



WGRFC CASE STUDY

VAR/SSHIP vs. NWSRFS Comparison
National Verification Team Requirement
04/22/2008



What is VAR?

- Variational Assimilation
- Uses real-time streamflows to “back” calculate initial state conditions
 - Assimilates real-time streamflow, real-time MAP and climatological MAPE into lumped SAC-UHG
 - Adjusts SAC states, MAP and MAPE
- Available at headwaters
- Ran at WGRFC
 - Since 2003
 - Hourly time step
 - Model forecast 72 hours out



More on VAR

- D.J. Seo and Lee Cajina instrumental in the VAR project at WGRFC
 - Billy Finn, Bob Corby, and Tracy Howieson were the main WGRFC employees in this effort
- VAR is now being tested/ran with SSHP at WGRFC
- Chip Gobs instrumental in VAR/SSHP setup
 - Tracy Howieson, Bob Corby, and Gregg Waller are the main WGRFC employees in this effort
- Hank Herr is still “the dude” and instrumental in getting WGRFC capable of verifying the data with IVP



VAR/SSHP



- Running the Site Specific model with and without VAR adjustments
 - The VAR adjustments include VAR and VAR “with mods”.
- SSHP uses either the SAC-SMA or MKC-API parameters. With VAR, with use the SAC-SMA parameters.
- With SSHP, SAC-SMA parameters sent to the WFO’s from NWSRFS
 - With VAR, “Sac” states are sent to the WFOs (currently tested across the hall at FWD)



WGRFC VAR Sites



File Options Display Modifications

Help

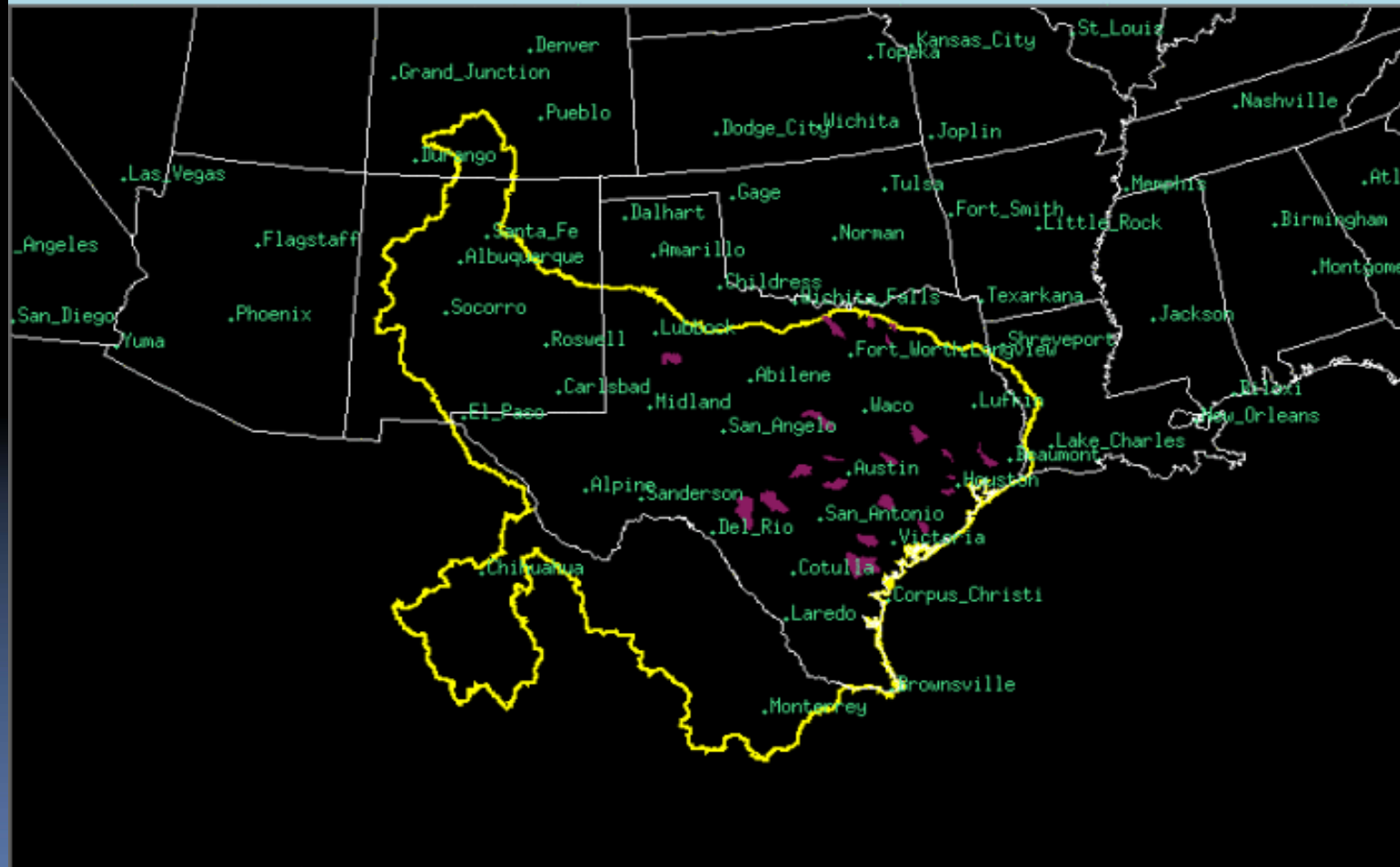
Latitude:

Longitude:

Distance:

Scale 1: 1435873

VARPOST





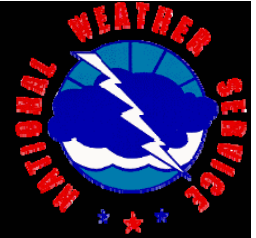
How WGRFC Handles This.



- Run VAR twice.
 - VAR (stand alone - FA type source) and VAR "with mods" (FC type source) side-by-side
- Volume of data...
 - VAR gens up forecast in hourly time step...out 72 hours.
 - WGRFC has 23 VAR points
 - 24 hours in a day...leads to 39744 forecasts ordinates per day (not counting VAR "with mods"/DHMS/SSHP)
 - WGRFC sends the forecasts with the basis time at synoptic times...



Example



- TTAA00 CCCC 021230
- CCCWRK00X
- :FORECASTS
- .E GNV T2 20080402 Z
DH12/DC200804021230/DUE/HGIFA/DIHo1
- .E1 /3.841/3.841/3.841/3.841/3.841/3.841/3.841/3.845
- .E2 /3.850/3.854/3.854/3.858/3.863/3.863/3.867/3.867
- .E3 /3.871/3.871/3.871/3.871/3.871/3.867/3.867/3.867
- .E4 /3.863/3.863/3.858/3.858/3.854/3.854/3.854/3.850
- .E5 /3.850/3.845/3.845/3.841/3.841/3.841/3.841/3.836
- .E6 /3.836/3.836/3.836/3.836/3.836/3.836/3.836/3.836
- .E7 /3.836/3.836/3.836/3.836/3.836/3.836/3.836/3.836
- .E8 /3.836/3.836/3.836/3.836/3.836/3.836/3.836/3.836
- .E9 /3.836/3.836/3.836/3.836/3.836/3.836/3.836/3.836
- .E10 /3.836
- .E GNV T2 20080402 Z
DH12/DC200804021230/DUE/HGIFB/DIHo1
- .E1 /5.771/5.768/5.766/5.763/5.761/5.759/5.756/5.754
- .E2 /5.751/5.749/5.747/5.744/5.742/5.739/5.737/5.734
- .E3 /5.731/5.728/5.726/5.723/5.720/5.717/5.715/5.712
- .E4 /5.709/5.706/5.704/5.701/5.698/5.696/5.693/5.690
- .E5 /5.687/5.685/5.682/5.679/5.677/5.674/5.672/5.669
- .E6 /5.667/5.664/5.662/5.659/5.657/5.655/5.652/5.650
- .E7 /5.647/5.645/5.642/5.640/5.637/5.635/5.632/5.630
- .E8 /5.628/5.625/5.623/5.620/5.618/5.616/5.613/5.611
- .E9 /5.608/5.606/5.604/5.601/5.599/5.597/5.594/5.592
- .E10 /5.589
- .E GNV T2 20080402 Z
DH12/DC200804021230/DUE/HGIFC/DIHo1
- .E1 /3.840/3.801/3.758/3.711/3.659/3.660/3.662/3.665
- .E2 /3.669/3.674/3.679/3.684/3.690/3.696/3.702/3.706
- .E3 /3.710/3.713/3.715/3.715/3.715/3.714/3.712/3.709
- .E4 /3.706/3.701/3.696/3.691/3.686/3.680/3.675/3.670
- .E5 /3.664/3.658/3.653/3.647/3.643/3.638/3.634/3.631
- .E6 /3.628/3.626/3.624/3.623/3.622/3.621/3.621/3.620
- .E7 /3.619/3.619/3.618/3.617/3.617/3.616/3.616/3.615
- .E8 /3.614/3.614/3.613/3.613/3.612/3.612/3.611/3.610
- .E9 /3.610/3.609/3.609/3.608/3.608/3.607/3.607/3.606
- .E10 /3.606
- .E GNV T2 20080402 Z
DH12/DC200804021230/DUE/HGIFU/DIHo1
- .E1 /4.222/4.220/4.219/4.217/4.216/4.215/4.215/4.215
- .E2 /4.215/4.216/4.218/4.219/4.220/4.222/4.224/4.225
- .E3 /4.226/4.226/4.226/4.225/4.224/4.223/4.222/4.220
- .E4 /4.217/4.214/4.212/4.209/4.206/4.202/4.199/4.196
- .E5 /4.193/4.190/4.187/4.184/4.181/4.179/4.176/4.174
- .E6 /4.172/4.171/4.170/4.168/4.167/4.166/4.166/4.165
- .E7 /4.164/4.163/4.162/4.161/4.161/4.160/4.159/4.158
- .E8 /4.157/4.157/4.156/4.155/4.154/4.154/4.153/4.152
- .E9 /4.152/4.151/4.150/4.150/4.149/4.148/4.148/4.147



WGRFC



- Once per week...hydrologist balances the VAR "with mods" forecast group (also known around here as VARPOST)
- Verification focal point pairs the data
 - 2 days worth of the VAR/SSHP/DHMS forecasts takes approx. 28 hours
 - 8 days takes approx 60 hours
- Note – many VAR basins are also DHMS basins as they meet the same "headwater" standards (this might prove valuable for future verification studies)



So...Let's Get Started



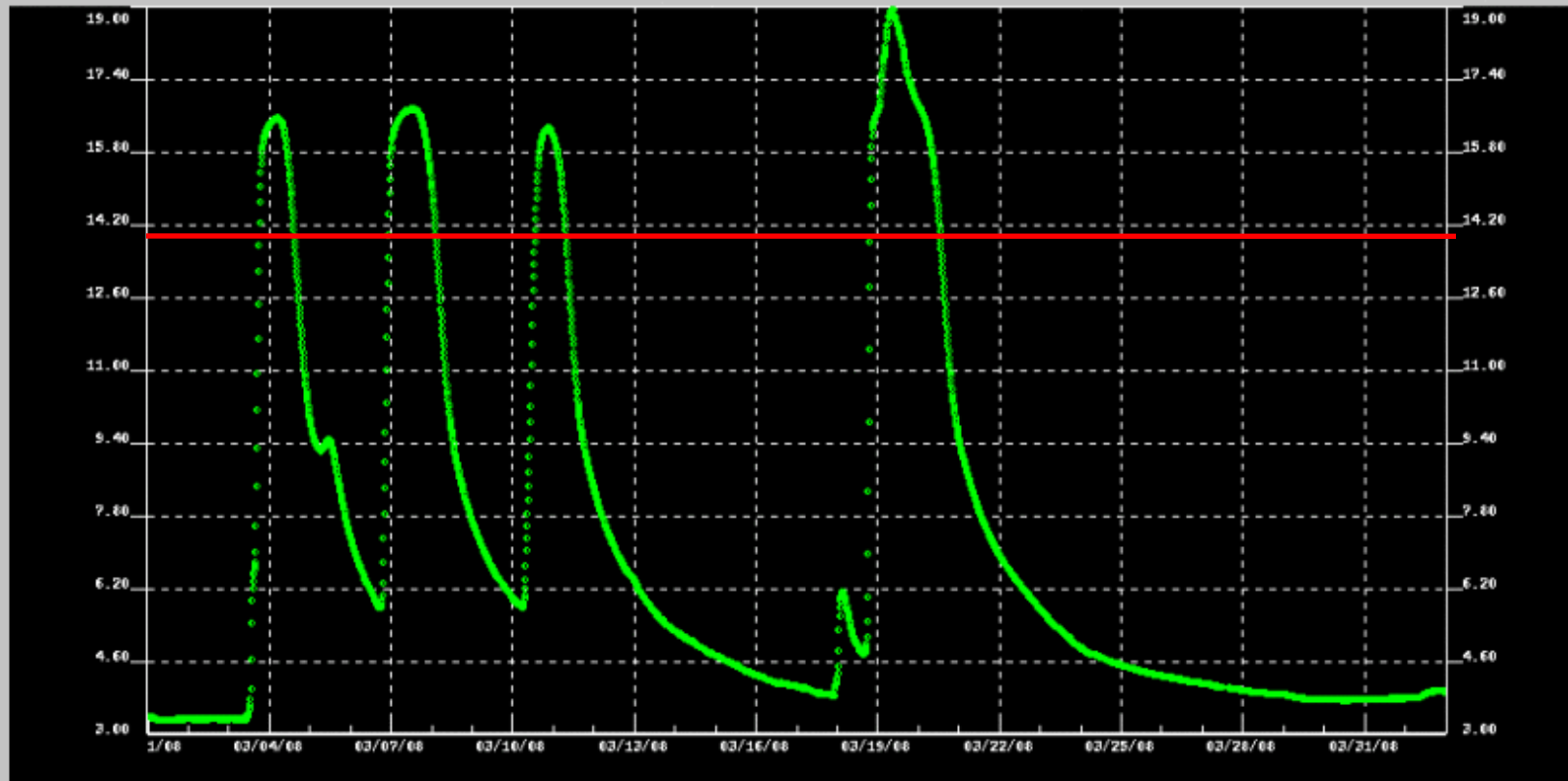
- Case Study focuses on this March 03/08.
- We had a couple of "events" across the area
- Focusing on three VAR basins...
 - GNVT₂ (Sabine River at Greenville) NE TX
 - MCKT₂ (East Fork Trinity River at McKinney) DFW Metro
 - SOLT₂ (Pine Island Bayou at Sour Lake) SE TX Coastal



