Precipitation Amount Moments against Analysis Interval for CBRFC  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-13 00:01:00 GMT  
 Lead times: 0 hours - 72 hours  
 Locations: GILNSLLH, GILNSLMH, GILNSLUH, GSFNSLLH, GSFNSLMH, GSFNSLUH, GVRNSLLH, GVRNSLUH, SFCA3LLH, SFCA3LMH, SFCA3LUH



All Gila MAPs

Plot of 6-Hourly Precipitation Amount Moments against Analysis Interval for CBRFC  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-13 00:01:00 GMT  
 Lead times: 0 hours - 72 hours  
 Locations: OACA3LLH, OACA3LUH, OAKA3HLH, OAKA3HMH, OAKA3HUH, VDCA3LLH, VDCA3LMH, VDCA3LUH, VDPA3HLH, VDPA3HMH, VDPA3HUH



All Verde MAPs



# RMSE vs. Location



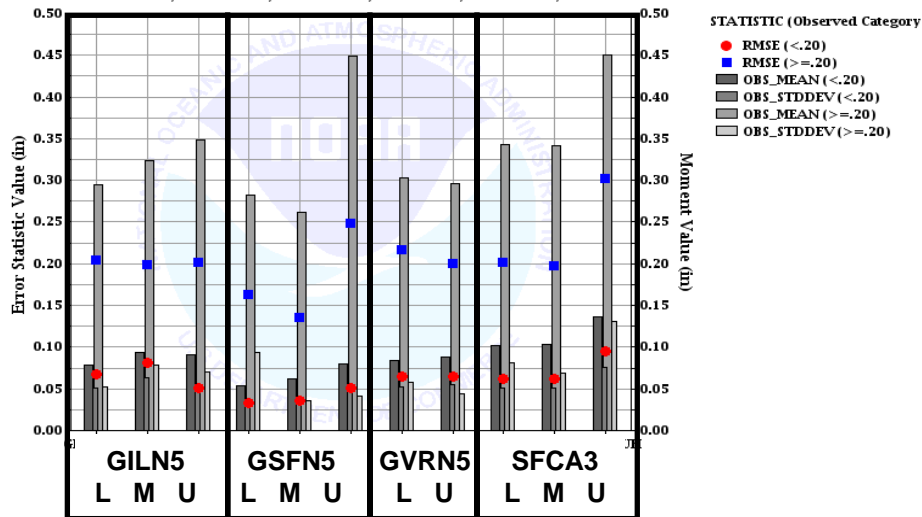
Compared by categories where

Cat 1 < 0.20"

Cat 2 >= 0.20"

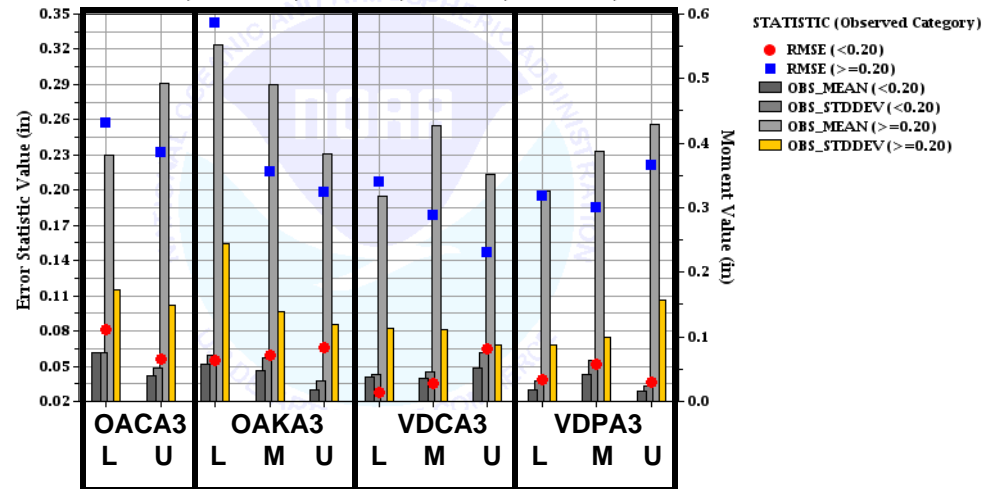
## GILA

Plot of 6-Hourly Precipitation Amount Error Statistics against Location for CBRFC  
 Compared Over Observed Category  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-13 00:00:00 GMT  
 Lead times: 0 hours - 72 hours  
 Locations: GILN5LLH, GILN5LMH, GILN5LUH, GSFN5LLH, GSFN5LMH,  
 GSFN5LUH, GVRN5LLH, GVRN5LUH, SFCA3LLH, SFCA3LMH, SFCA3LUH



## VERDE

Plot of 6-Hourly Precipitation Amount Error Statistics against Location for CBRFC  
 Compared Over Observed Category  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-13 00:01:00 GMT  
 Lead times: 0 hours - 72 hours  
 Locations: OACA3LLH, OACA3LUH, OAKA3HLH, OAKA3HMH, OAKA3HUH,  
 VDCA3LLH, VDCA3LMH, VDCA3LUH, VDPA3HLH, VDPA3HMH, VDPA3HUH





# Bias vs. Location



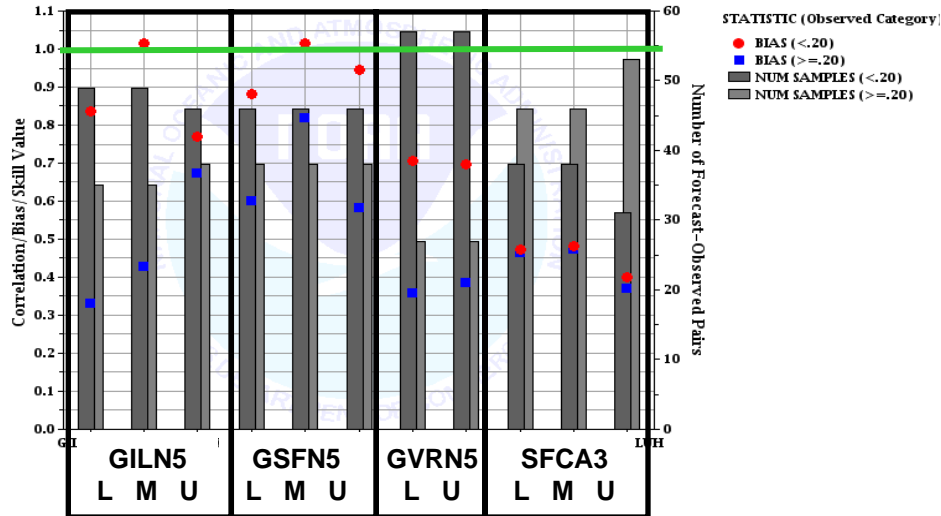
Compared by categories where

Cat 1 < 0.20

Cat 2 >= 0.20

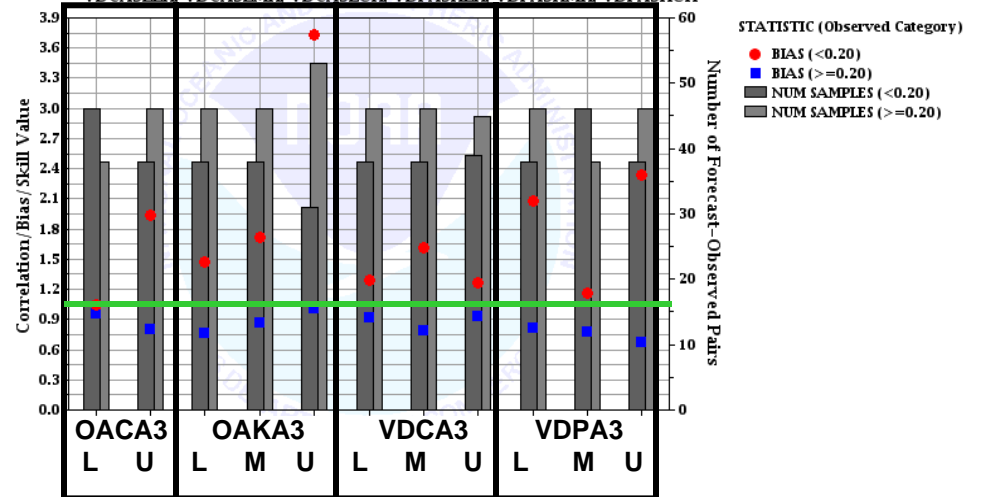
## GILA

Plot of 6-Hourly Precipitation Amount Correlation, Bias, and/or Skill against Location for CBRFC  
 Compared Over Observed Category  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-13 00:00:00 GMT  
 Lead times: 0 hours - 72 hours  
 Locations: GILN5LLH, GILN5LMH, GILN5LUH, GSFN5LLH, GSFN5LMH, GSFN5LUH, GVRN5LLH, GVRN5LMH, GVRN5LUH, SFCA3LLH, SFCA3LMH, SFCA3LUH



## VERDE

Plot of 6-Hourly Precipitation Amount Correlation, Bias, and/or Skill against Location for CBRFC  
 Compared Over Observed Category  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-13 00:01:00 GMT  
 Lead times: 0 hours - 72 hours  
 Locations: OACA3LLH, OACA3LUH, OAKA3HLH, OAKA3HMH, OAKA3HUH, VDCA3LLH, VDCA3LMH, VDCA3LUH, VDPA3HLH, VDPA3HMH, VDPA3HUH



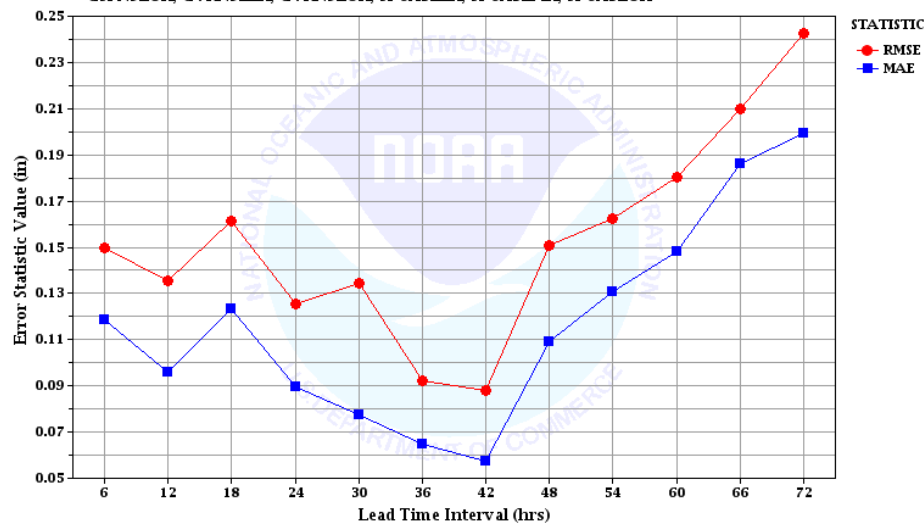


# Lead Time Statistics



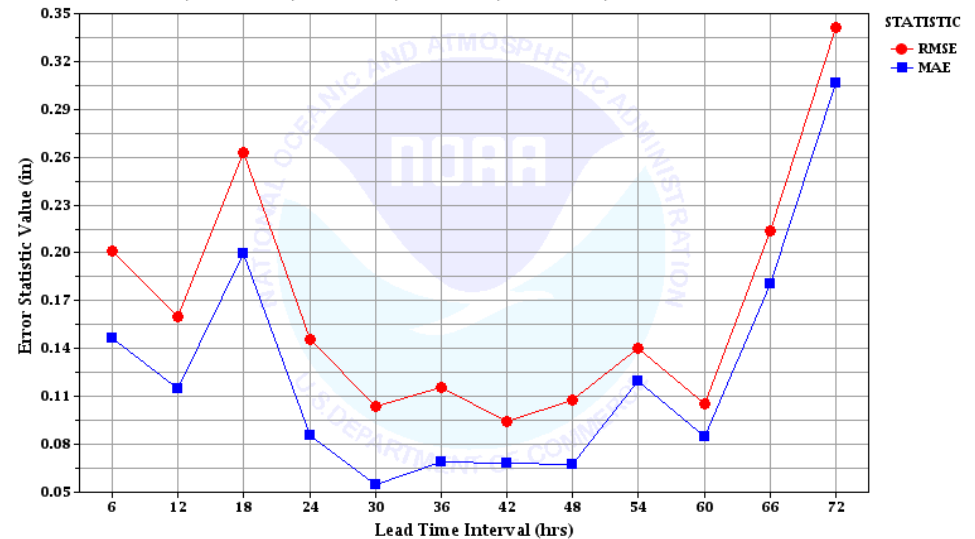
## GILA

Plot of 6-Hourly Precipitation Amount Error Statistics against Leadtime Interval for CBRFC  
Time Period: 2005-02-10 18:00:00 GMT - 2005-02-13 00:01:00 GMT  
Lead times: 0 hours - 72 hours  
Locations: GILN5LLH, GILN5LMH, GILN5LUH, GSFN5LLH, GSFN5LMH,  
GSFN5LUH, GVRN5LLH, GVRN5LUH, SFCA3LLH, SFCA3LMH, SFCA3LUH



## VERDE

Plot of 6-Hourly Precipitation Amount Error Statistics against Leadtime Interval for CBRFC  
Time Period: 2005-02-10 18:00:00 GMT - 2005-02-13 00:01:00 GMT  
Lead times: 0 hours - 72 hours  
Locations: OACA3LLH, OACA3LUH, OAKA3HLH, OAKA3HMH, OAKA3HUH,  
VDCA3LLH, VDCA3LMH, VDCA3LUH, VDPA3HLH, VDPA3HMH, VDPA3HUH