GNVT2 March, 2008



ID: GNVT2



Days Displayed in Window

33

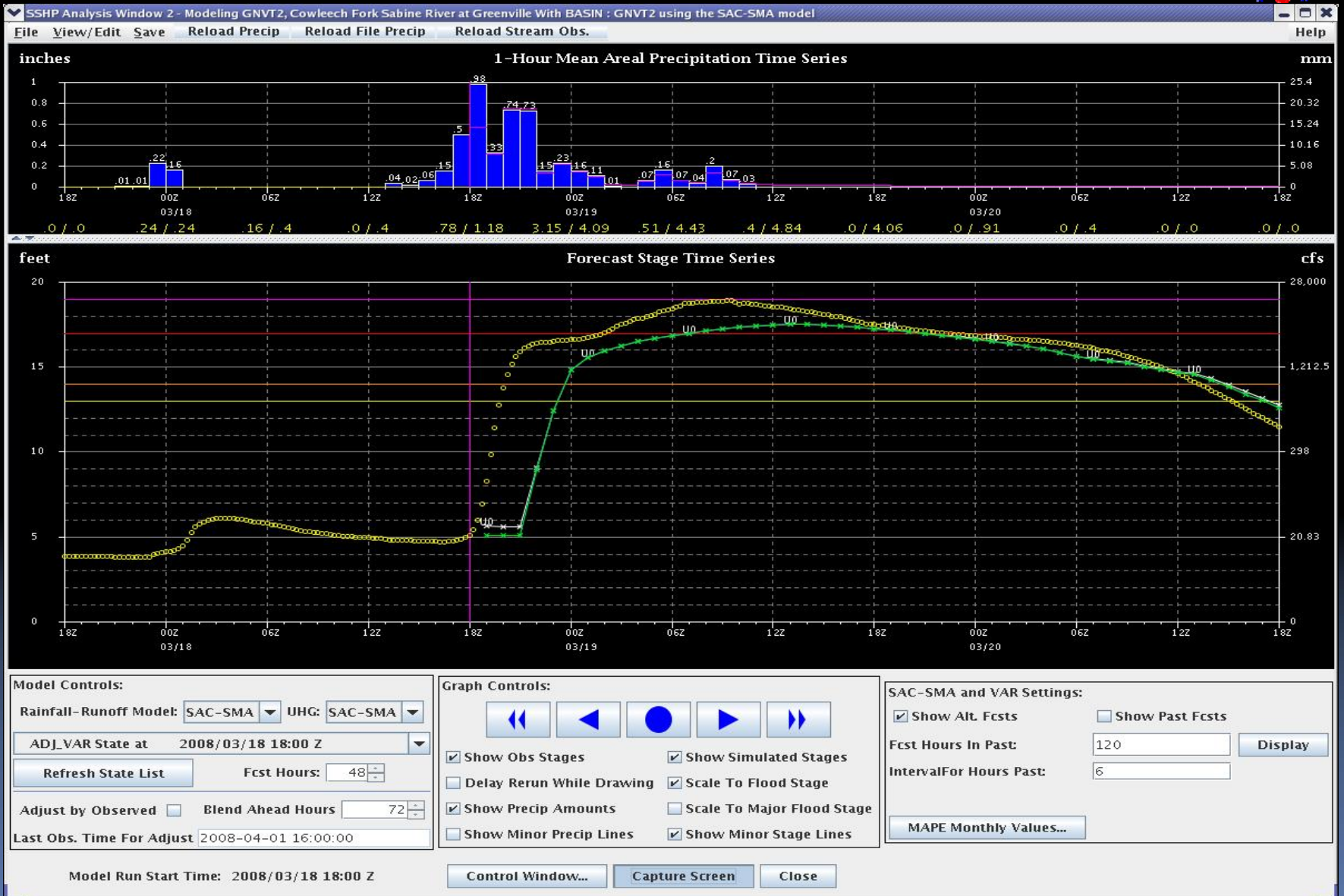
Vertical Scale

1

Close



One event - GNV2

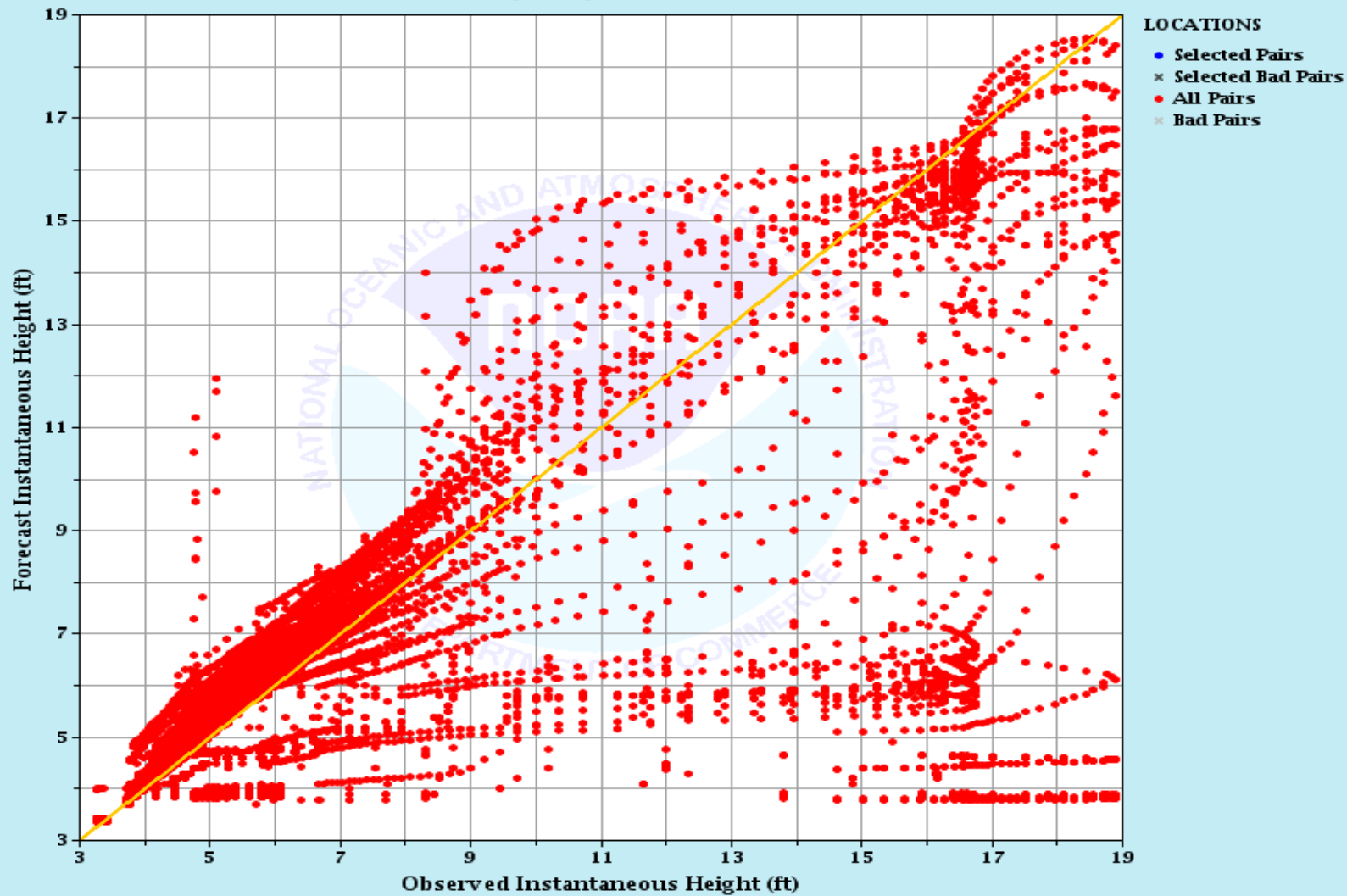




GNVT2



Plot of Forecast-Observed Instantaneous Height Data Pairs for NONE
Time Period: 2008-03-01 00:00:00 GMT - 2008-03-31 23:59:59 GMT
Lead times: ALL
Selected Location: No Name Available [NONE]

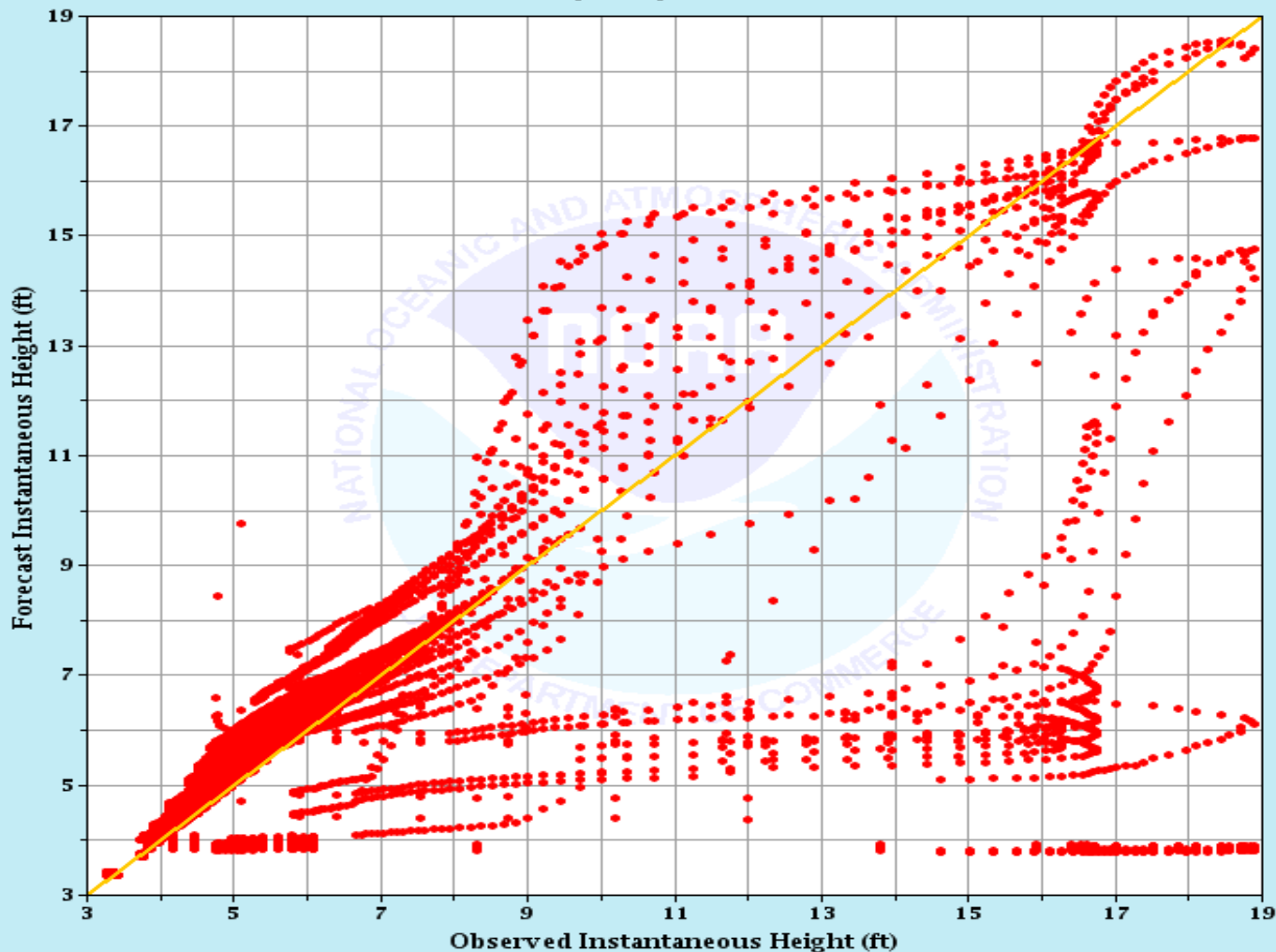




GNVT2 - VAR (FA)



Plot of Forecast-Observed Instantaneous Height Data Pairs for NONE
Time Period: 2008-03-01 00:00:00 GMT - 2008-03-31 23:59:59 GMT
Lead times: ALL
Selected Location: No Name Available [NONE]



LOCATIONS

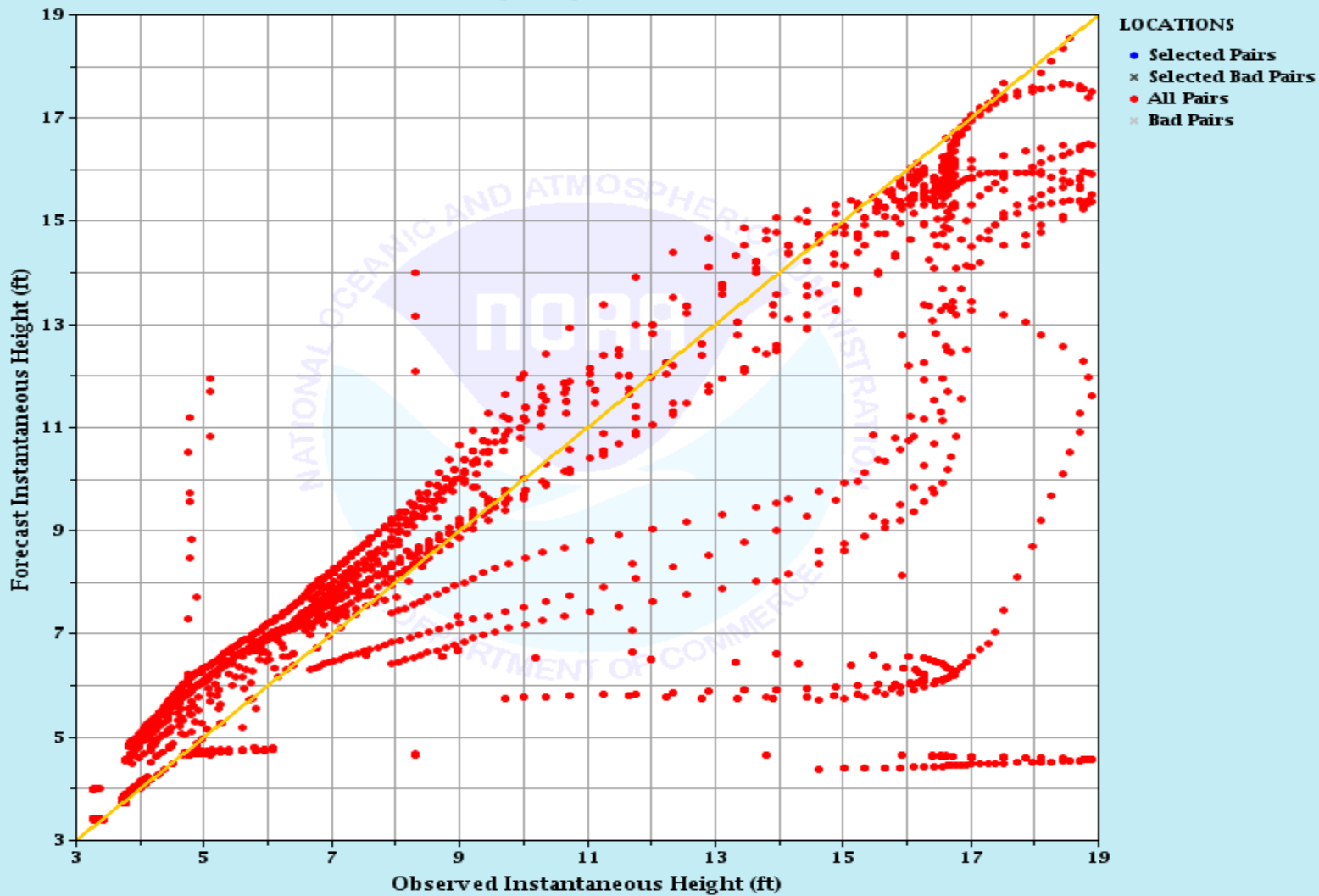
- Selected Pairs
- × Selected Bad Pairs
- All Pairs
- × Bad Pairs



GNVT2 - VAR with Mods (FC)



Plot of Forecast-Observed Instantaneous Height Data Pairs for NONE
Time Period: 2008-03-01 00:00:00 GMT - 2008-03-31 23:59:59 GMT
Lead times: ALL
Selected Location: No Name Available [NONE]

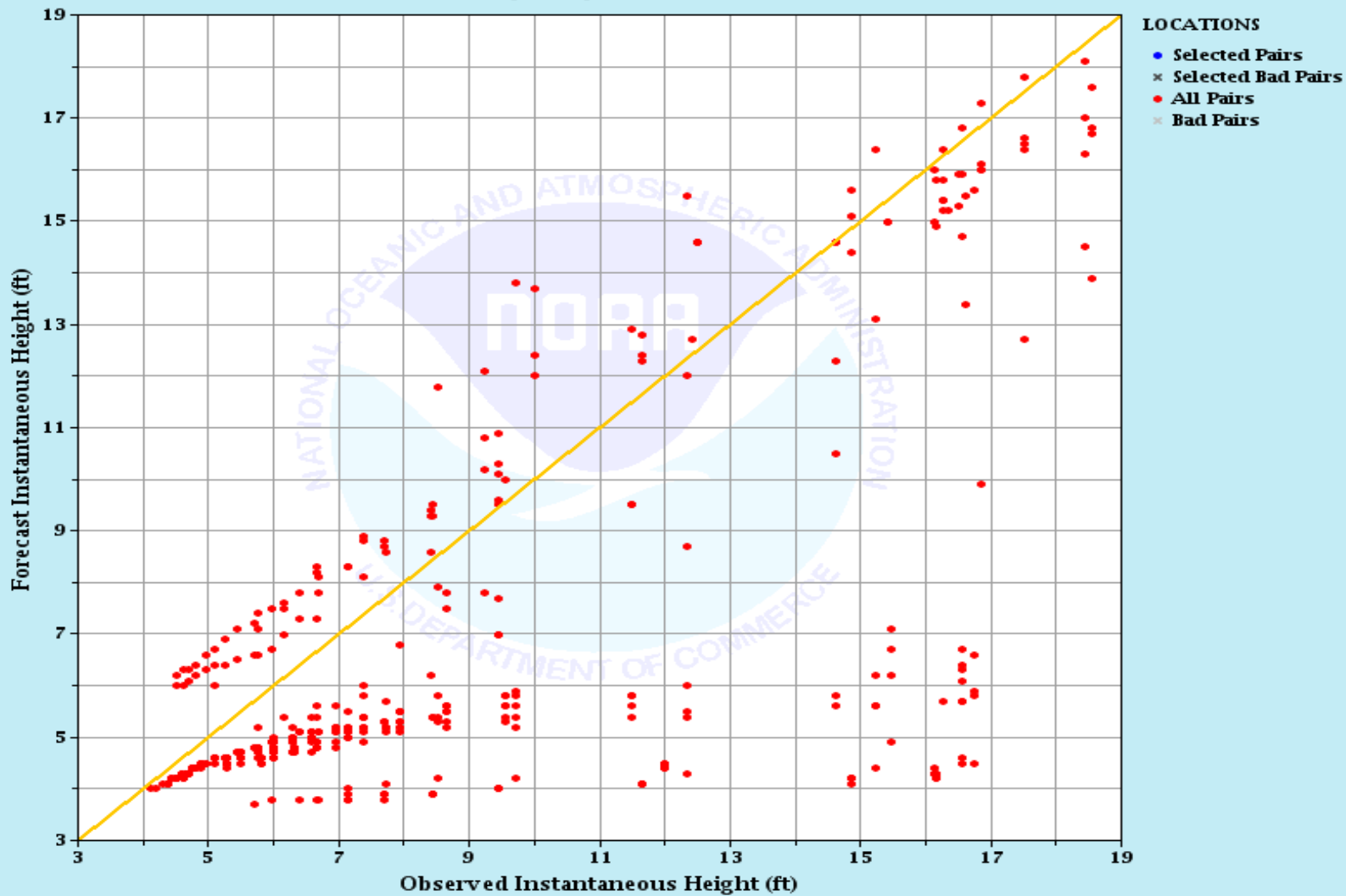




GNVT2 - WGRFC NWSRFS (FF)



Plot of Forecast-Observed Instantaneous Height Data Pairs for NONE
Time Period: 2008-03-01 00:00:00 GMT - 2008-03-31 23:59:59 GMT
Lead times: ALL
Selected Location: No Name Available [NONE]

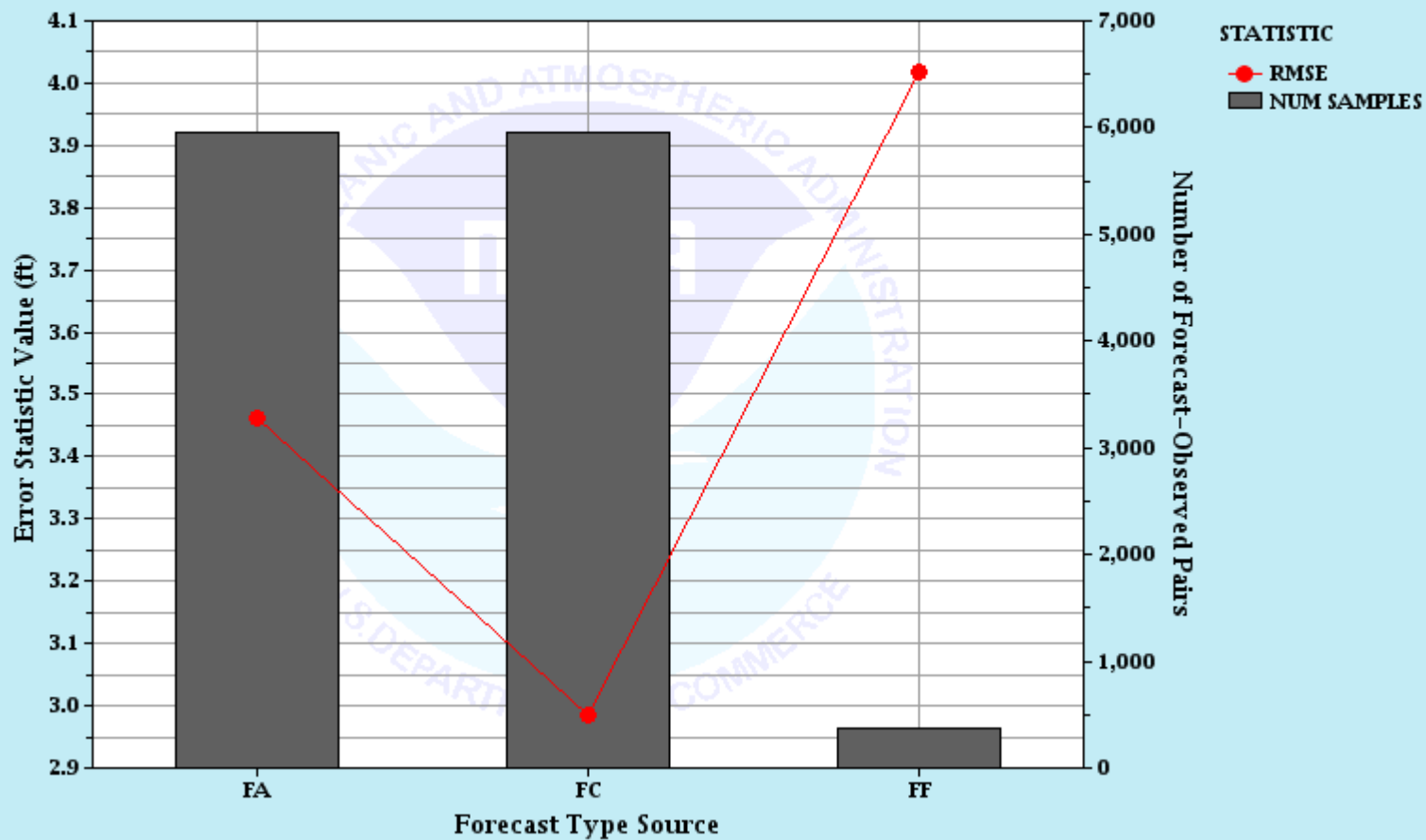




GNVT2 - RMSE



Plot of Instantaneous Height Error Statistics against Forecast Type Source for WGRFC
Time Period: 2008-03-01 00:00:00 GMT - 2008-03-31 23:59:59 GMT
Lead times: All lead times included
Locations: GNVT2