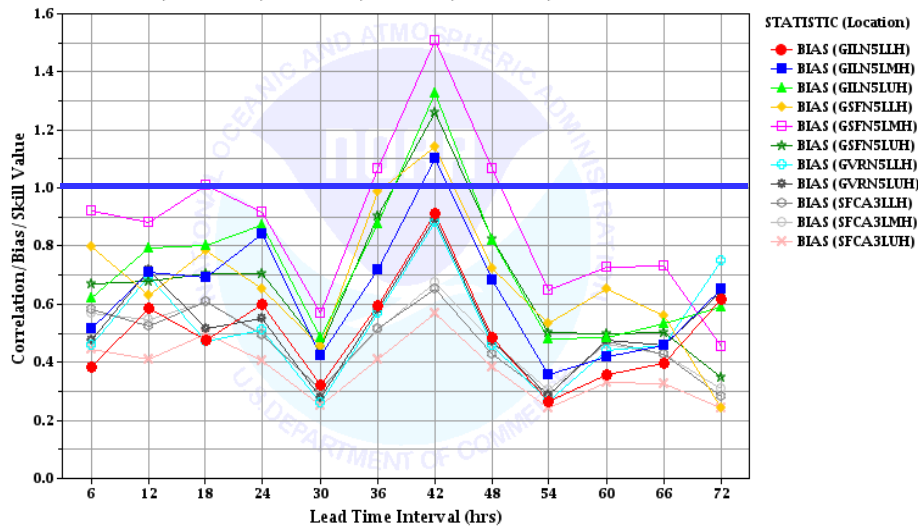


# Lead Time Statistics



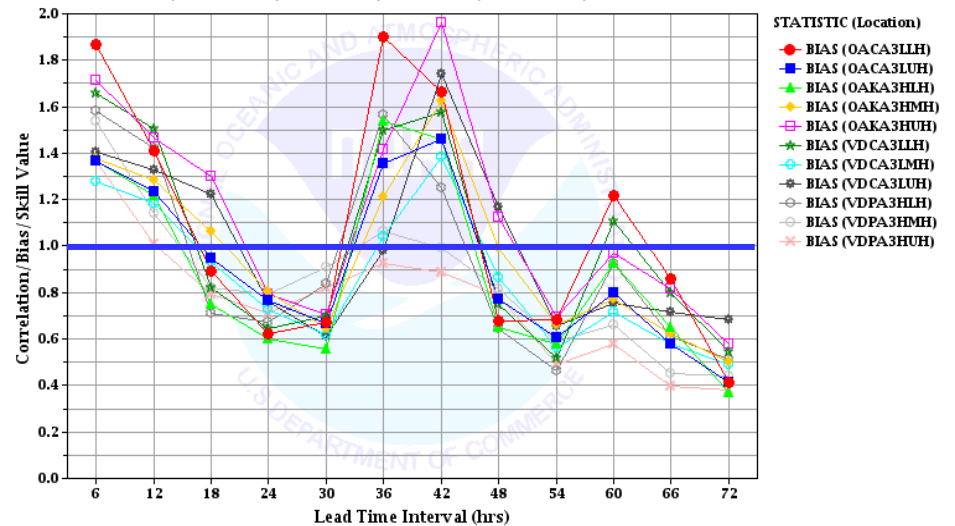
## GILA

Plot of 6-Hourly Precipitation Amount Correlation, Bias, and/or Skill against Leadtime Interval for CBRFC Compared Over Location  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-13 00:01:00 GMT  
 Lead times: 0 hours - 72 hours  
 Locations: GILN5LLH, GILN5LMH, GILN5LUH, G5FN5LLH, G5FN5LMH, G5FN5LUH, GVRN5LLH, GVRN5LUH, SFCA3LLH, SFCA3LMH, SFCA3LUH



## VERDE

Plot of 6-Hourly Precipitation Amount Correlation, Bias, and/or Skill against Leadtime Interval for CBRFC Compared Over Location  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-13 00:01:00 GMT  
 Lead times: 0 hours - 72 hours  
 Locations: OACA3LLH, OACA3LUH, OAKA3HLH, OAKA3MH, OAKA3HUH, VDCA3LLH, VDCA3LMH, VDCA3LUH, VDPA3HLH, VDPA3MH, VDPA3HUH





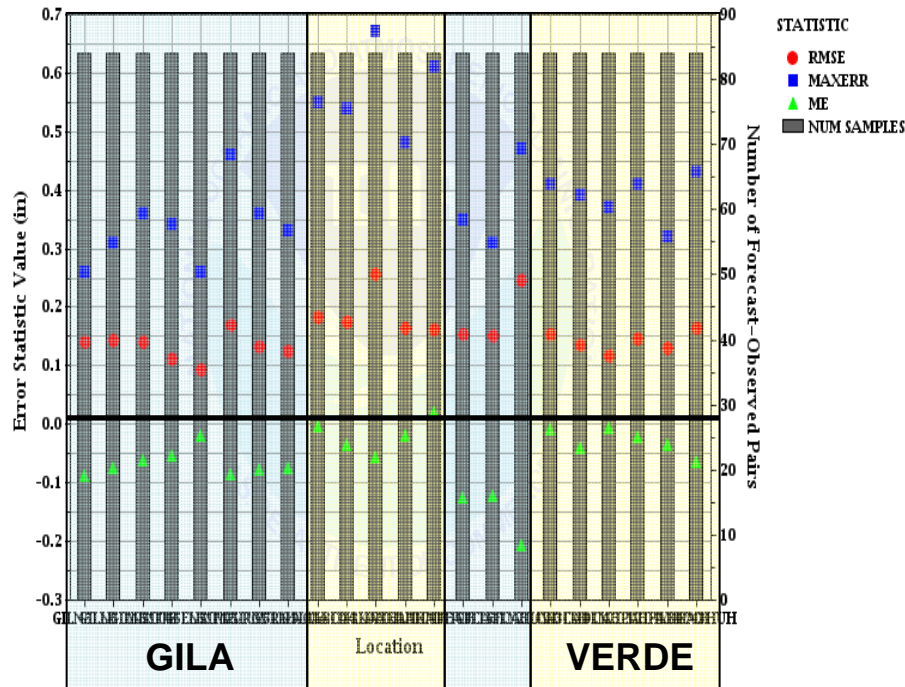


# Gila vs. Verde MAP



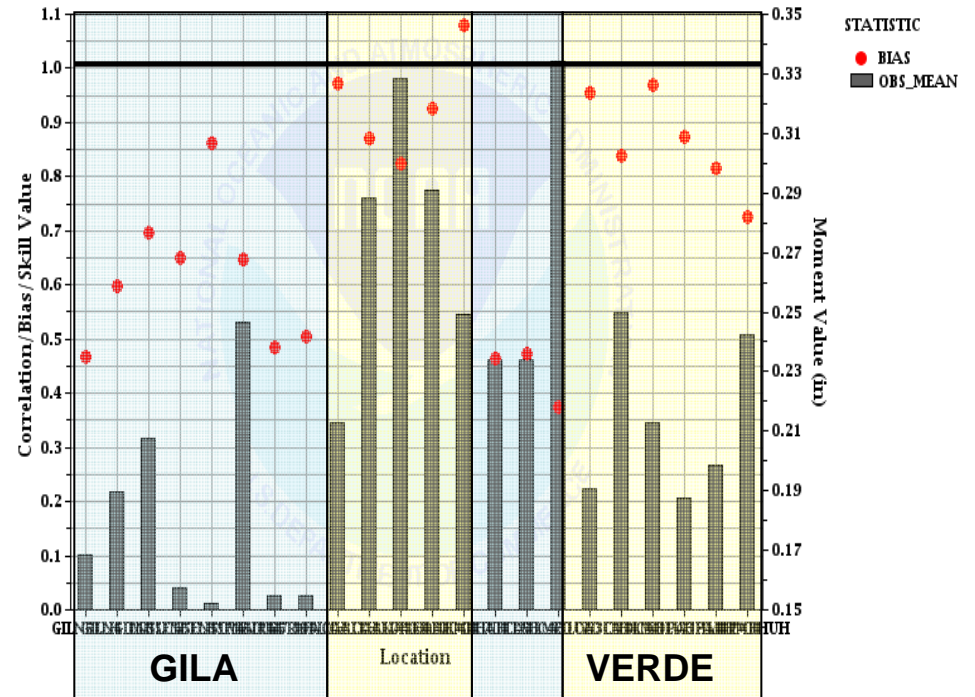
## RMSE, MAXERR, ME by Location

Plot of 6-Hourly Precipitation Amount Error Statistics against Location for CBRFC  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-13 00:01:00 GMT  
 Lead times: 0 hours - 72 hours  
 Locations: GILN5LLH, GILN5LMH, GILN5LUH, GSFN5LLH, GSFN5LMH, GSFN5LUH, GVRN5LLH, GVRN5LUH, OACA3LLH, OACA3LUH, OAKA3HLH,...



## Bias by Location

Plot of 6-Hourly Precipitation Amount Correlation, Bias, and/or Skill against Location for CBRFC  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-13 00:01:00 GMT  
 Lead times: 0 hours - 72 hours  
 Locations: GILN5LLH, GILN5LMH, GILN5LUH, GSFN5LLH, GSFN5LMH, GSFN5LUH, GVRN5LLH, GVRN5LUH, OACA3LLH, OACA3LUH, OAKA3HLH,...



QPF slightly better in Verde Basin



# Raw Model Flow Scatter Plots



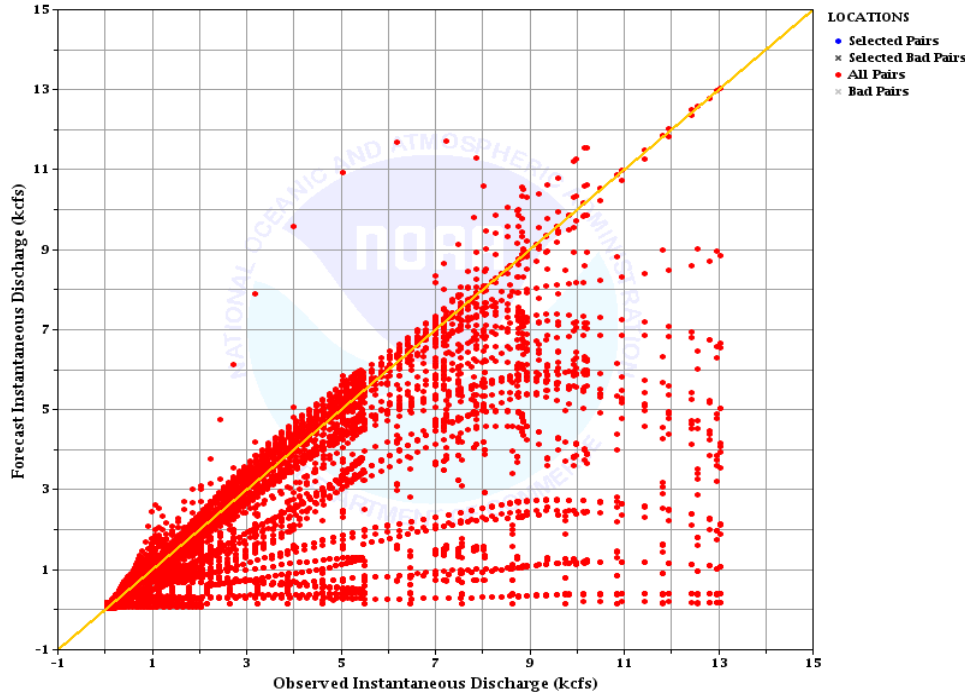
## GILA

GILN5, GVRN5,  
GSFN5, SFCA3

## VERDE

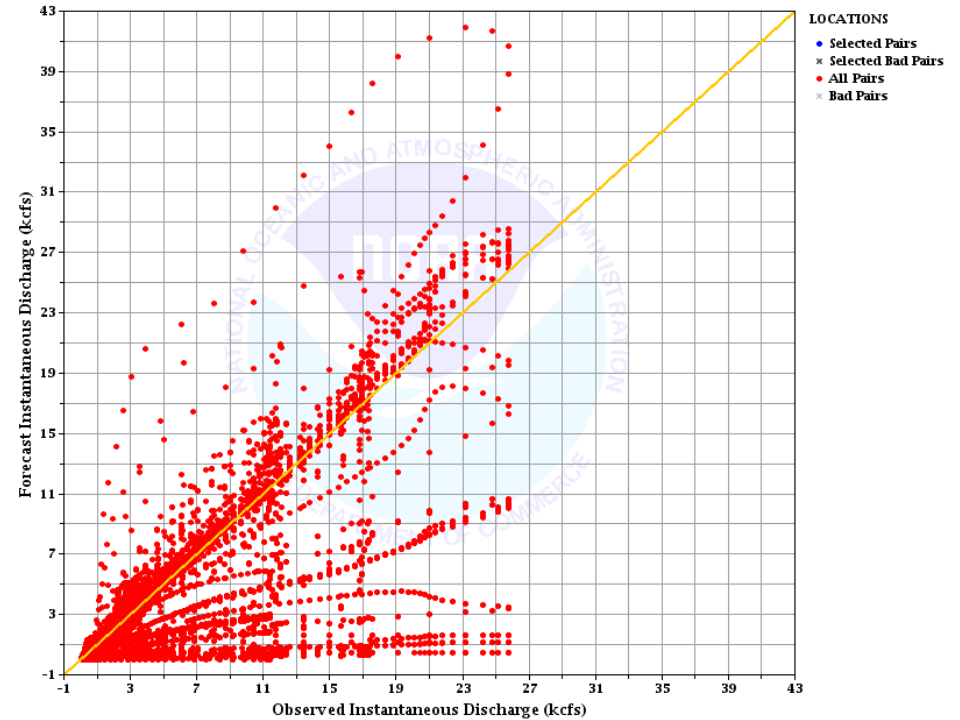
VDPA3, VDCA3,  
OAKA3, OACA3

Plot of Forecast-Observed Instantaneous Discharge Data Pairs for NONE  
Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
Lead times: 0 hours - 120 hours  
Selected Location: No Name Available [NONE]



• Under-forecast

Plot of Forecast-Observed Instantaneous Discharge Data Pairs for NONE  
Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
Lead times: 0 hours - 120 hours  
Selected Location: No Name Available [NONE]



• Better spread

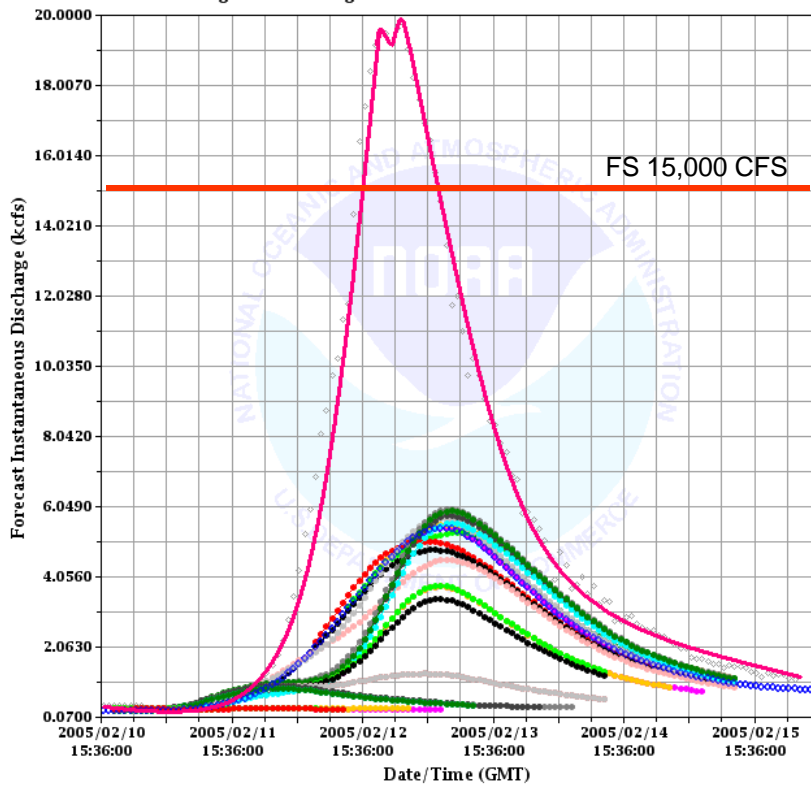


# Gila Raw Model Time Series



## GILN5

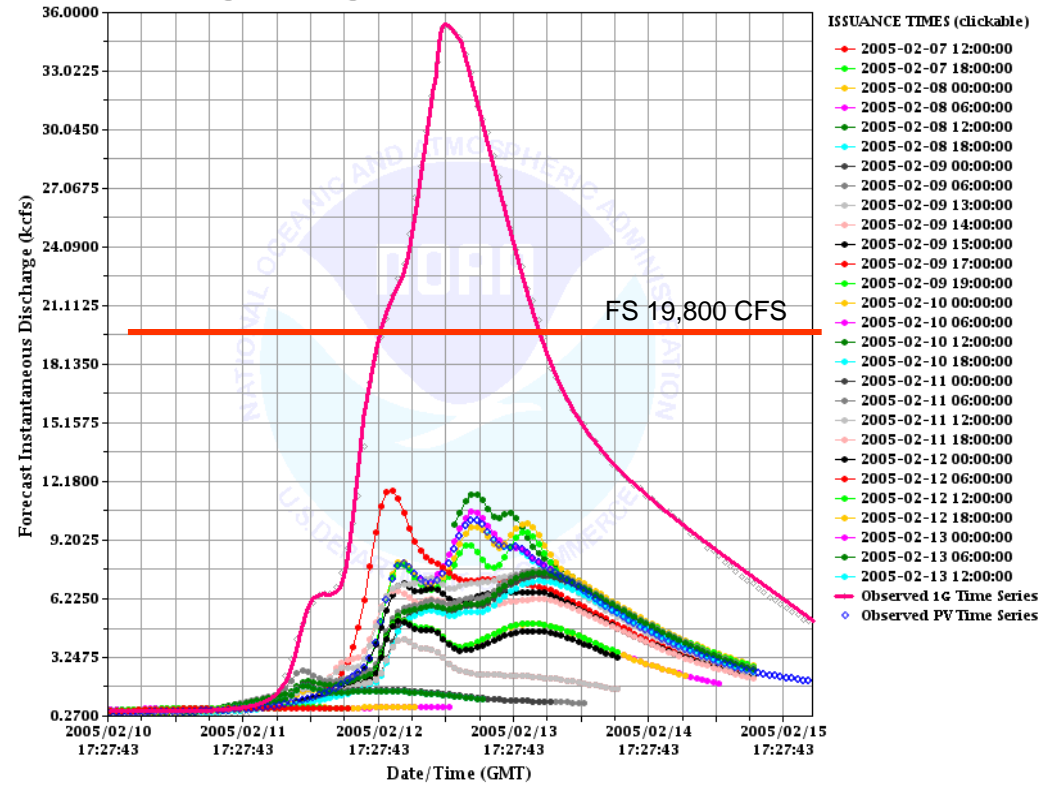
Plot of Forecast and Observed Instantaneous Discharge Time Series for CBRFC  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Location: Gila - Gila, nr [GILN5(QRIFVZZ)]  
 Forecast Categories: No Categories Defined



Upstream

## GVRN5

Plot of Forecast and Observed Instantaneous Discharge Time Series for CBRFC  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Location: Gila - Virden, nr, Blue Ck, blo [GVRN5(QRIFVZZ)]  
 Forecast Categories: No Categories Defined



Downstream

ISSUANCE TIMES (clickable)

- 2005-02-07 12:00:00
- 2005-02-07 18:00:00
- 2005-02-08 00:00:00
- 2005-02-08 06:00:00
- 2005-02-08 12:00:00
- 2005-02-08 18:00:00
- 2005-02-09 00:00:00
- 2005-02-09 06:00:00
- 2005-02-09 13:00:00
- 2005-02-09 14:00:00
- 2005-02-09 15:00:00
- 2005-02-09 17:00:00
- 2005-02-09 19:00:00
- 2005-02-10 00:00:00
- 2005-02-10 06:00:00
- 2005-02-10 12:00:00
- 2005-02-10 18:00:00
- 2005-02-11 00:00:00
- 2005-02-11 06:00:00
- 2005-02-11 12:00:00
- 2005-02-11 18:00:00
- 2005-02-12 00:00:00
- 2005-02-12 06:00:00
- 2005-02-12 12:00:00
- 2005-02-12 18:00:00
- 2005-02-13 00:00:00
- 2005-02-13 06:00:00
- 2005-02-13 12:00:00
- Observed 1G Time Series
- Observed PV Time Series



# Gila Raw Model Time Series

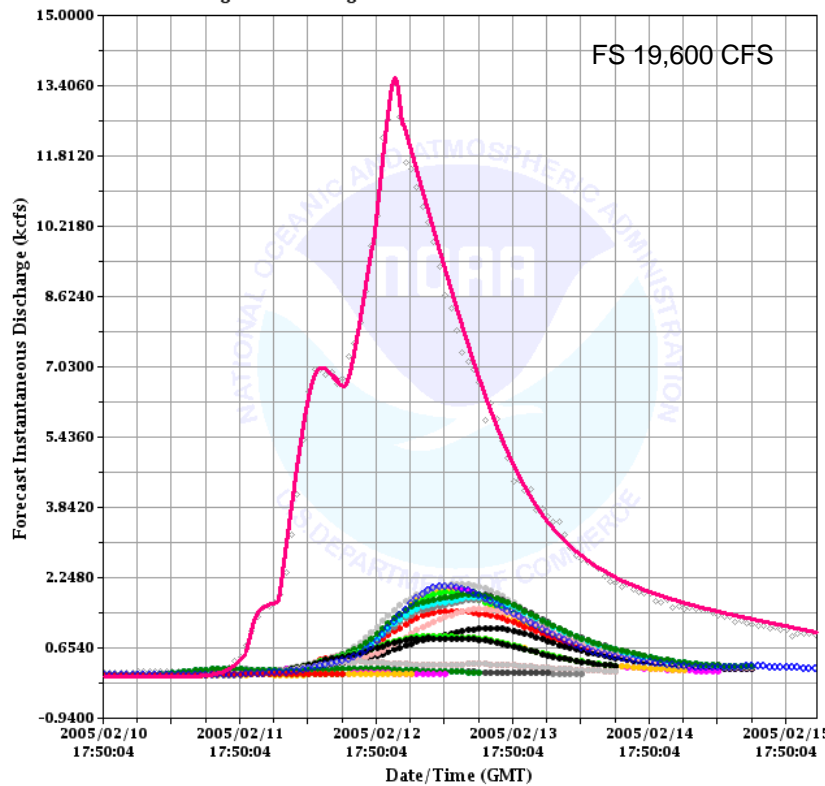


## GSFN5

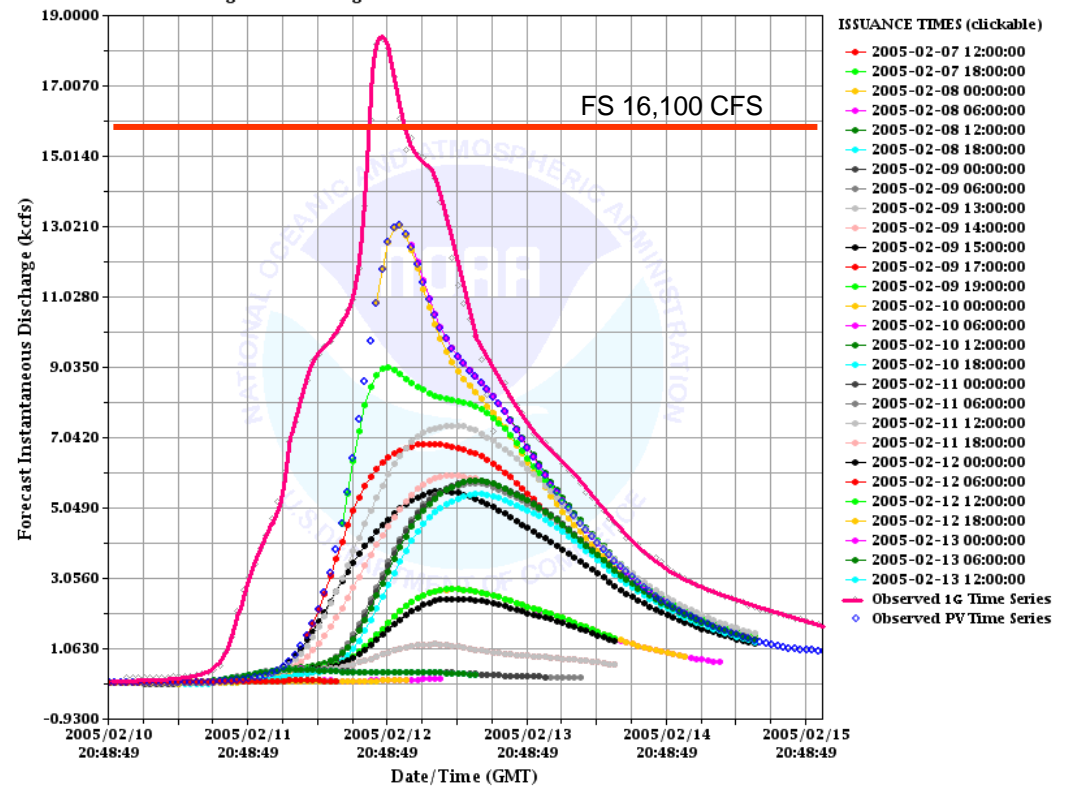
## SFCA3

Plot of Forecast and Observed Instantaneous Discharge Time Series for CBRFC  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Location: San Francisco - Greenwood, nr [GSFN5(QRIFVZZ)]  
 Forecast Categories: No Categories Defined

Plot of Forecast and Observed Instantaneous Discharge Time Series for CBRFC  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Location: San Francisco - Clifton [SFCA3(QRIFVZZ)]  
 Forecast Categories: No Categories Defined