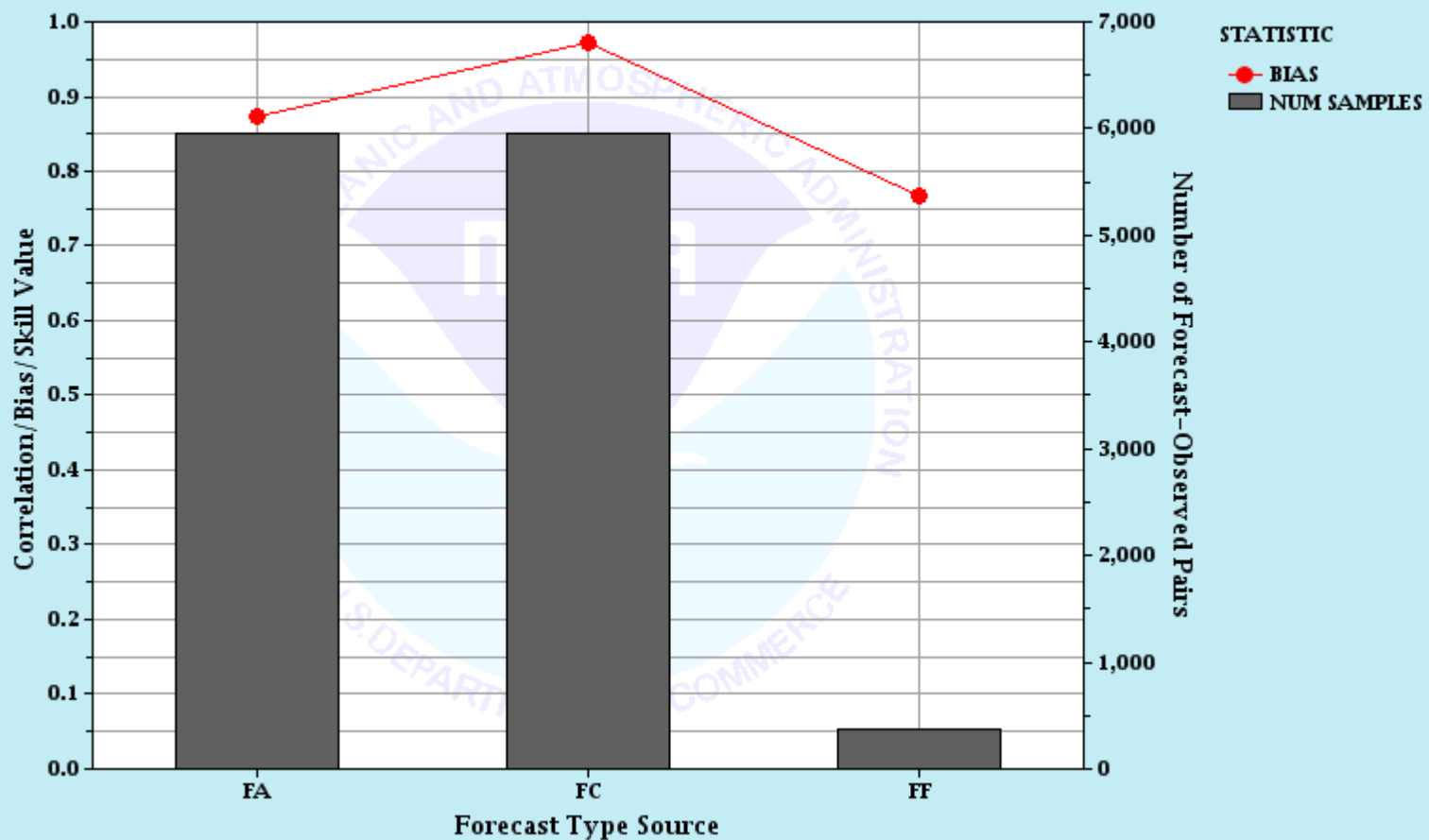




GNVT2 Bias

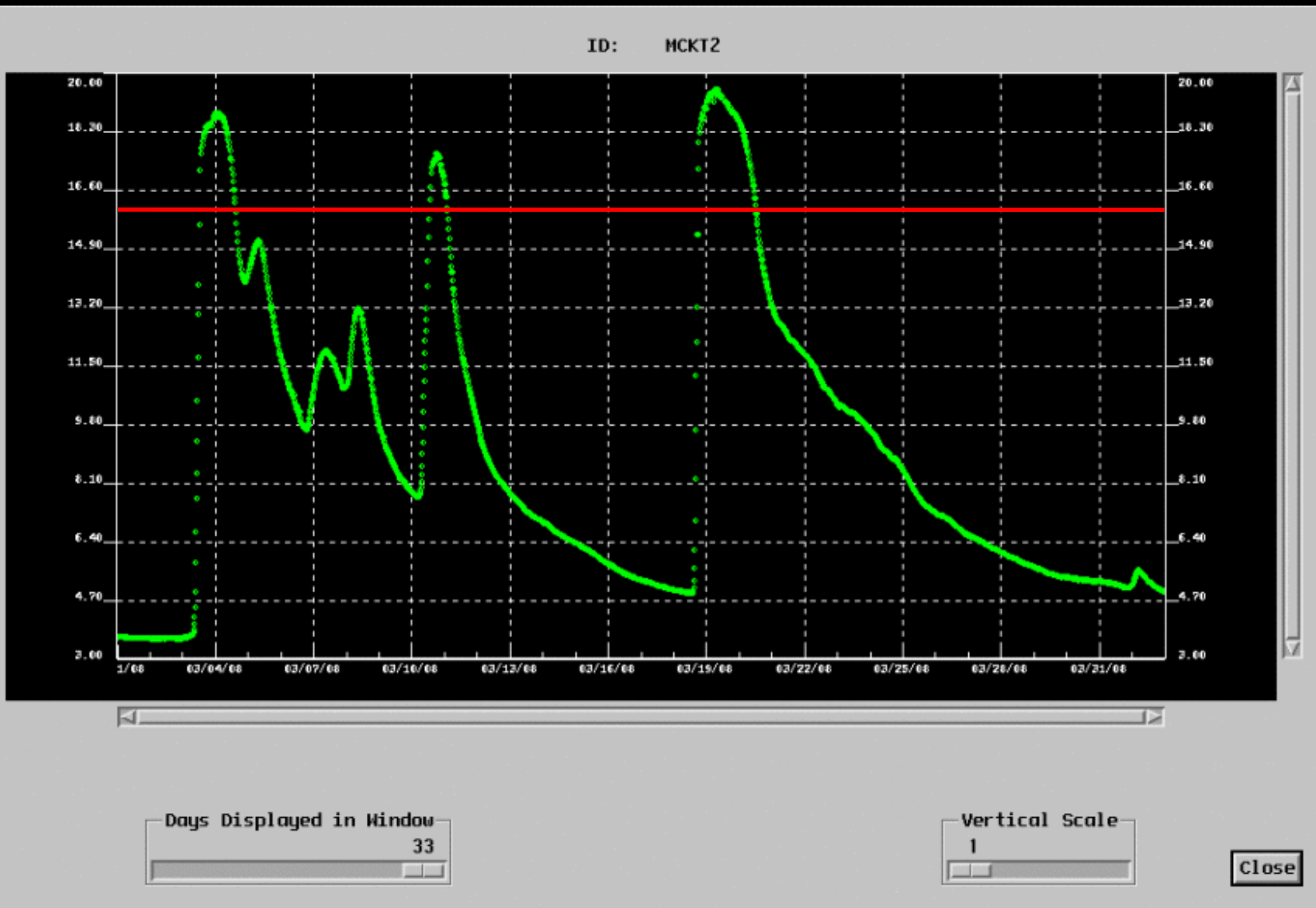


Plot of Instantaneous Height Correlation, Bias, and/or Skill against Forecast Type Source for WGRFC
Time Period: 2008-03-01 00:00:00 GMT - 2008-03-31 23:59:59 GMT
Lead times: All lead times included
Locations: GNVT2