Upstream



Downstream



# Verde Raw Model Time Series

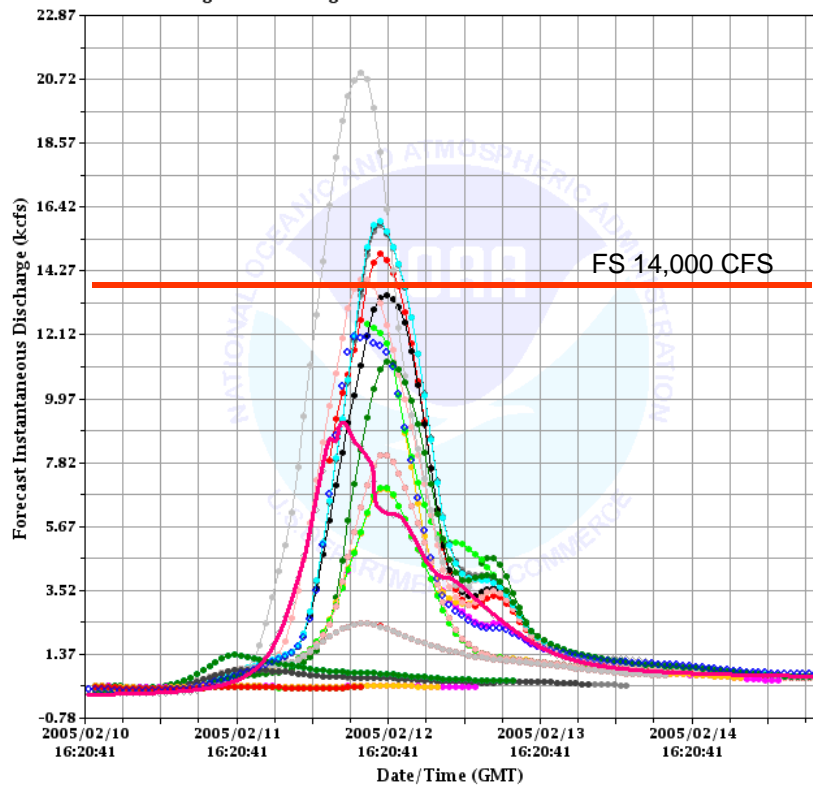


## OAKA3

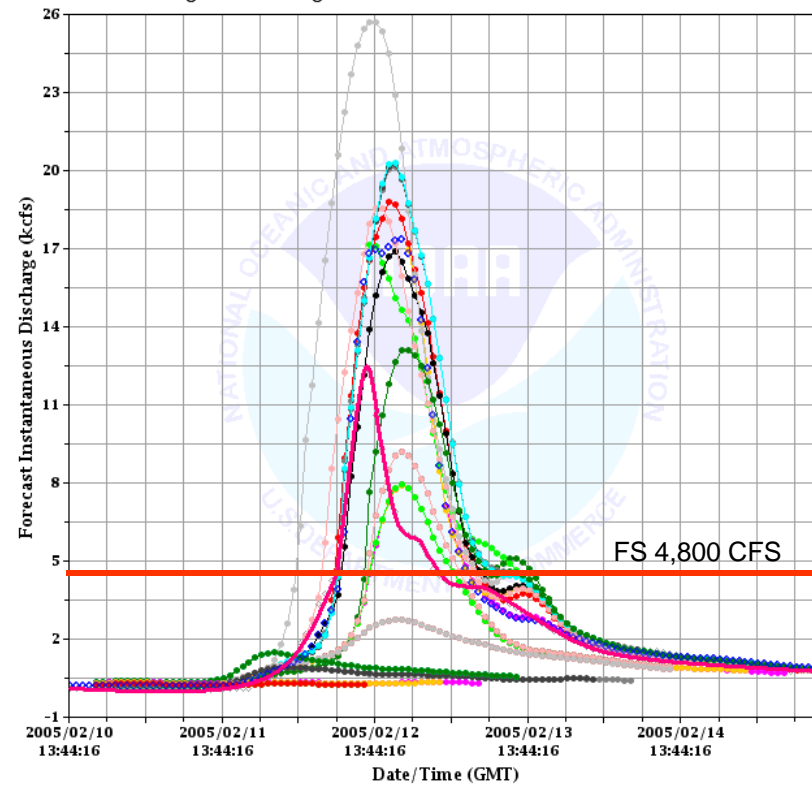
## OACA3

Plot of Forecast and Observed Instantaneous Discharge Time Series for CBRFC  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Location: Oak Ck - Sedona [OAKA3(QRIFVZZ)]  
 Forecast Categories: No Categories Defined

Plot of Forecast and Observed Instantaneous Discharge Time Series for CBRFC  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Location: Oak Ck - Cornville, nr [OACA3(QRIFVZZ)]  
 Forecast Categories: No Categories Defined



### Upstream



### Downstream

ISSUANCE TIMES (clickable)

- 2005-02-07 12:00:00
- 2005-02-07 18:00:00
- 2005-02-08 00:00:00
- 2005-02-08 06:00:00
- 2005-02-08 12:00:00
- 2005-02-08 18:00:00
- 2005-02-09 00:00:00
- 2005-02-09 06:00:00
- 2005-02-09 13:00:00
- 2005-02-09 14:00:00
- 2005-02-09 15:00:00
- 2005-02-09 17:00:00
- 2005-02-09 19:00:00
- 2005-02-10 00:00:00
- 2005-02-10 06:00:00
- 2005-02-10 12:00:00
- 2005-02-10 18:00:00
- 2005-02-11 00:00:00
- 2005-02-11 06:00:00
- 2005-02-11 12:00:00
- 2005-02-11 18:00:00
- 2005-02-12 00:00:00
- 2005-02-12 06:00:00
- 2005-02-12 12:00:00
- 2005-02-12 18:00:00
- 2005-02-13 00:00:00
- 2005-02-13 06:00:00
- 2005-02-13 12:00:00
- Observed 1G Time Series
- Observed PV Time Series



# Verde Raw Model Time Series

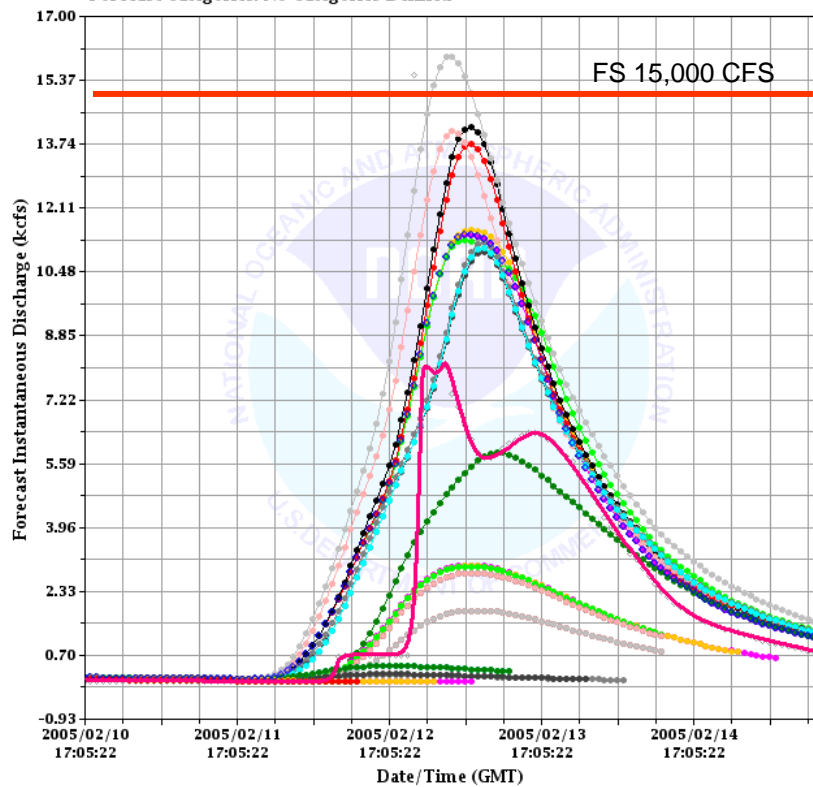


## VDPA3

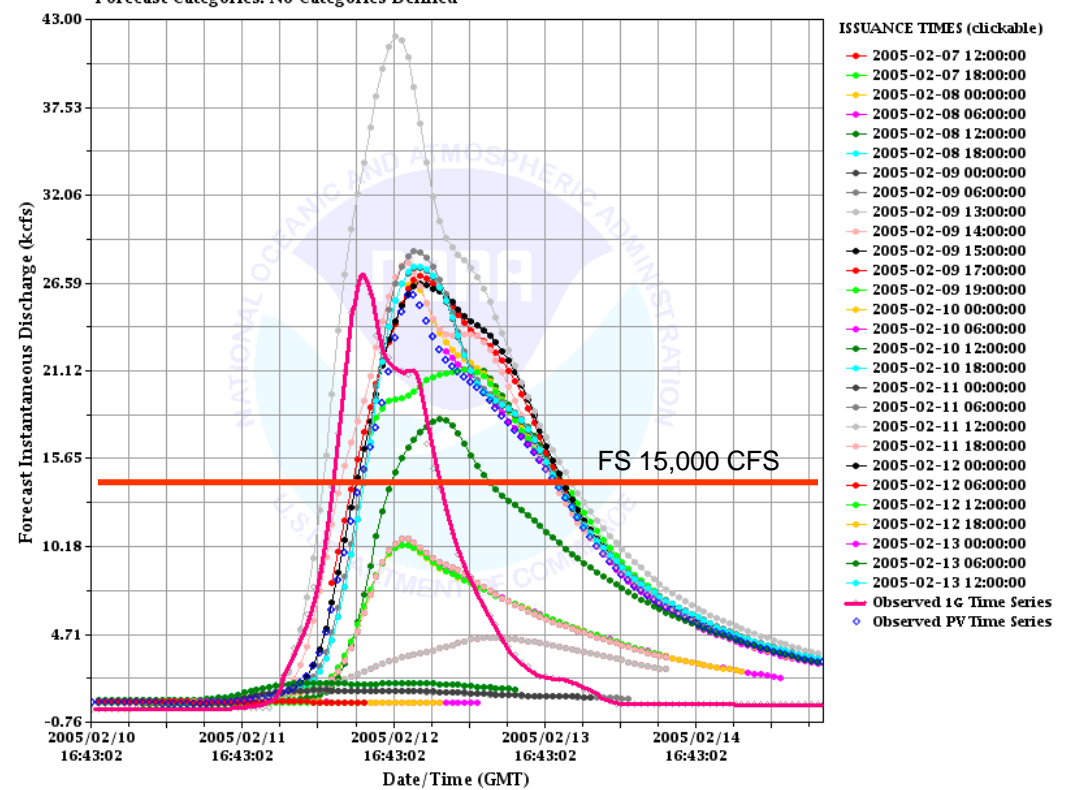
## VDCA3

Plot of Forecast and Observed Instantaneous Discharge Time Series for CBRFC  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Location: Verde - Paulden, nr [VDPA3(QRIFVZZ)]  
 Forecast Categories: No Categories Defined

Plot of Forecast and Observed Instantaneous Discharge Time Series for CBRFC  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Location: Verde - Clarkdale [VDCA3(QRIFVZZ)]  
 Forecast Categories: No Categories Defined



Upstream



Downstream

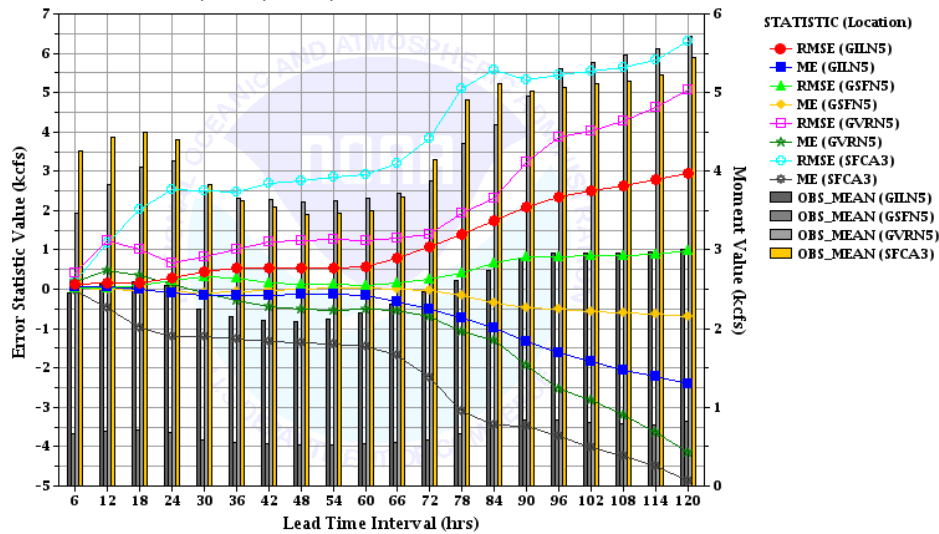


# RMSE/ME by Lead Time



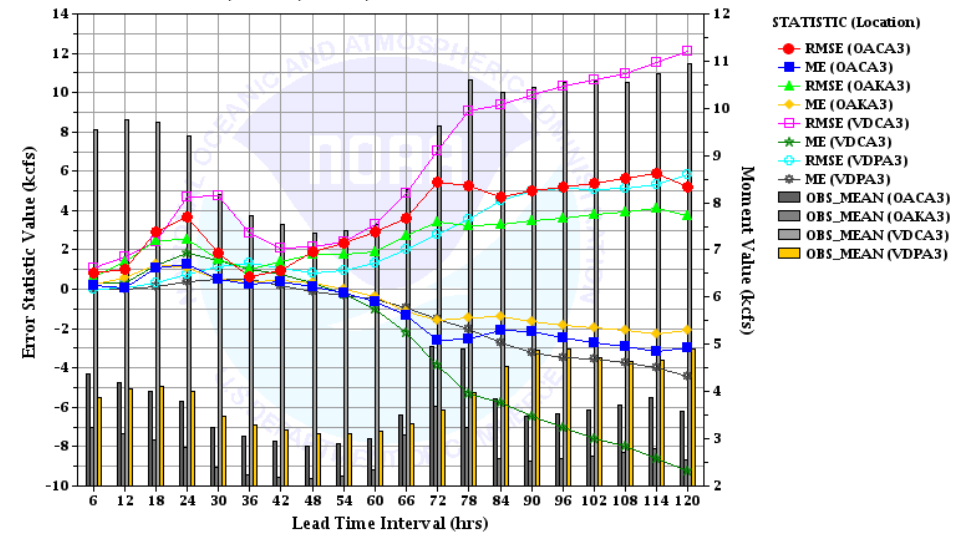
## GILA

Plot of Instantaneous Discharge Error Statistics against Leadtime Interval for CBRFC  
 Compared Over Location  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Locations: GILN5, G5FN5, GVRN5, SFCA3



## VERDE

Plot of Instantaneous Discharge Error Statistics against Leadtime Interval for CBRFC  
 Compared Over Location  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Locations: OACA3, OAKA3, VDCA3, VDPA3

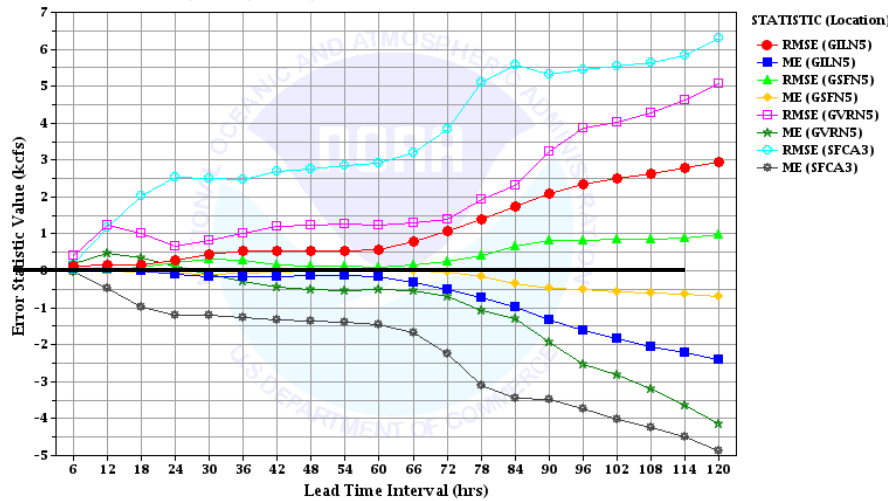




# Gila RMSE/ME by Lead Time

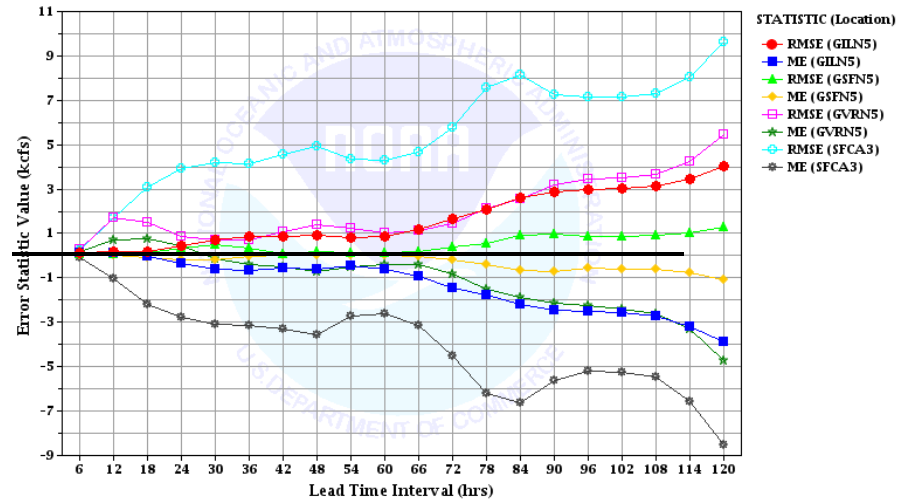


Plot of Instantaneous Discharge Error Statistics against Leadtime Interval for CBRFC  
 Compared Over Location  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Locations: GILN5, GSFN5, GVRN5, SFCA3



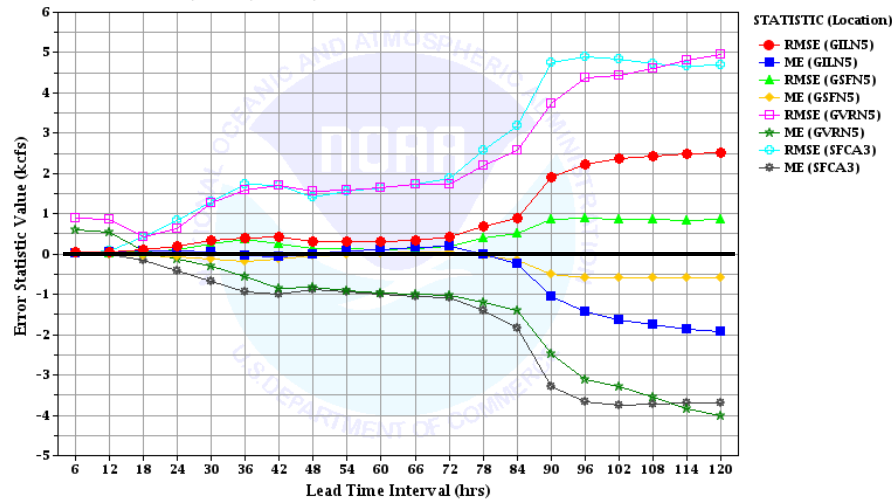
Full Time Series

Plot of Instantaneous Discharge Error Statistics against Leadtime Interval for CBRFC  
 Compared Over Location  
 Time Period: 2005-02-11 18:00:00 GMT - 2005-02-13 06:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Locations: GILN5, GSFN5, GVRN5, SFCA3



Rising Limb

Plot of Instantaneous Discharge Error Statistics against Leadtime Interval for CBRFC  
 Compared Over Location  
 Time Period: 2005-02-13 06:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Locations: GILN5, GSFN5, GVRN5, SFCA3



Recession

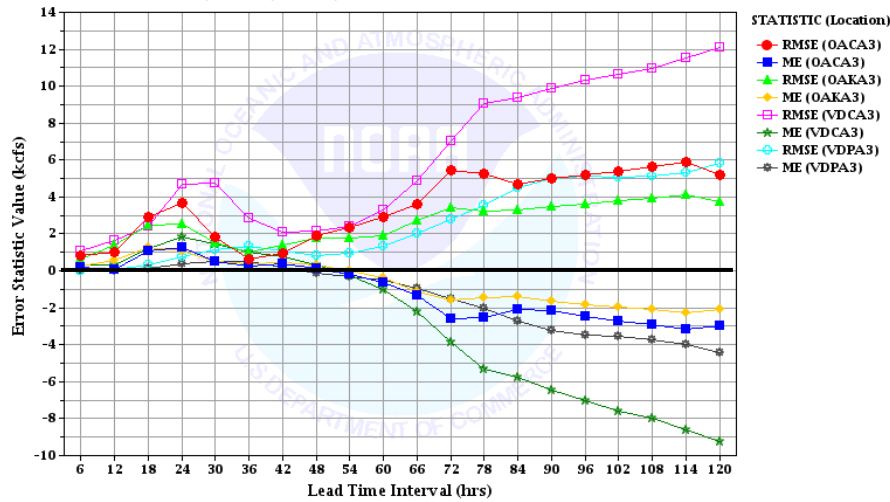




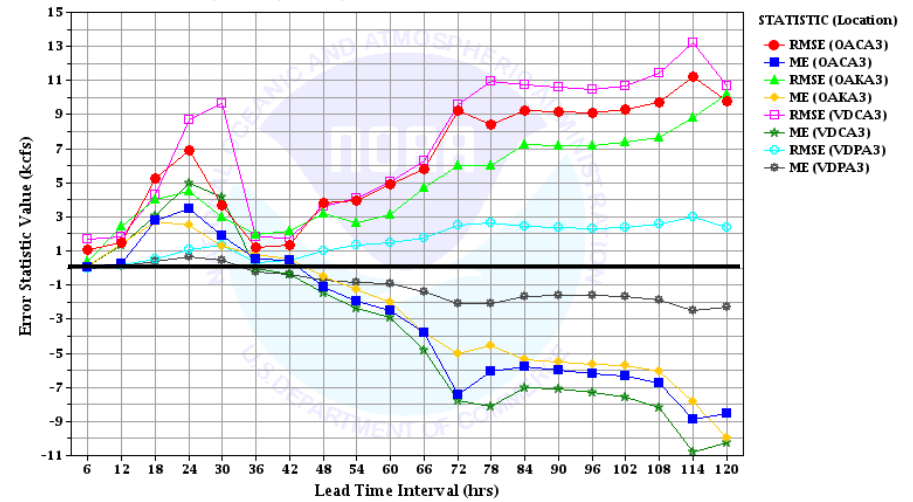
# Verde RMSE/ME by Lead Time



Plot of Instantaneous Discharge Error Statistics against Leadtime Interval for CBRFC  
 Compared Over Location  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Locations: OACA3, OAKA3, VDCA3, VDPA3

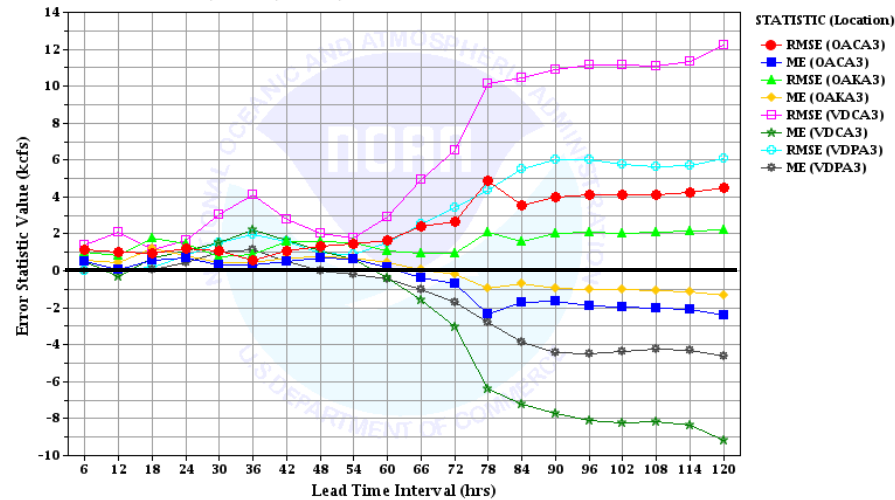


Plot of Instantaneous Discharge Error Statistics against Leadtime Interval for CBRFC  
 Compared Over Location  
 Time Period: 2005-02-11 18:00:00 GMT - 2005-02-12 18:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Locations: OACA3, OAKA3, VDCA3, VDPA3



## Full Time Series

Plot of Instantaneous Discharge Error Statistics against Leadtime Interval for CBRFC  
 Compared Over Location  
 Time Period: 2005-02-12 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Locations: OACA3, OAKA3, VDCA3, VDPA3



## Recession

## Rising Limb

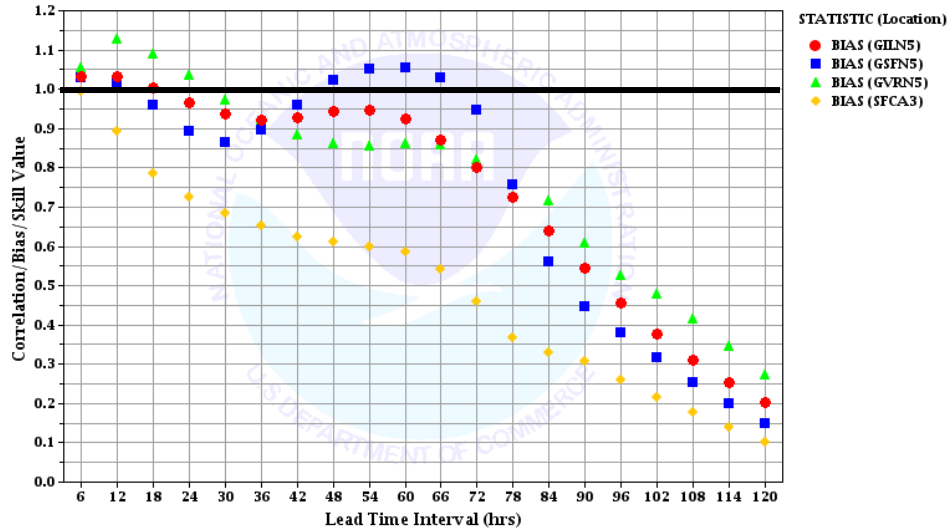


# Bias by Lead Time



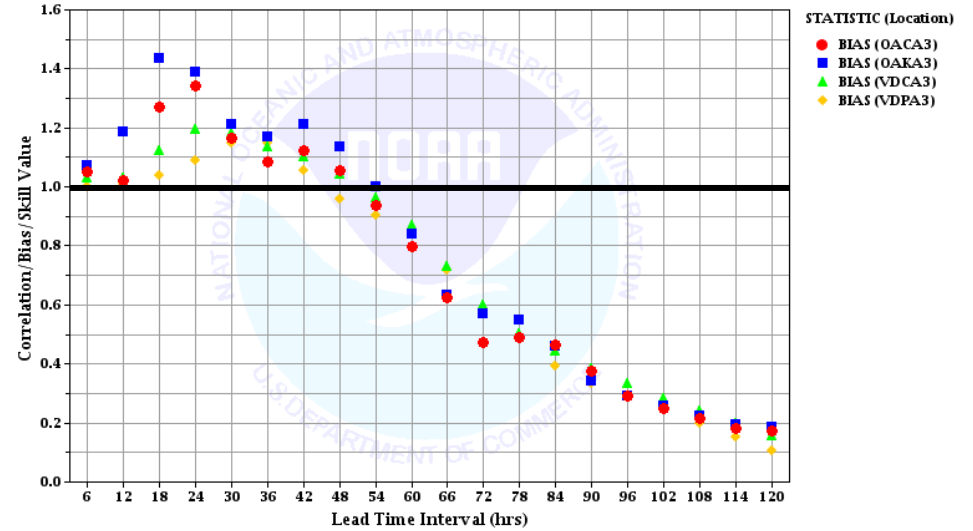
## GILA

Plot of Instantaneous Discharge Correlation, Bias, and/or Skill against Leadtime Interval for CBRFC Compared Over Location  
Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
Lead times: 0 hours - 120 hours  
Locations: GILN5, GSFN5, GVRN5, SFCA3



## VERDE

Plot of Instantaneous Discharge Correlation, Bias, and/or Skill against Leadtime Interval for CBRFC Compared Over Location  
Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
Lead times: 0 hours - 120 hours  
Locations: OACA3, OAKA3, VDCA3, VDPA3