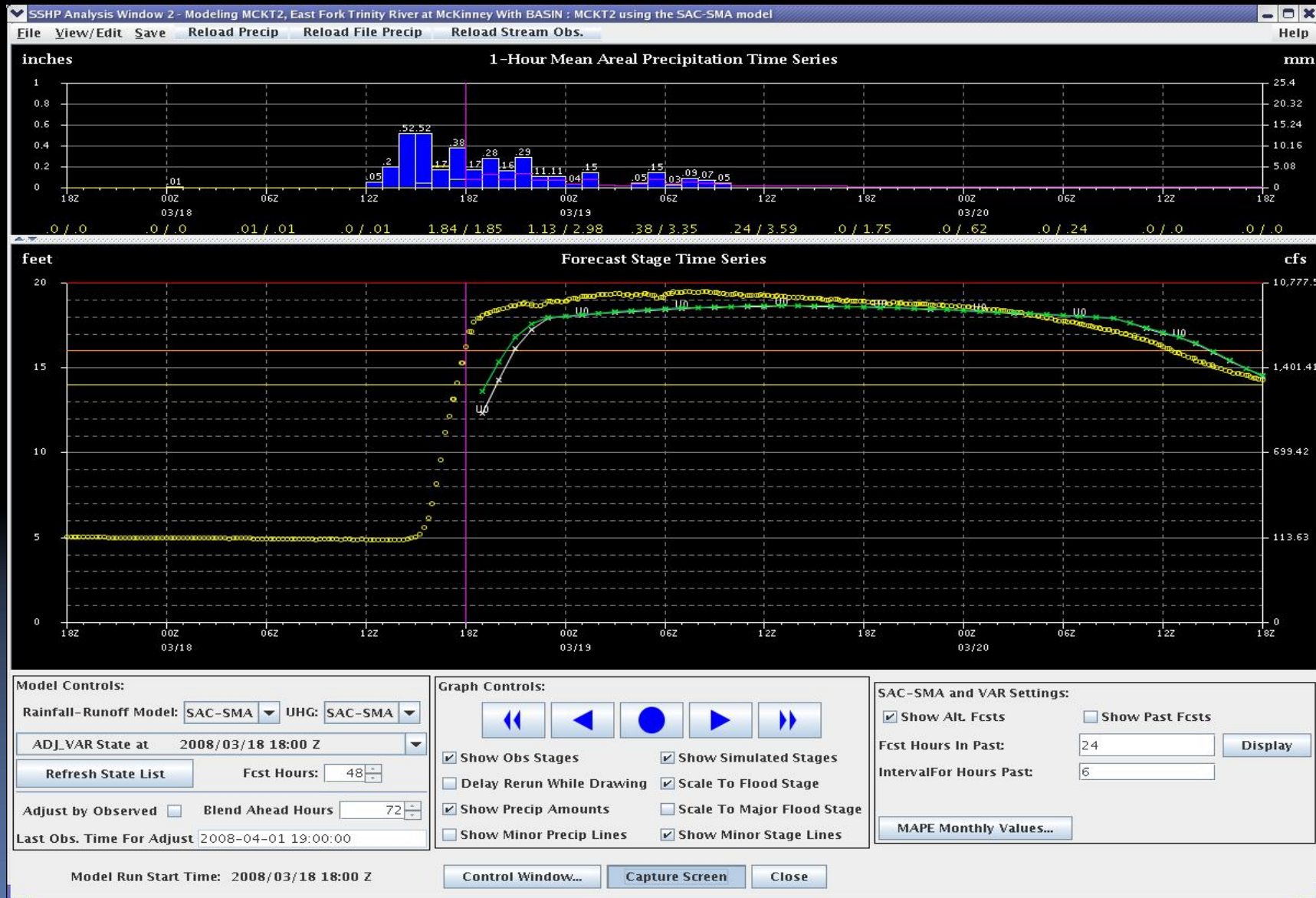


MCKT2 March, 2008





Same event - MCKT2

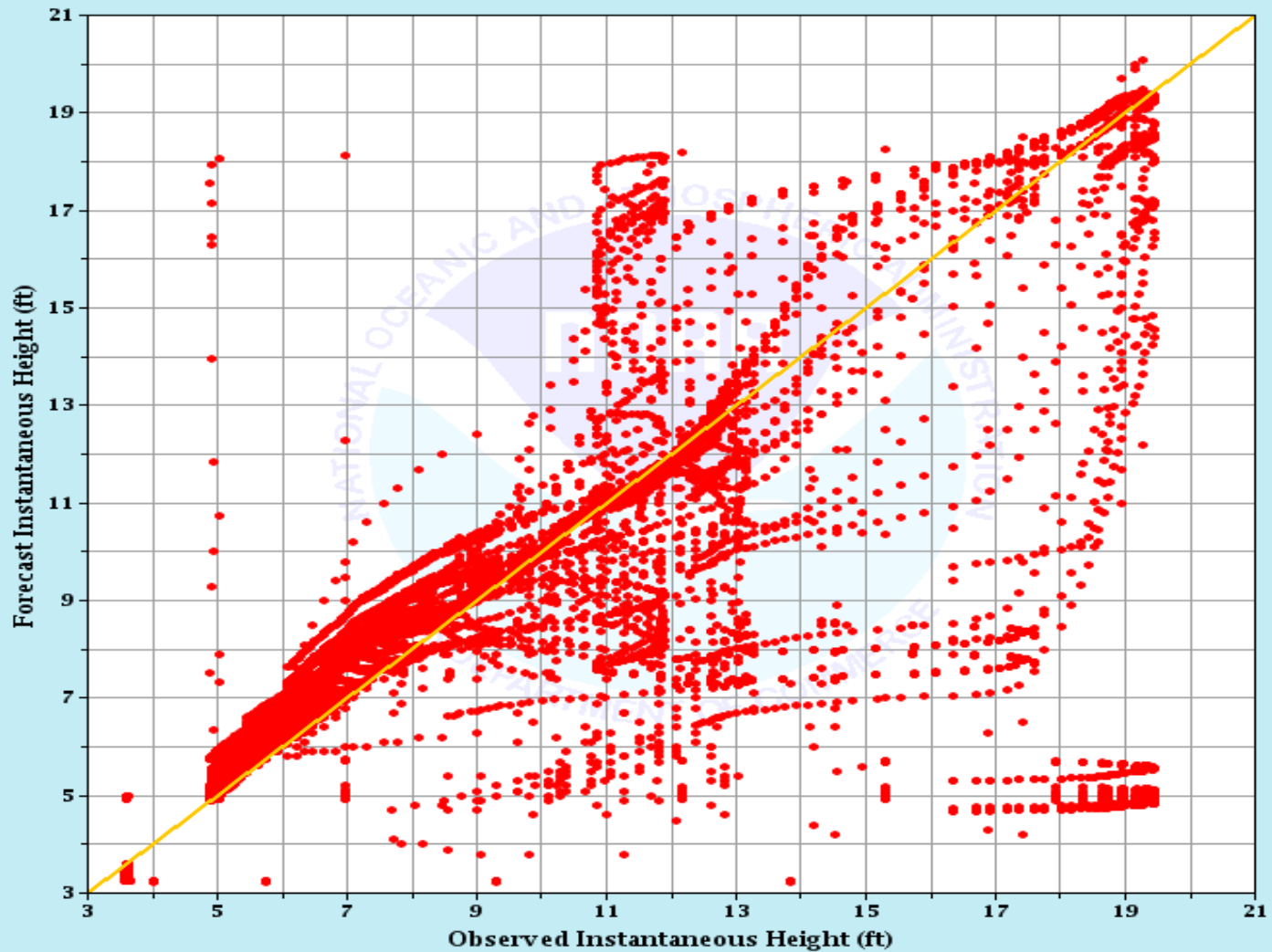




MCKT2



Plot of Forecast-Observed Instantaneous Height Data Pairs for NONE
Time Period: 2008-03-01 00:00:00 GMT - 2008-03-31 23:59:59 GMT
Lead times: ALL
Selected Location: No Name Available [NONE]



LOCATIONS

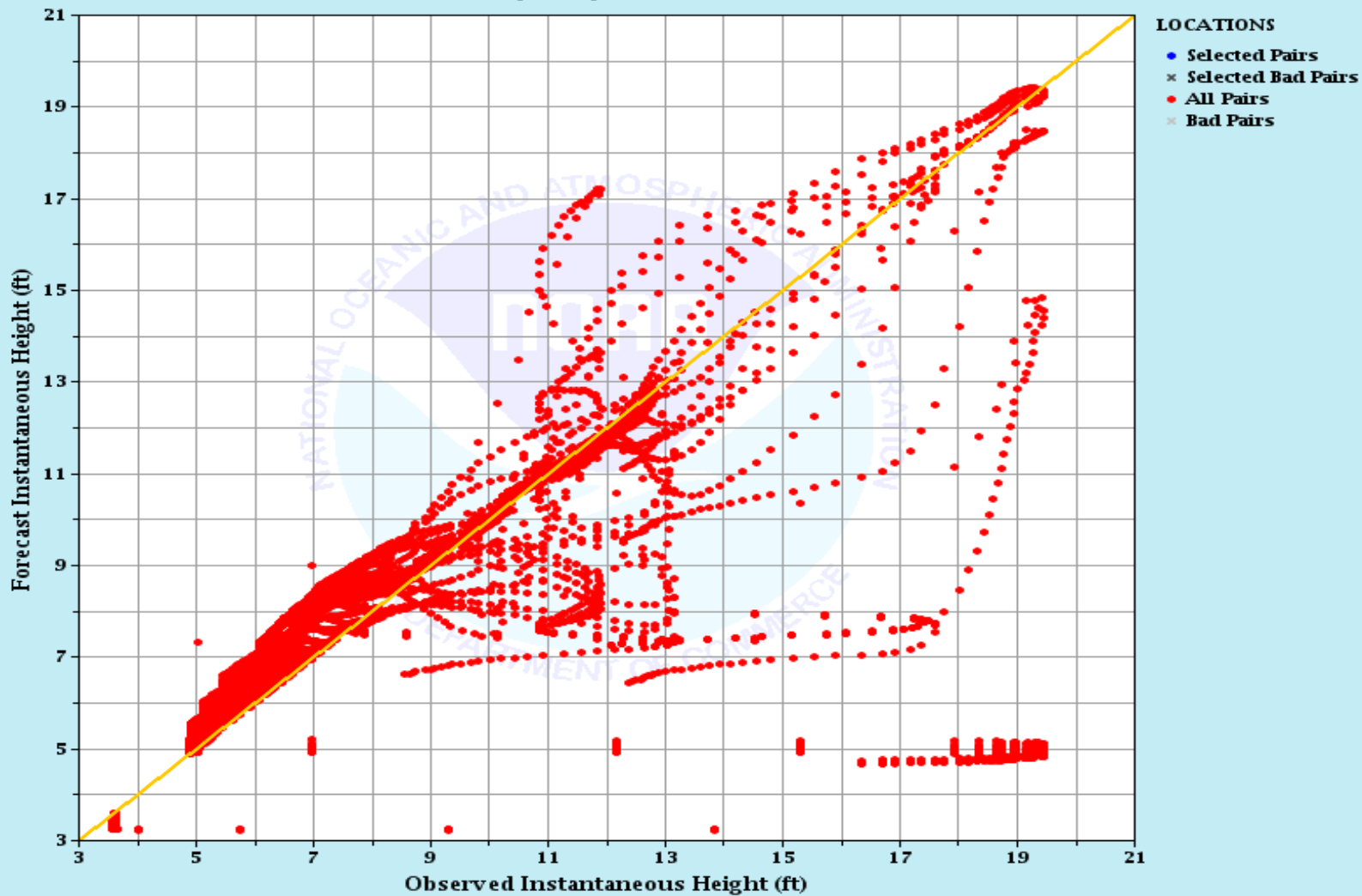
- Selected Pairs
- × Selected Bad Pairs
- All Pairs
- × Bad Pairs



MCKT2 - VAR (FA)



Plot of Forecast-Observed Instantaneous Height Data Pairs for NONE
Time Period: 2008-03-01 00:00:00 GMT - 2008-03-31 23:59:59 GMT
Lead times: ALL
Selected Location: No Name Available [NONE]

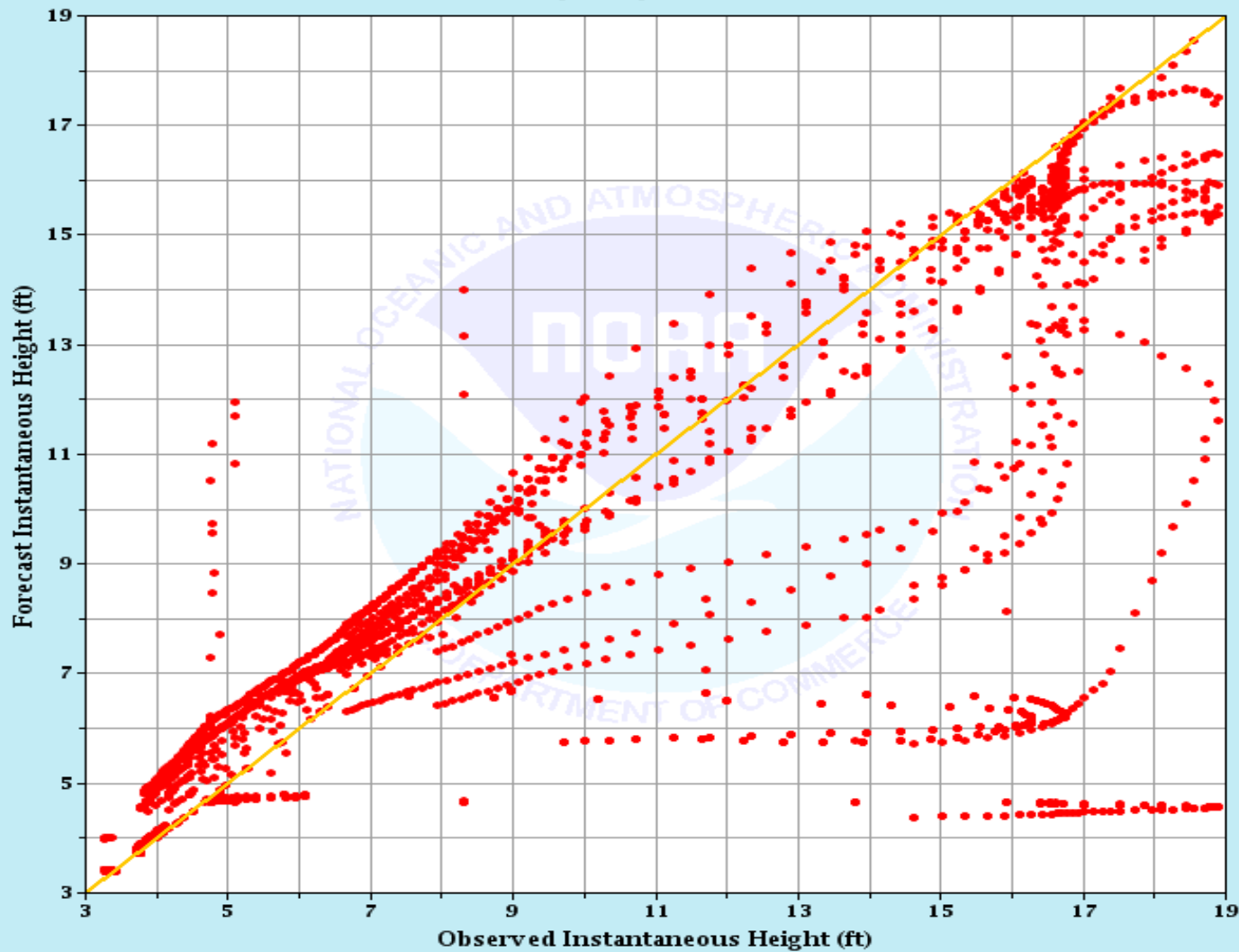




MCKT2 - VAR with Mods (FC)