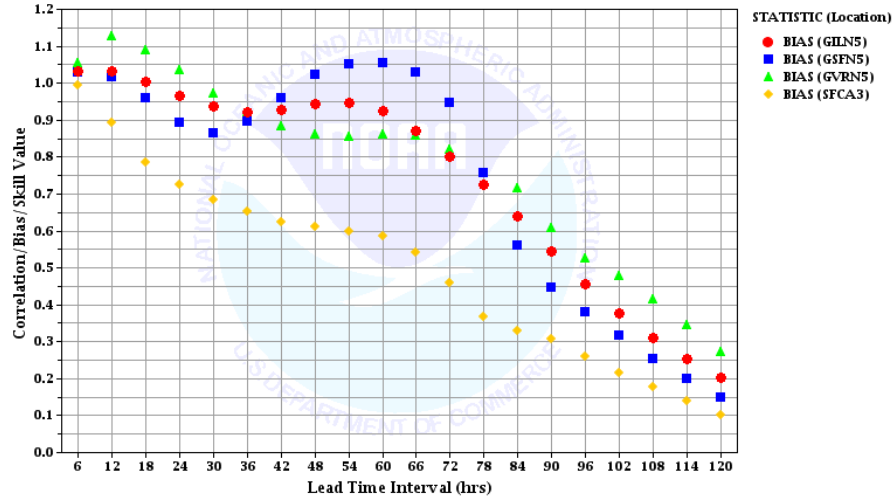




# Gila Bias by Lead Time

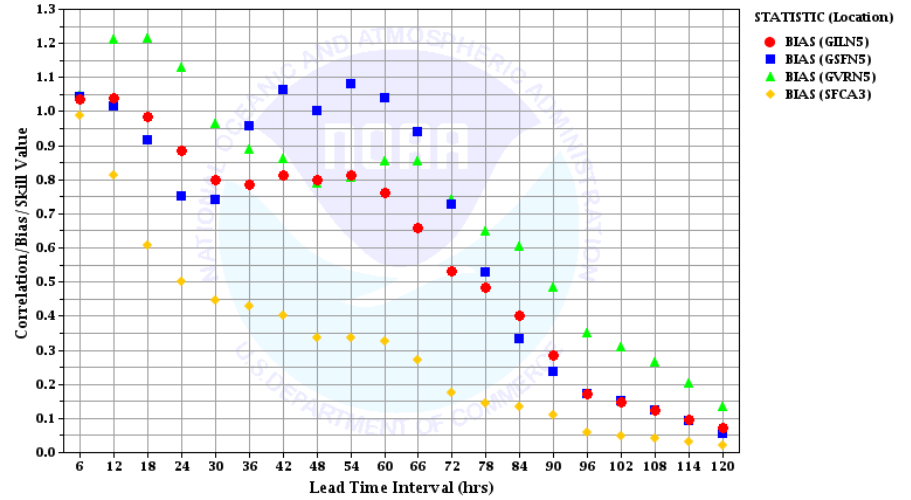


Plot of Instantaneous Discharge Correlation, Bias, and/or Skill against Leadtime Interval for CBRFC  
 Compared Over Location  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Locations: GILN5, GSFN5, GVRN5, SFCA3



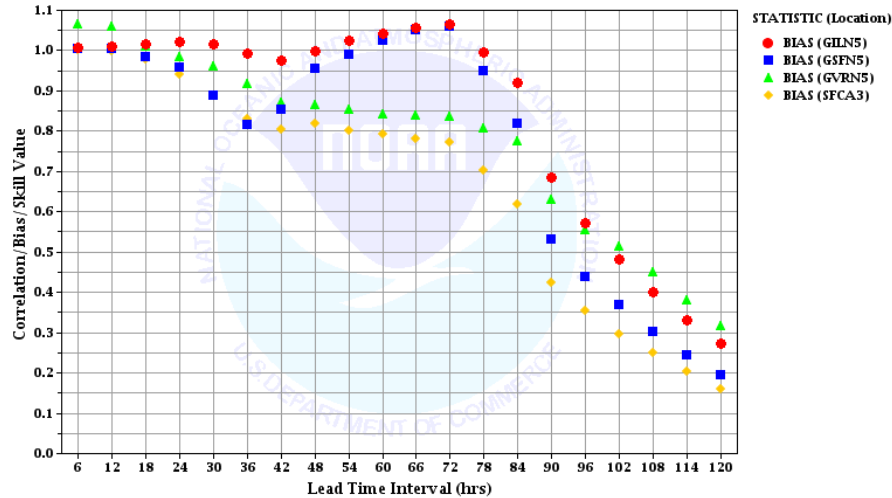
Full Time Series

Plot of Instantaneous Discharge Correlation, Bias, and/or Skill against Leadtime Interval for CBRFC  
 Compared Over Location  
 Time Period: 2005-02-11 18:00:00 GMT - 2005-02-13 06:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Locations: GILN5, GSFN5, GVRN5, SFCA3



Rising Limb

Plot of Instantaneous Discharge Correlation, Bias, and/or Skill against Leadtime Interval for CBRFC  
 Compared Over Location  
 Time Period: 2005-02-13 06:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Locations: GILN5, GSFN5, GVRN5, SFCA3



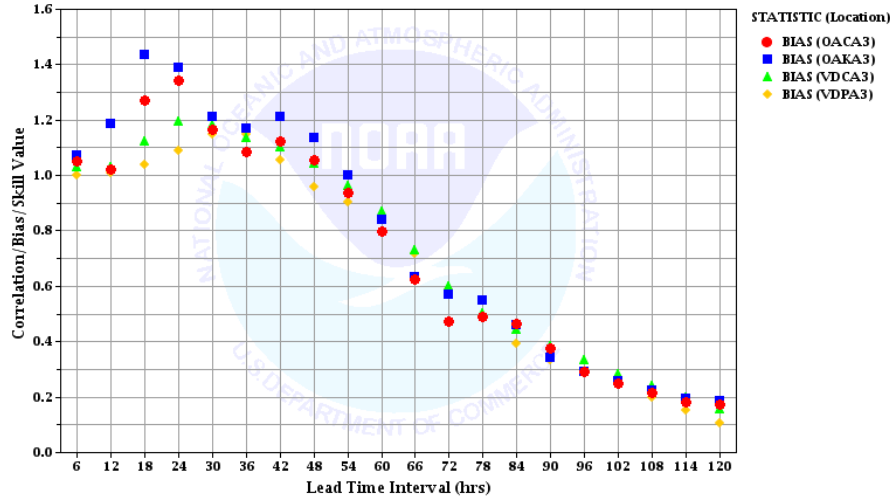
Recession



# Verde Bias by Lead Time

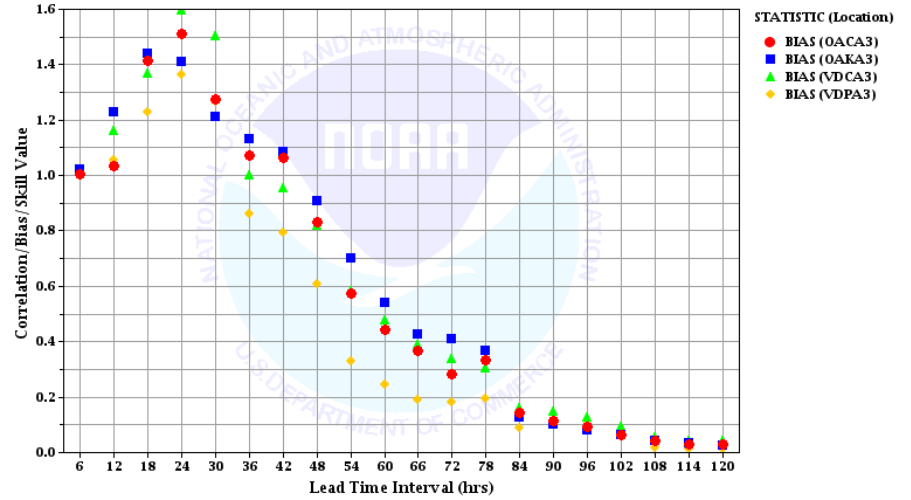


Plot of Instantaneous Discharge Correlation, Bias, and/or Skill against Leadtime Interval for CBRFC  
 Compared Over Location  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Locations: OACA3, OAKA3, VDCA3, VDPA3



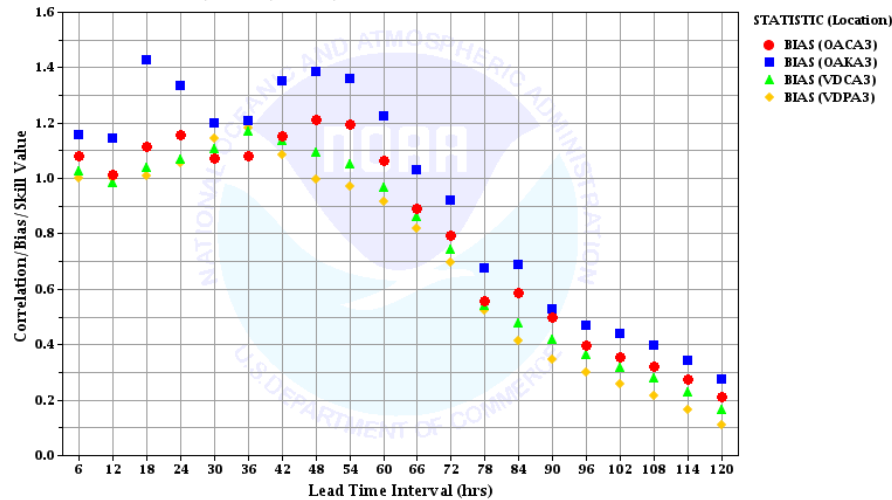
Full Time Series

Plot of Instantaneous Discharge Correlation, Bias, and/or Skill against Leadtime Interval for CBRFC  
 Compared Over Location  
 Time Period: 2005-02-11 18:00:00 GMT - 2005-02-12 18:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Locations: OACA3, OAKA3, VDCA3, VDPA3



Rising Limb

Plot of Instantaneous Discharge Correlation, Bias, and/or Skill against Leadtime Interval for CBRFC  
 Compared Over Location  
 Time Period: 2005-02-12 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Locations: OACA3, OAKA3, VDCA3, VDPA3



Recession

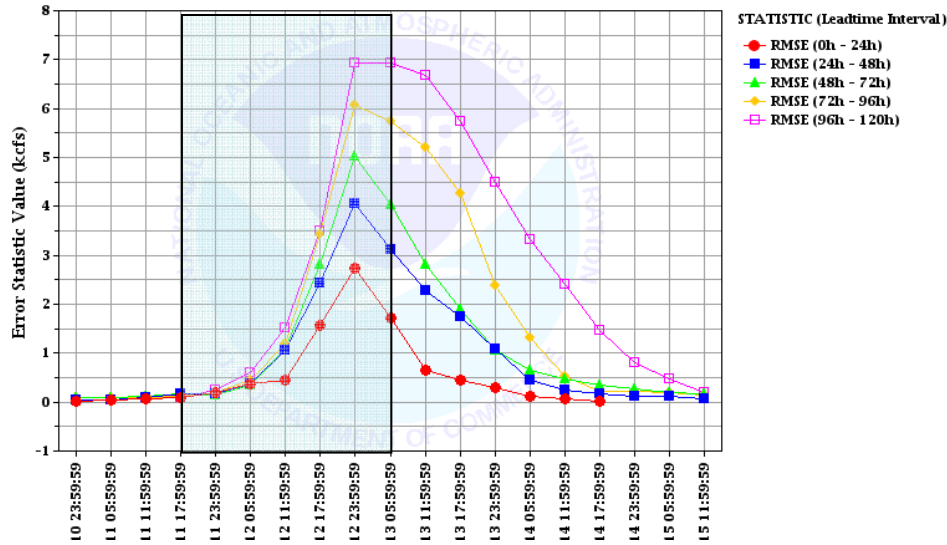


# RMSE by Analysis Interval



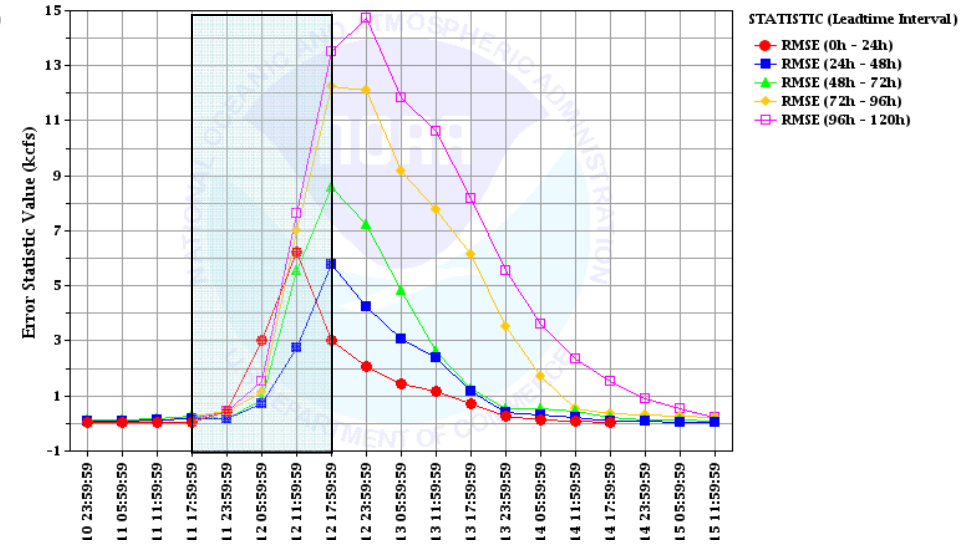
## GILA

Plot of Instantaneous Discharge Error Statistics against Analysis Interval for CBRFC  
Compared Over Leadtime Interval  
Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
Lead times: 0 hours - 120 hours  
Locations: GILN5, G5FN5, GVRN5, 5FCA3