Plot of Forecast-Observed Instantaneous Height Data Pairs for NONE
Time Period: 2008-03-01 00:00:00 GMT - 2008-03-31 23:59:59 GMT
Lead times: ALL
Selected Location: No Name Available [NONE]



LOCATIONS

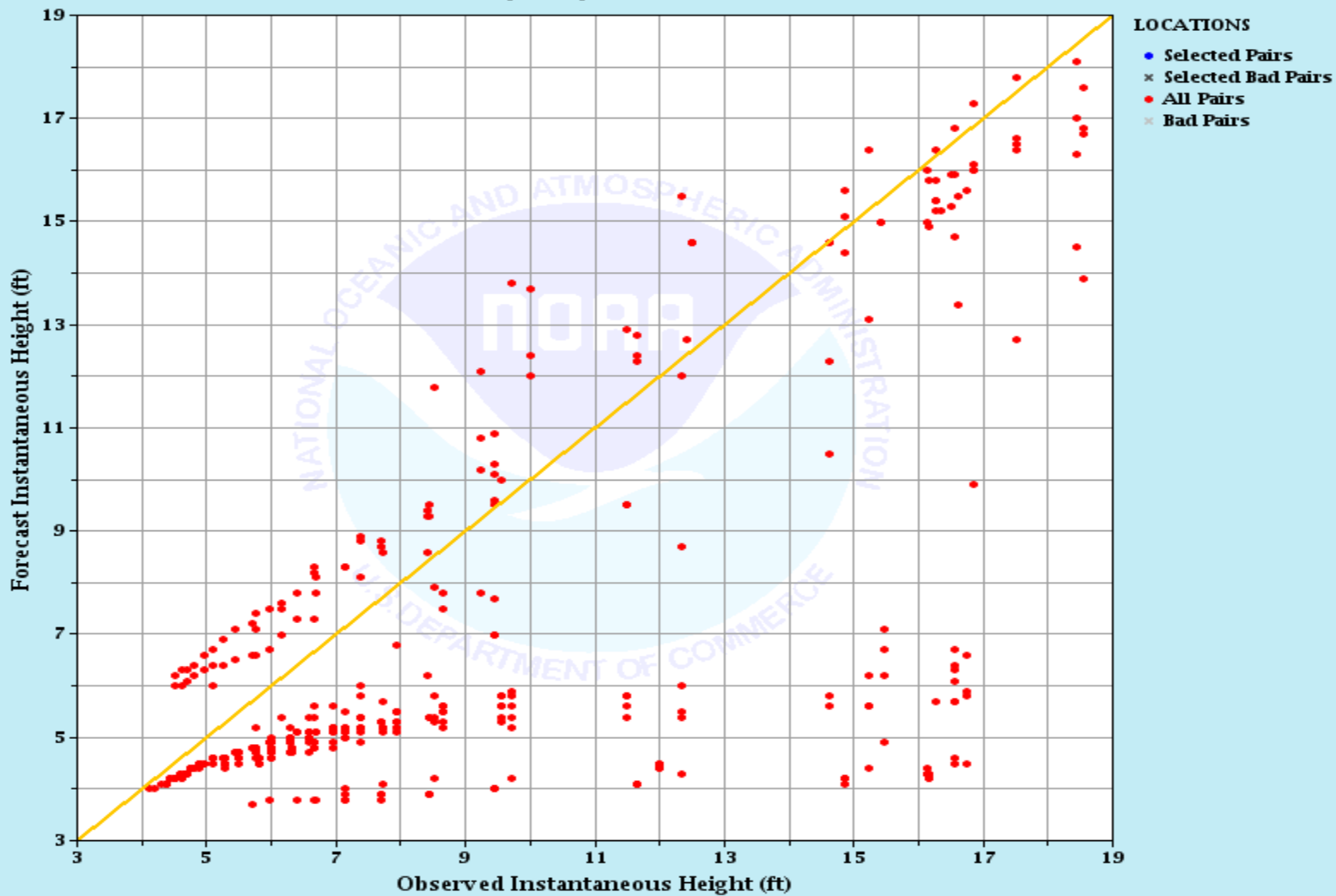
- Selected Pairs
- × Selected Bad Pairs
- All Pairs
- × Bad Pairs



MCKT2 - WGRFC NWSRFS (FF)



Plot of Forecast-Observed Instantaneous Height Data Pairs for NONE
Time Period: 2008-03-01 00:00:00 GMT - 2008-03-31 23:59:59 GMT
Lead times: ALL
Selected Location: No Name Available [NONE]

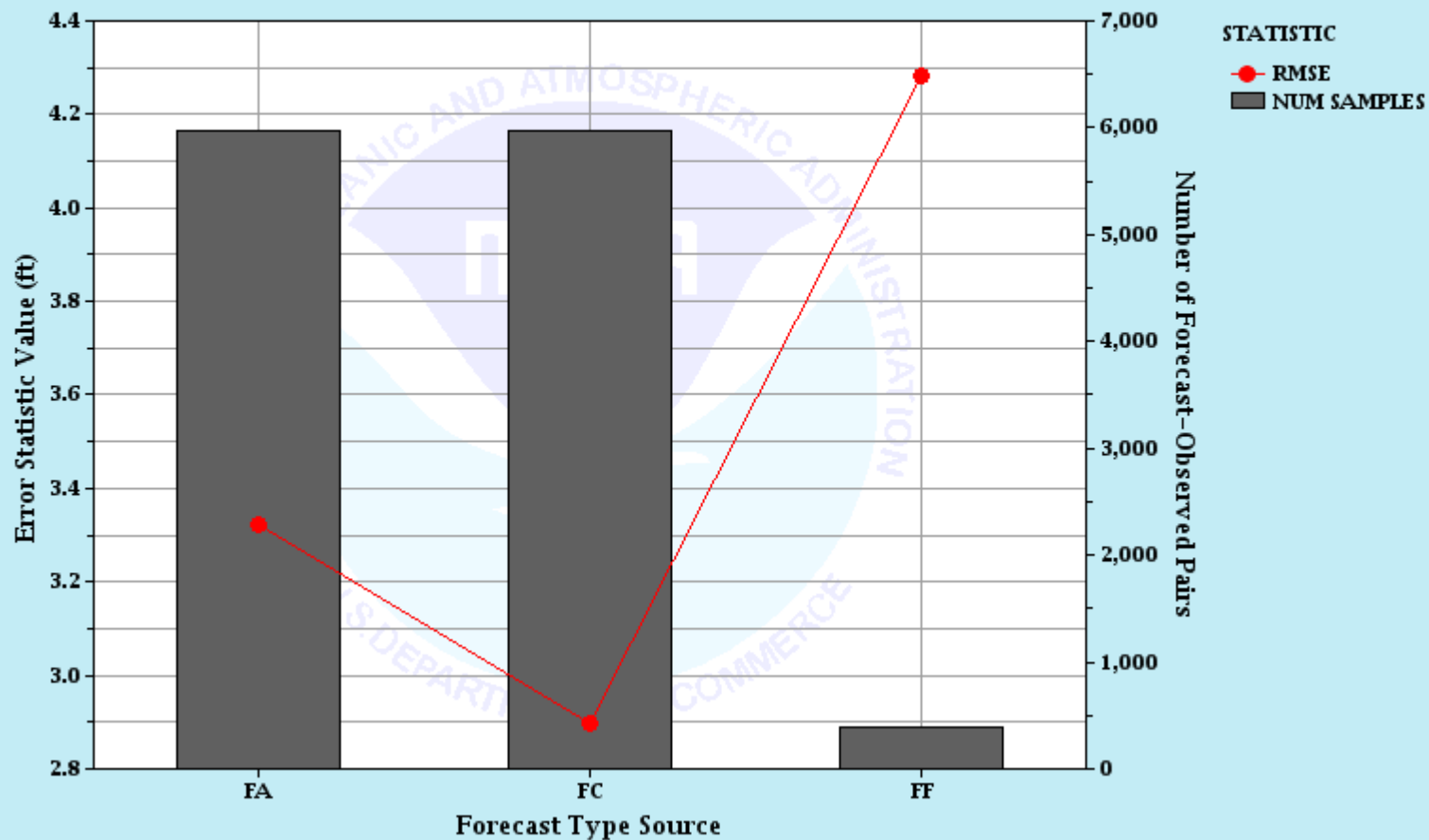




MCKT2 - RMSE



Plot of Instantaneous Height Error Statistics against Forecast Type Source for WGRFC
Time Period: 2008-03-01 00:00:00 GMT - 2008-03-31 23:59:59 GMT
Lead times: All lead times included
Locations: MCKT2

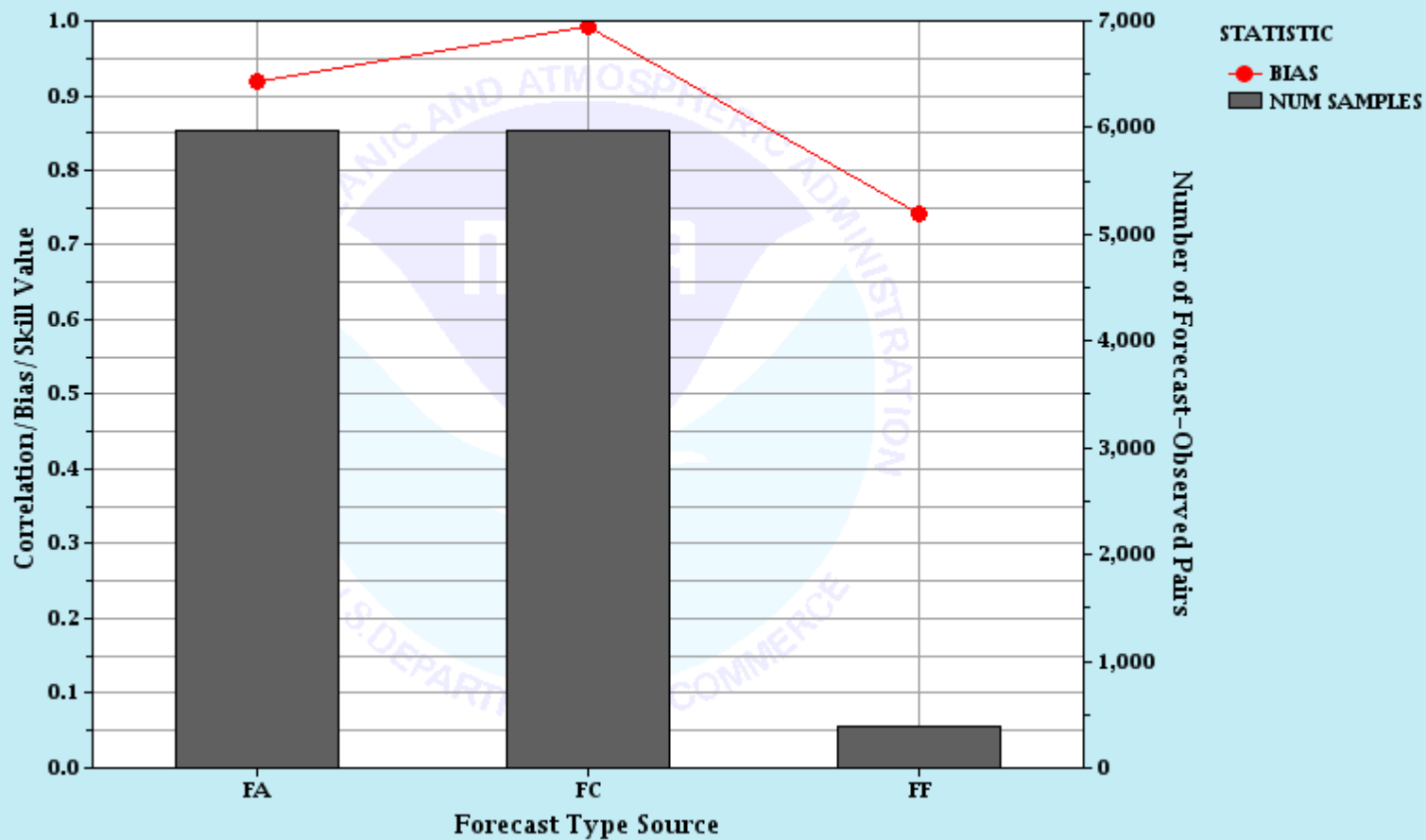




MCKT2 - Bias



Plot of Instantaneous Height Correlation, Bias, and/or Skill against Forecast Type Source for WGRFC
Time Period: 2008-03-01 00:00:00 GMT - 2008-03-31 23:59:59 GMT
Lead times: All lead times included
Locations: MCKT2





Results So Far...

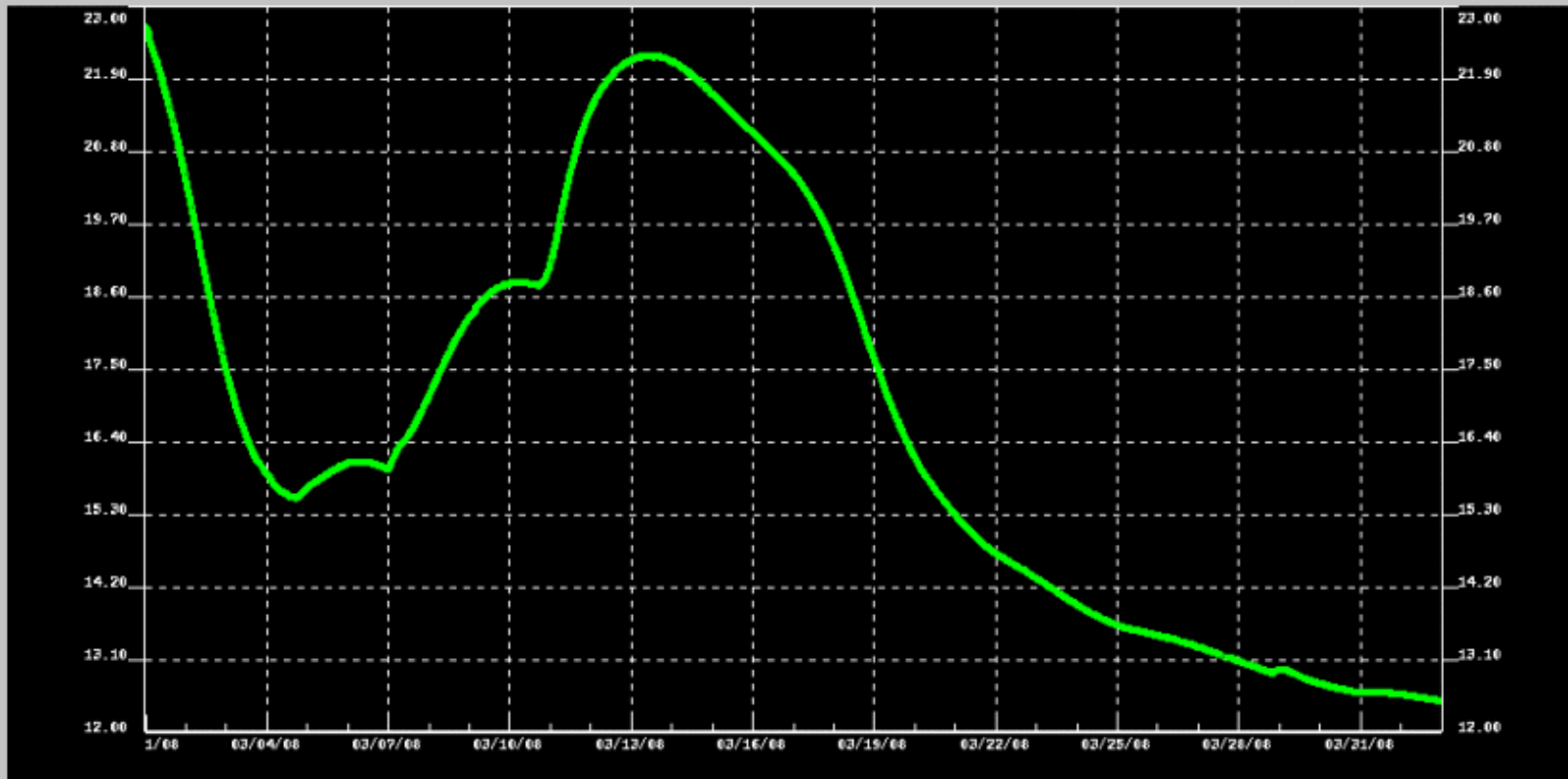
- At both GNVT₂ and MCKT₂, VAR with mods performs best (lower RMSE and bias closer to 1).
- VAR on its own (no mods) beats NWSRFS (human)
- Larger sample size of the VAR forecasts is significant and cannot be over-looked.
- However...We are comparing apples and oranges.
 - GNVT₂ and MCKT₂ are flood only forecasts
 - VAR are daily (more like 4X daily)
 - Let's compare to a WGRFC daily



SOLT2 March, 2008



ID: SOLT2



Days Displayed in Window

33

Vertical Scale

1

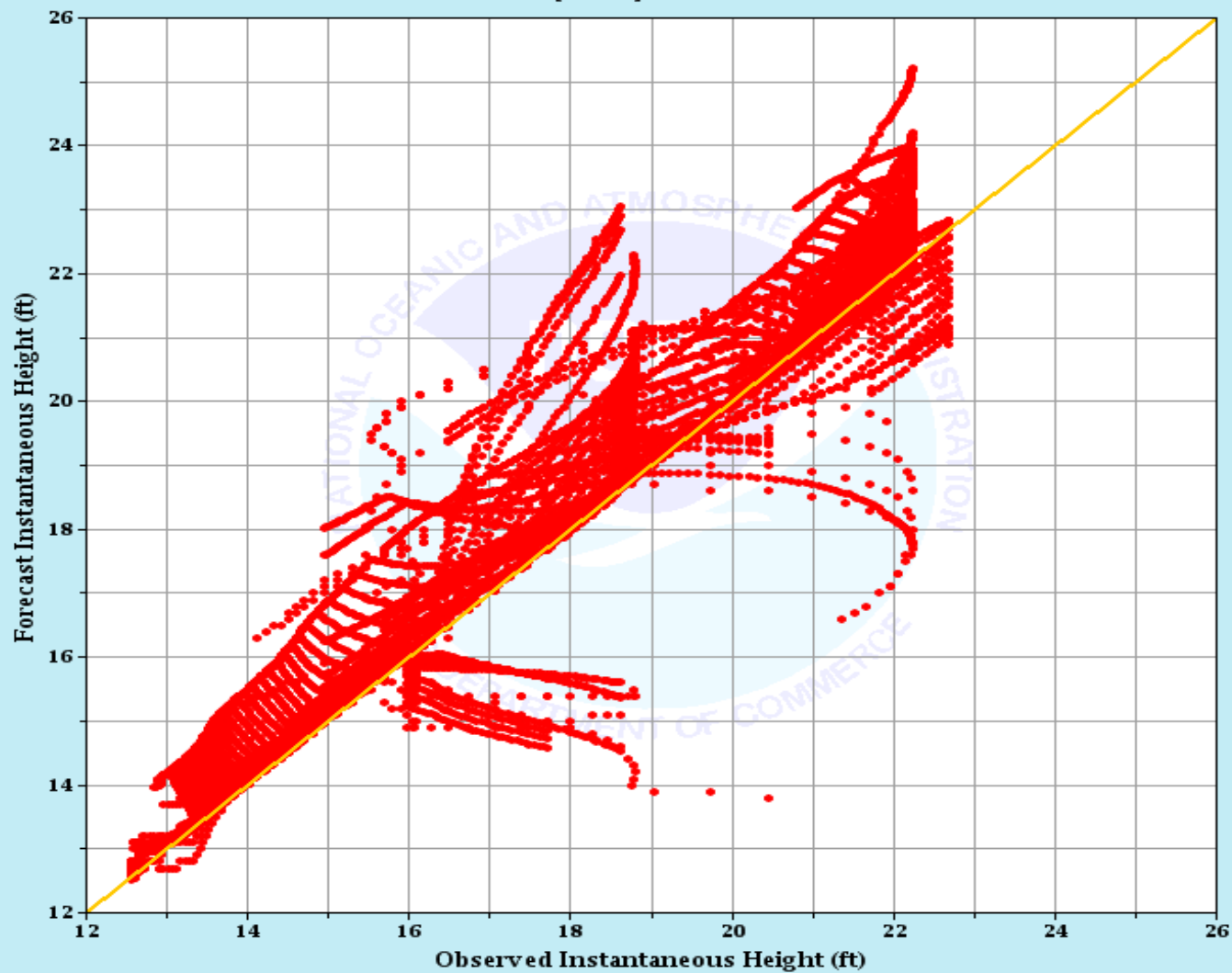
Close



SOLT2



Plot of Forecast-Observed Instantaneous Height Data Pairs for NONE
Time Period: 2008-03-01 00:00:00 GMT - 2008-03-31 23:59:59 GMT
Lead times: ALL
Selected Location: No Name Available [NONE]



LOCATIONS

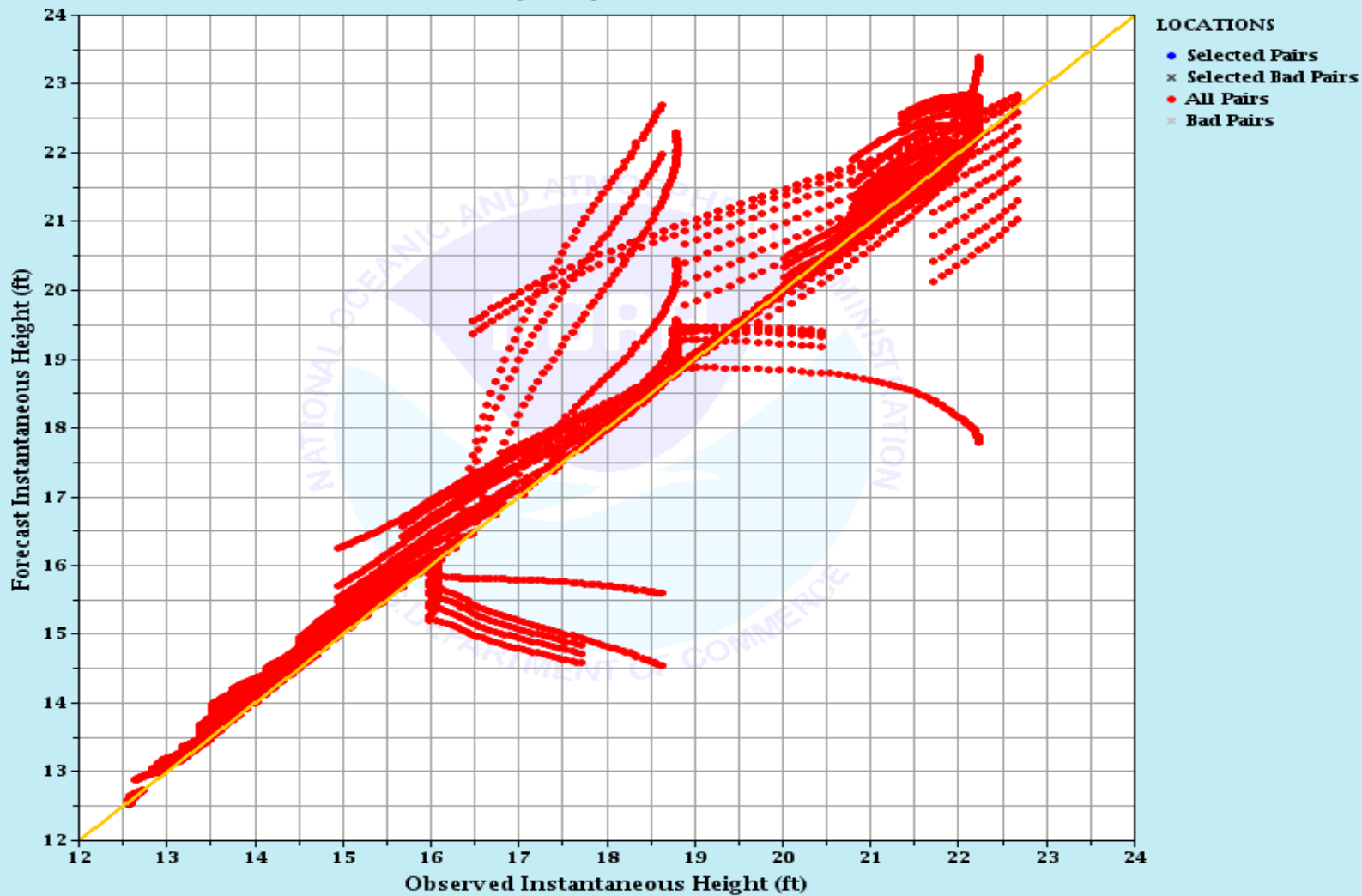
- Selected Pairs
- × Selected Bad Pairs
- All Pairs
- × Bad Pairs