## VERDE

Plot of Instantaneous Discharge Error Statistics against Analysis Interval for CBRFC  
Compared Over Leadtime Interval  
Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
Lead times: 0 hours - 120 hours  
Locations: OACA3, OAKA3, VDCA3, VDPA3



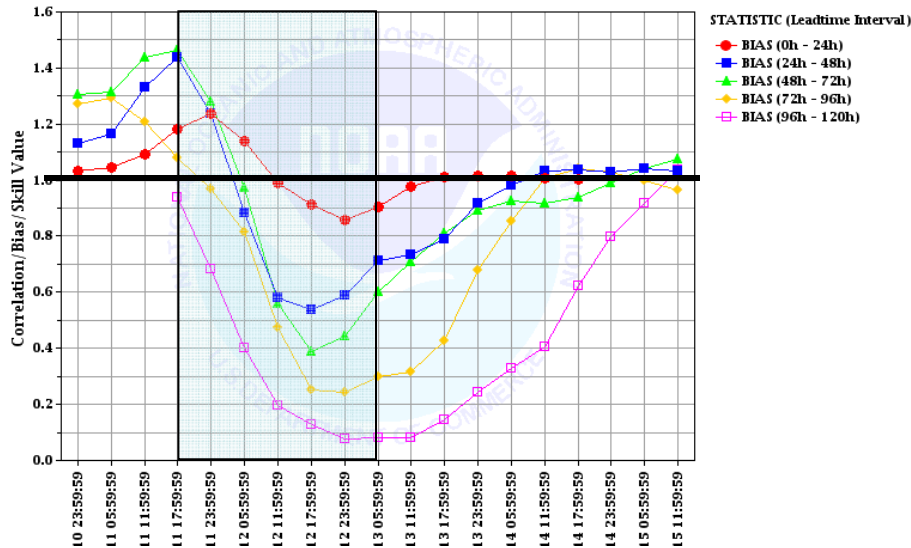


# Bias by Analysis Interval



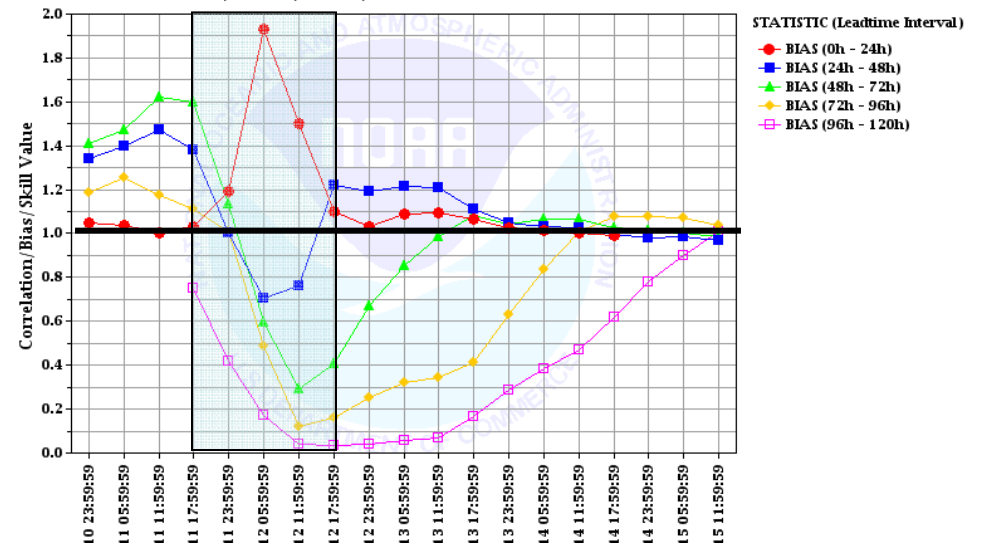
## GILA

Plot of Instantaneous Discharge Correlation, Bias, and/or Skill against Analysis Interval for CBRFC Compared Over Leadtime Interval  
Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
Lead times: 0 hours - 120 hours  
Locations: GILN5, GSFN5, GVRN5, SFCA3



## VERDE

Plot of Instantaneous Discharge Correlation, Bias, and/or Skill against Analysis Interval for CBRFC Compared Over Leadtime Interval  
Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
Lead times: 0 hours - 120 hours  
Locations: OACA3, OAKA3, VDCA3, VDPA3



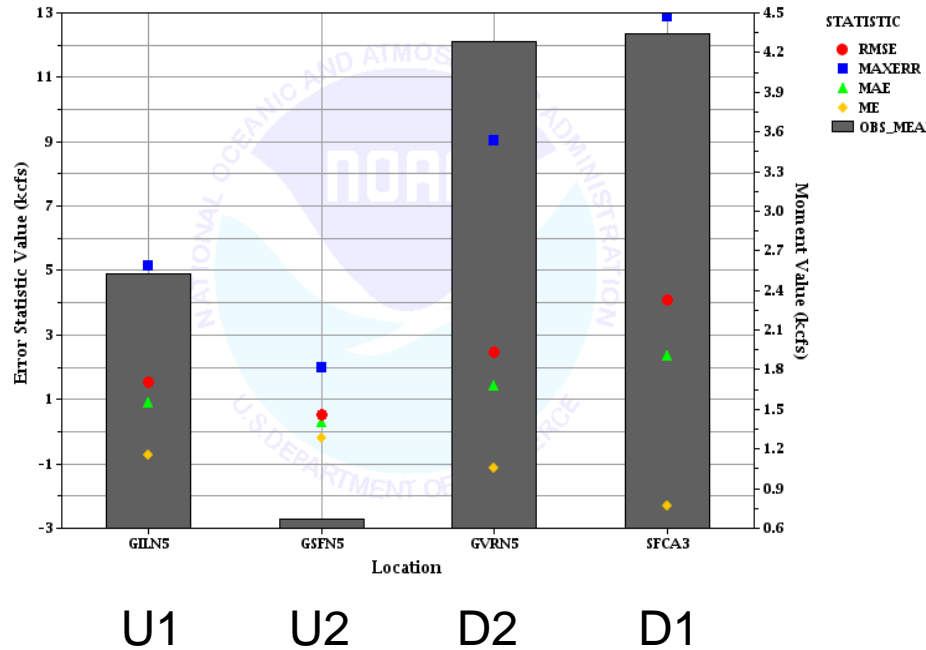


# Error Statistics



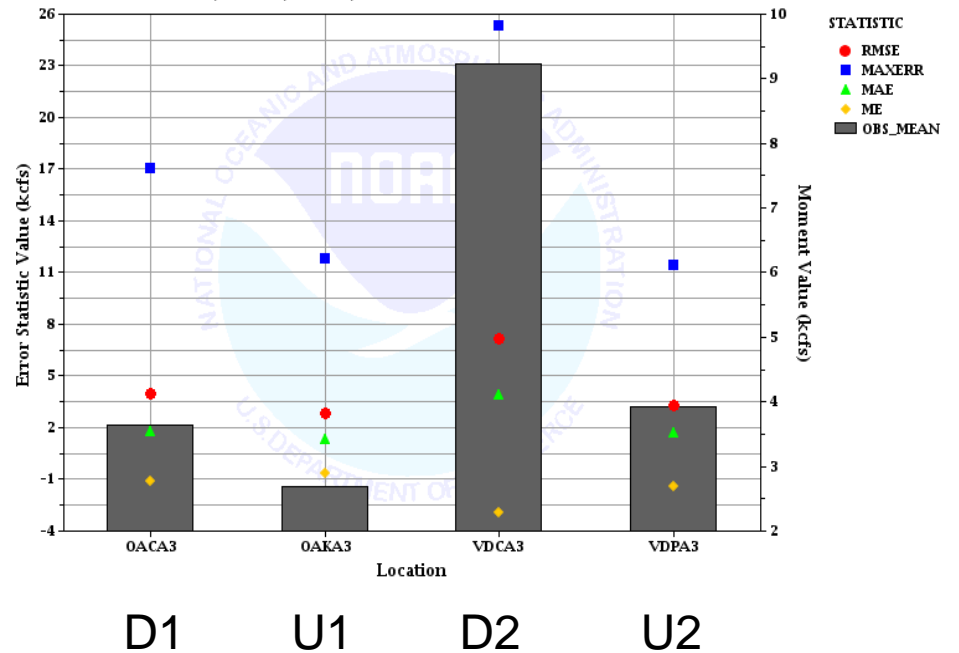
## GILA

Plot of Instantaneous Discharge Error Statistics against Location for CBRFC  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Locations: GILN5, G5FN5, GVRN5, SFCA3



## VERDE

Plot of Instantaneous Discharge Error Statistics against Location for CBRFC  
 Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
 Lead times: 0 hours - 120 hours  
 Locations: OACA3, OAKA3, VDCA3, VDPA3

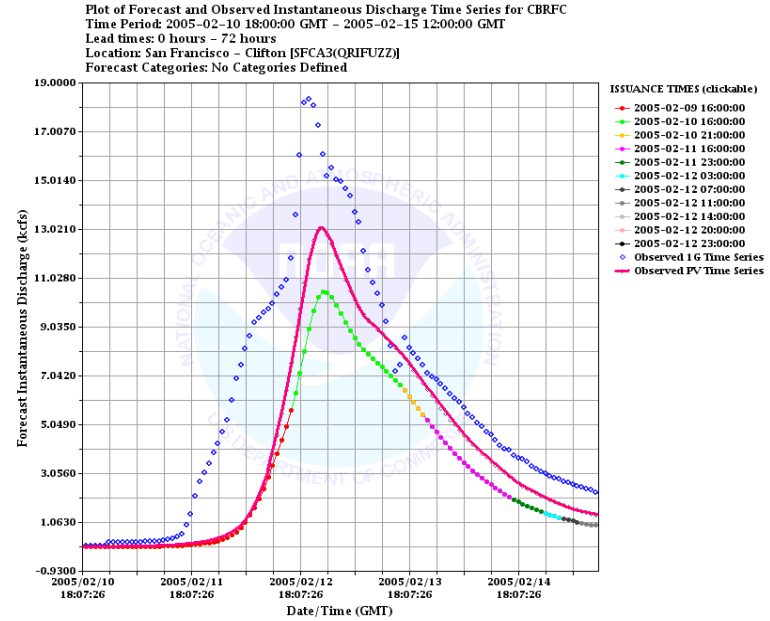
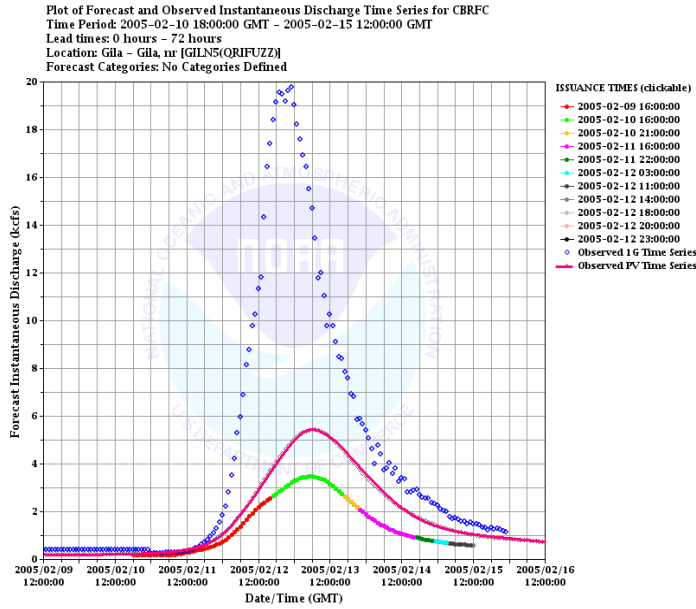




# Gila Flow Comparison

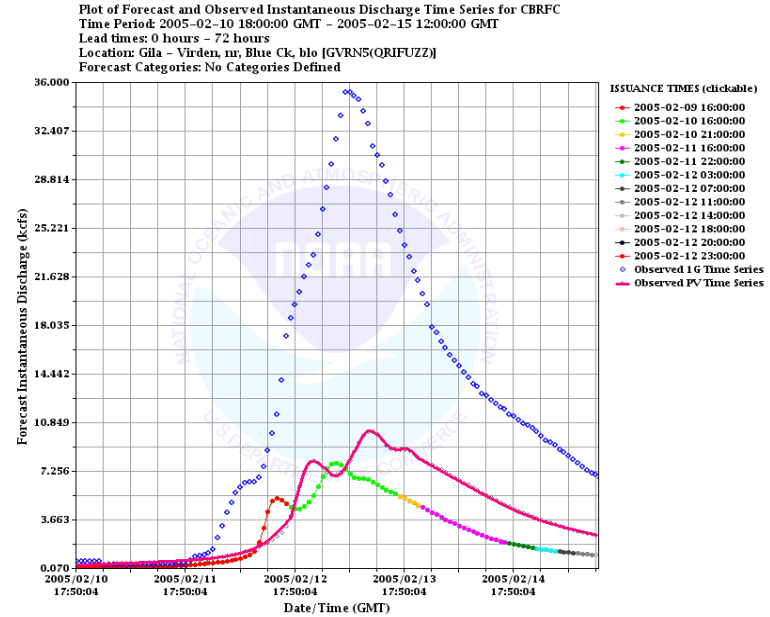
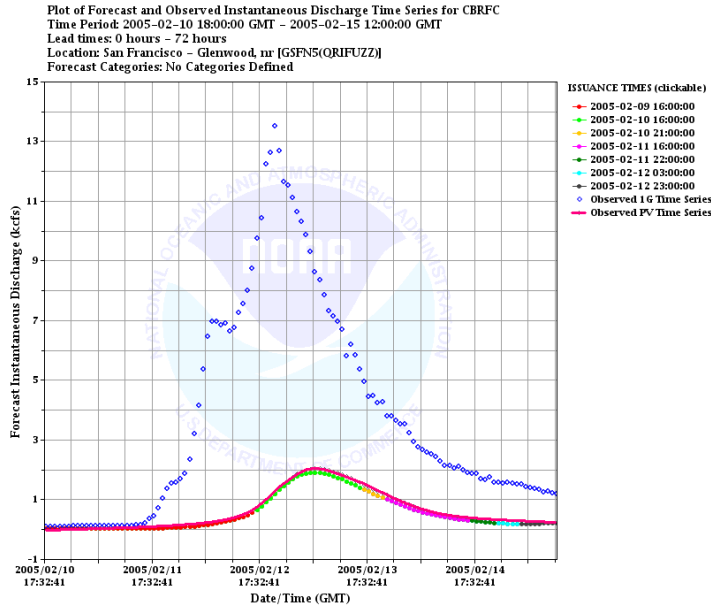


## GILN5



## SFCA3

## GSFN5



## GVRN5



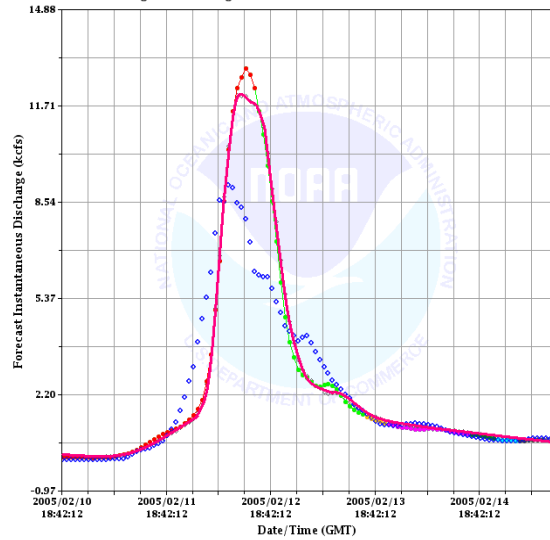


# Verde Flow Comparison



OAKA3

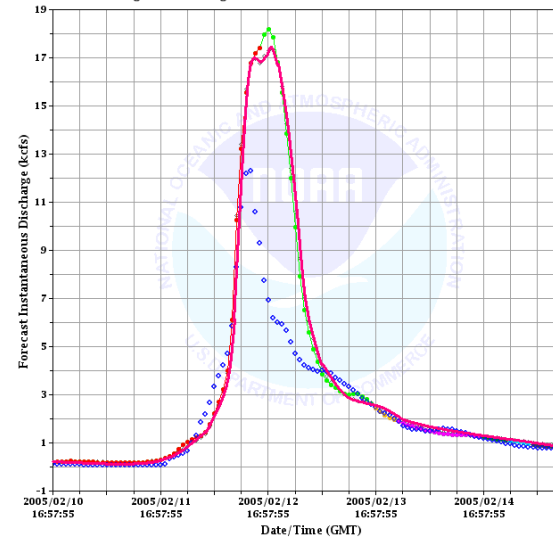
Plot of Forecast and Observed Instantaneous Discharge Time Series for CBRFC  
Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
Lead times: 0 hours - 72 hours  
Location: Oak Ck - Sedona [OAKA3(QRIFUZZ)]  
Forecast Categories: No Categories Defined



- ISSUANCE TIMES (clickable)
- 2005-02-09 15:00:00
- 2005-02-10 16:00:00
- 2005-02-10 21:00:00
- 2005-02-11 16:00:00
- 2005-02-11 22:00:00
- 2005-02-12 03:00:00
- 2005-02-12 09:00:00
- 2005-02-12 11:00:00
- 2005-02-12 18:00:00
- Observed 1G Time Series
- Observed PV Time Series

OACA3

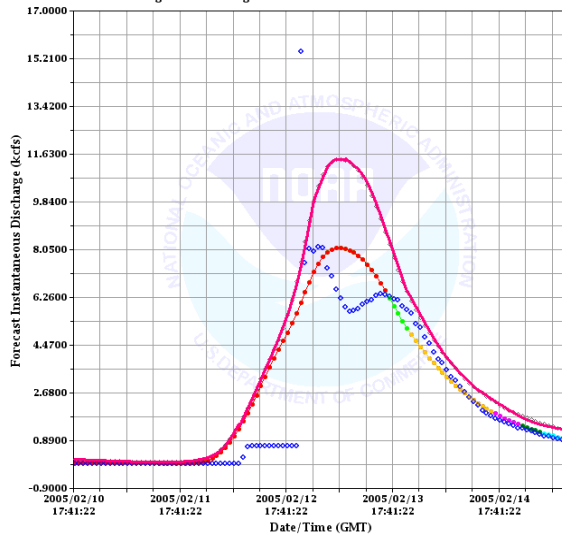
Plot of Forecast and Observed Instantaneous Discharge Time Series for CBRFC  
Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
Lead times: 0 hours - 72 hours  
Location: Oak Ck - Cornville, nr [OACA3(QRIFUZZ)]  
Forecast Categories: No Categories Defined



- ISSUANCE TIMES (clickable)
- 2005-02-09 15:00:00
- 2005-02-10 16:00:00
- 2005-02-10 21:00:00
- 2005-02-11 16:00:00
- 2005-02-11 22:00:00
- 2005-02-12 03:00:00
- 2005-02-12 09:00:00
- 2005-02-12 11:00:00
- 2005-02-12 18:00:00
- 2005-02-12 20:00:00
- Observed 1G Time Series
- Observed PV Time Series

VDPA3

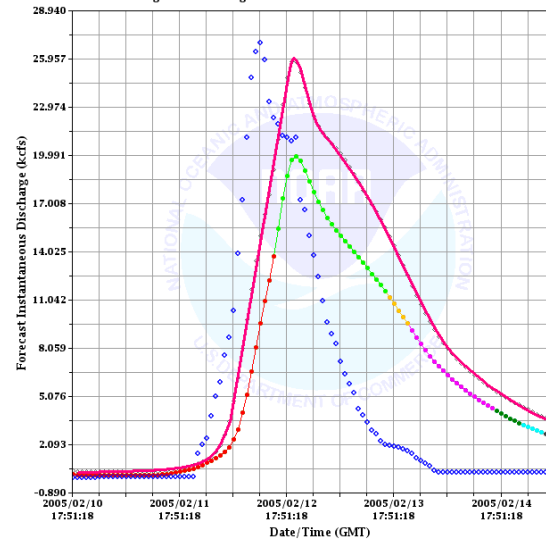
Plot of Forecast and Observed Instantaneous Discharge Time Series for CBRFC  
Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
Lead times: 0 hours - 72 hours  
Location: Verde - Paulden, nr [VDPA3(QRIFUZZ)]  
Forecast Categories: No Categories Defined



- ISSUANCE TIMES (clickable)
- 2005-02-10 16:00:00
- 2005-02-10 21:00:00
- 2005-02-11 16:00:00
- 2005-02-11 22:00:00
- 2005-02-12 03:00:00
- 2005-02-12 09:00:00
- Observed 1G Time Series
- Observed PV Time Series

VDCA3

Plot of Forecast and Observed Instantaneous Discharge Time Series for CBRFC  
Time Period: 2005-02-10 18:00:00 GMT - 2005-02-15 12:00:00 GMT  
Lead times: 0 hours - 72 hours  
Location: Verde - Clarkdale [VDCA3(QRIFUZZ)]  
Forecast Categories: No Categories Defined



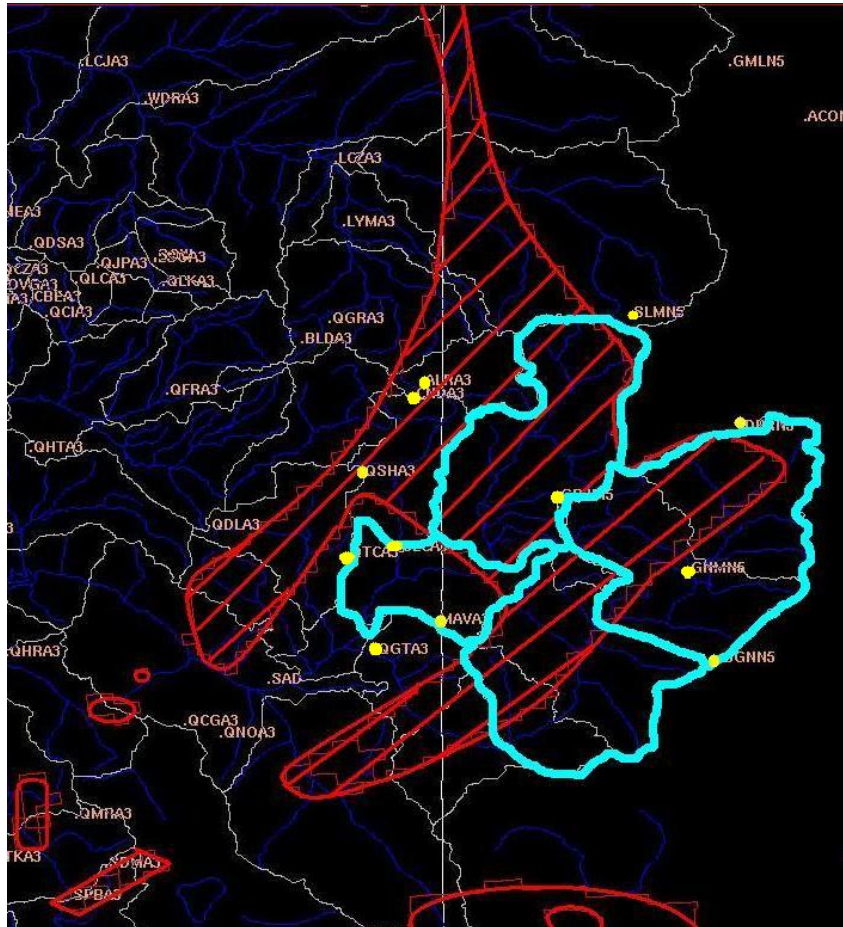
- ISSUANCE TIMES (clickable)
- 2005-02-09 15:00:00
- 2005-02-10 16:00:00
- 2005-02-10 21:00:00
- 2005-02-11 16:00:00
- 2005-02-11 22:00:00
- 2005-02-12 03:00:00
- 2005-02-12 09:00:00
- Observed 1G Time Series
- Observed PV Time Series



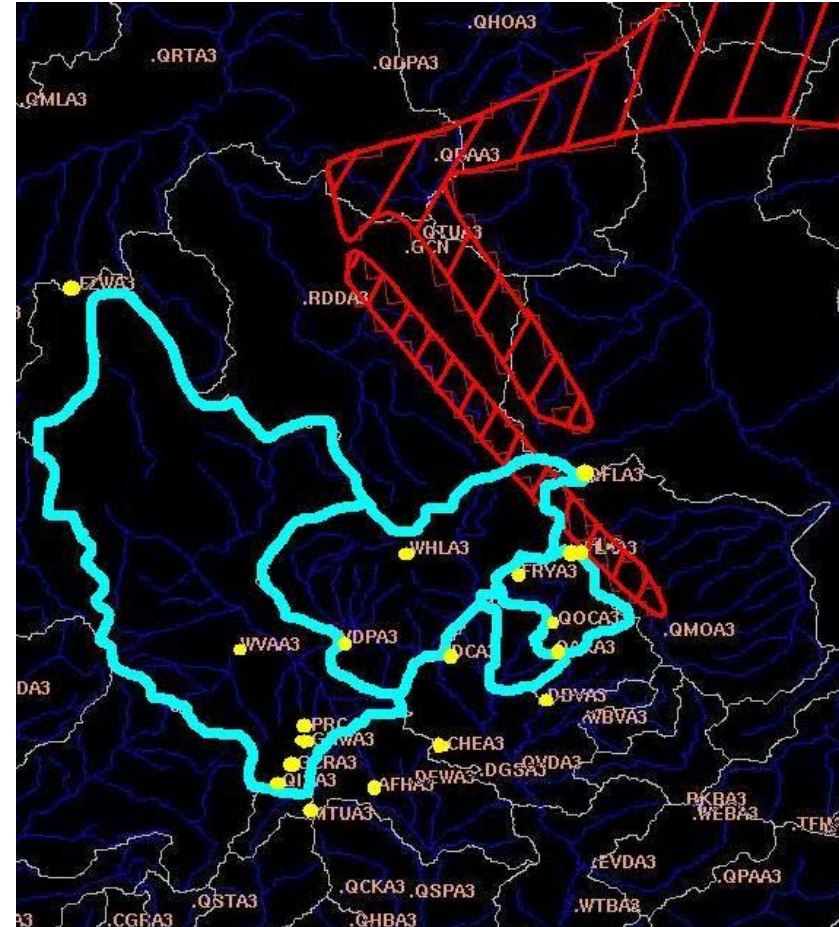
# No Radar Coverage



GILA



VERDE





# Gila vs. Verde Findings



- In the Gila Basin QPF was too low and so were flow forecasts.
- In the Verde Basin QPF was also a bit low, but flow forecasts were too high.
- Better QPF in the Verde Basin than in the Gila Basin did not translate into better flow forecasts.
- Incorrect QPF does not fully explain poor flow forecasts in either basin.
  - Was the observed precipitation (MPE issues) correct?
  - Were the model states (especially soil moisture) correct?



# Findings Continued



- MAPs appeared to have an effect on the simulation
- Initial conditions also played a roll in simulation
- Helpful to separate periods to see effects