SOLT2 - VAR (FA)



Plot of Forecast-Observed Instantaneous Height Data Pairs for NONE
Time Period: 2008-03-01 00:00:00 GMT - 2008-03-31 23:59:59 GMT
Lead times: ALL
Selected Location: No Name Available [NONE]

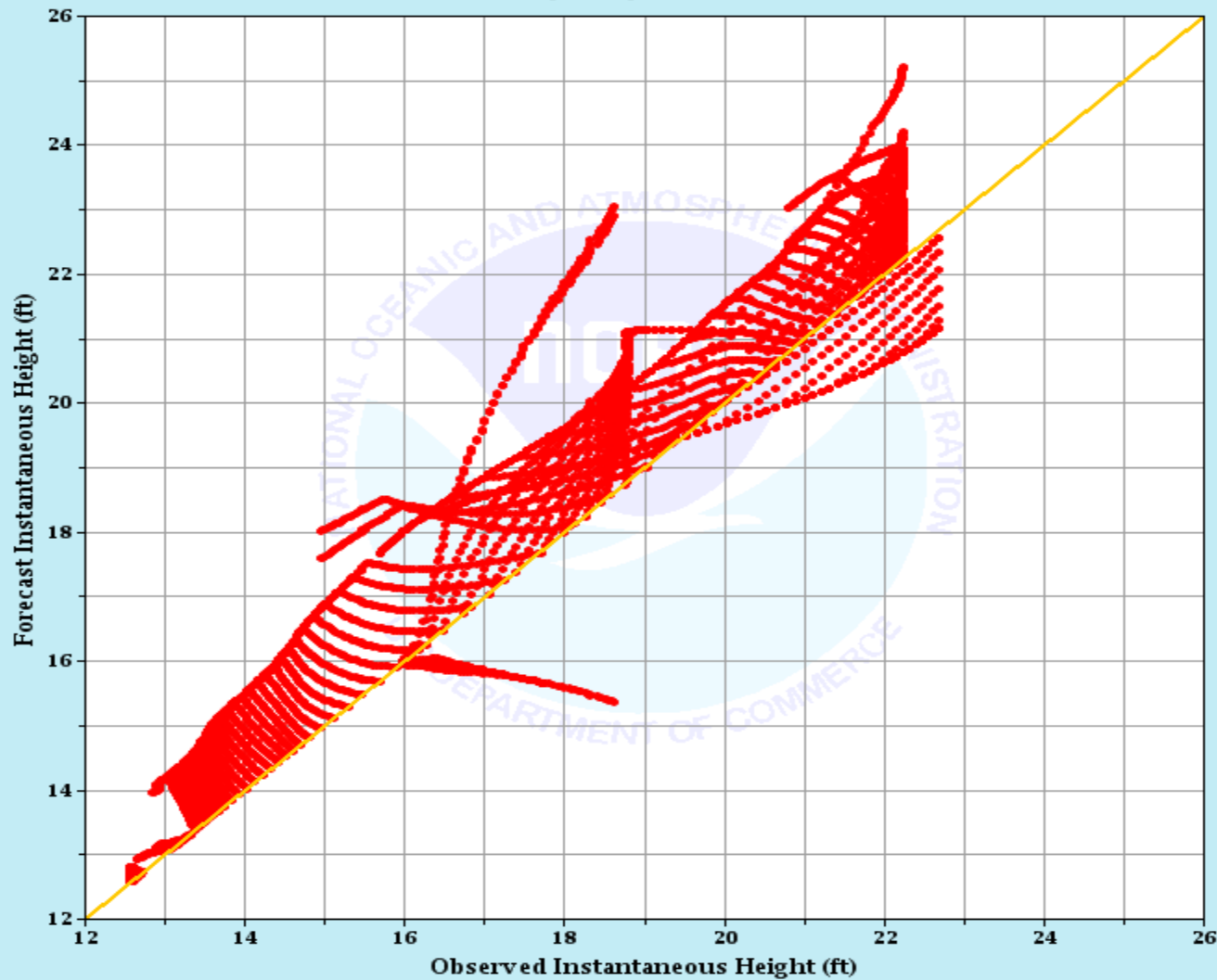




SOLT2 - VAR with Mods (FO)



Plot of Forecast-Observed Instantaneous Height Data Pairs for NONE
Time Period: 2008-03-01 00:00:00 GMT - 2008-03-31 23:59:59 GMT
Lead times: ALL
Selected Location: No Name Available [NONE]



LOCATIONS

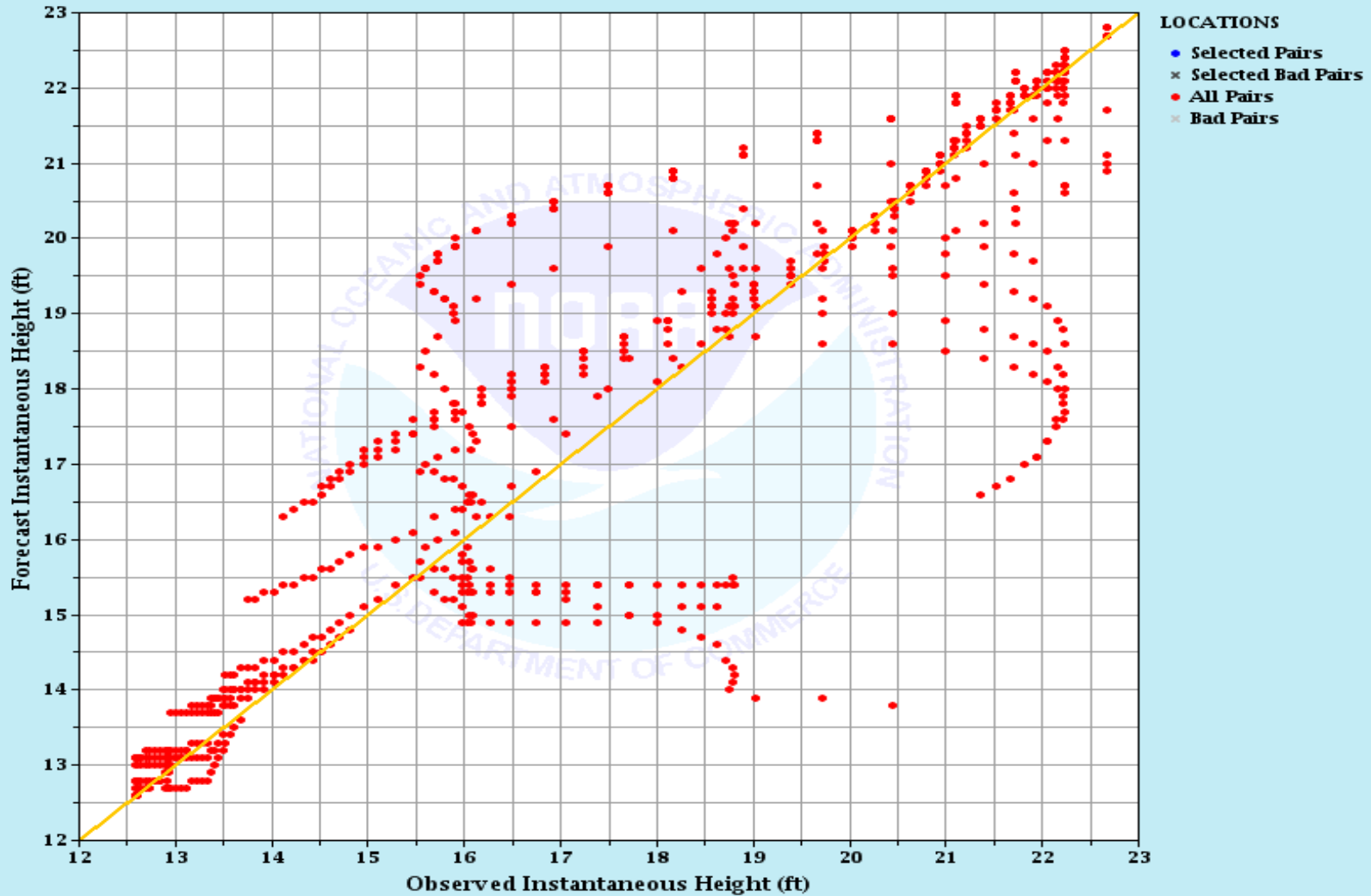
- Selected Pairs
- × Selected Bad Pairs
- All Pairs
- × Bad Pairs



SOLT2 - WGRFC NWSRFS (FR)



Plot of Forecast-Observed Instantaneous Height Data Pairs for NONE
Time Period: 2008-03-01 00:00:00 GMT - 2008-03-31 23:59:59 GMT
Lead times: ALL
Selected Location: No Name Available [NONE]

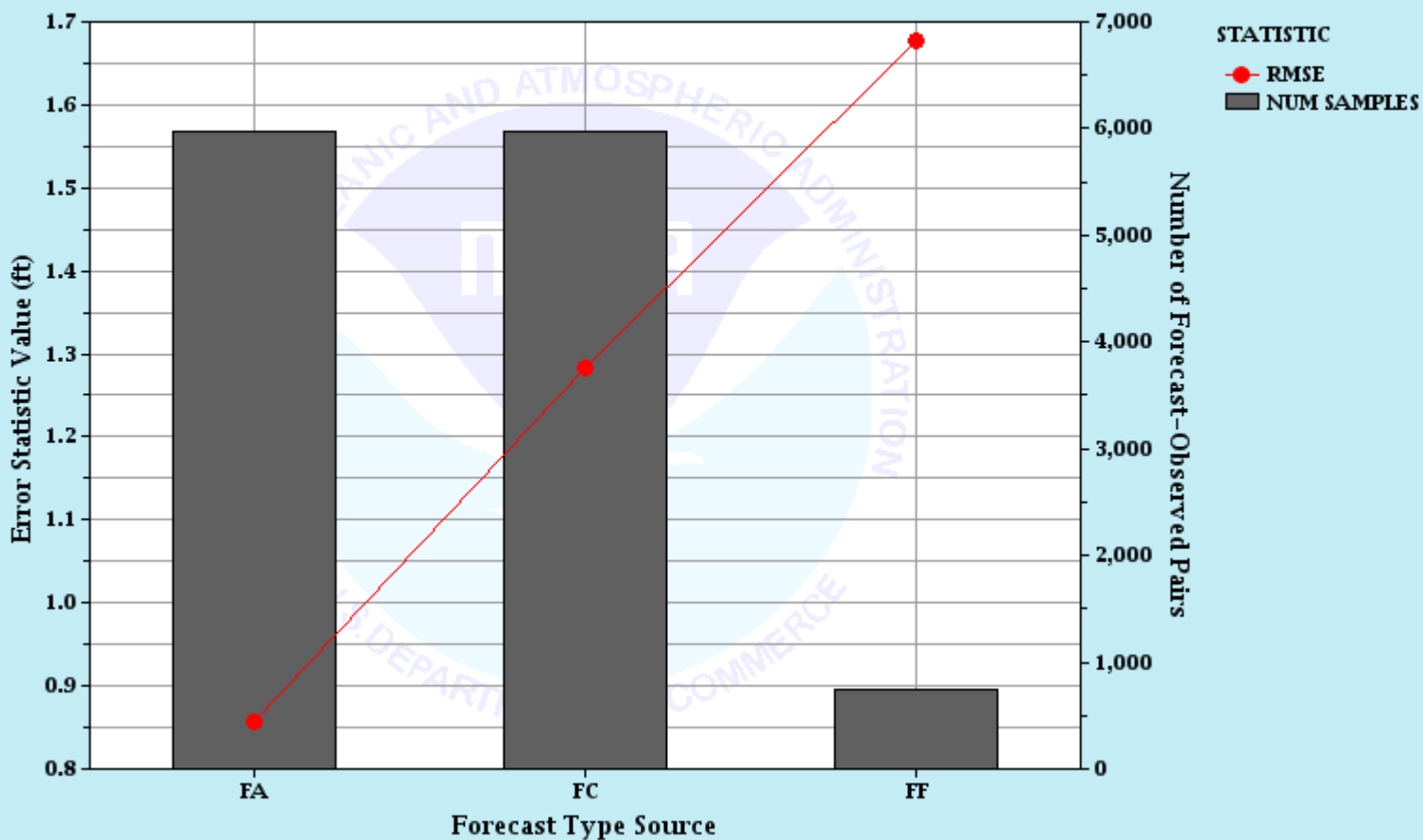




SOLT2 - RMSE



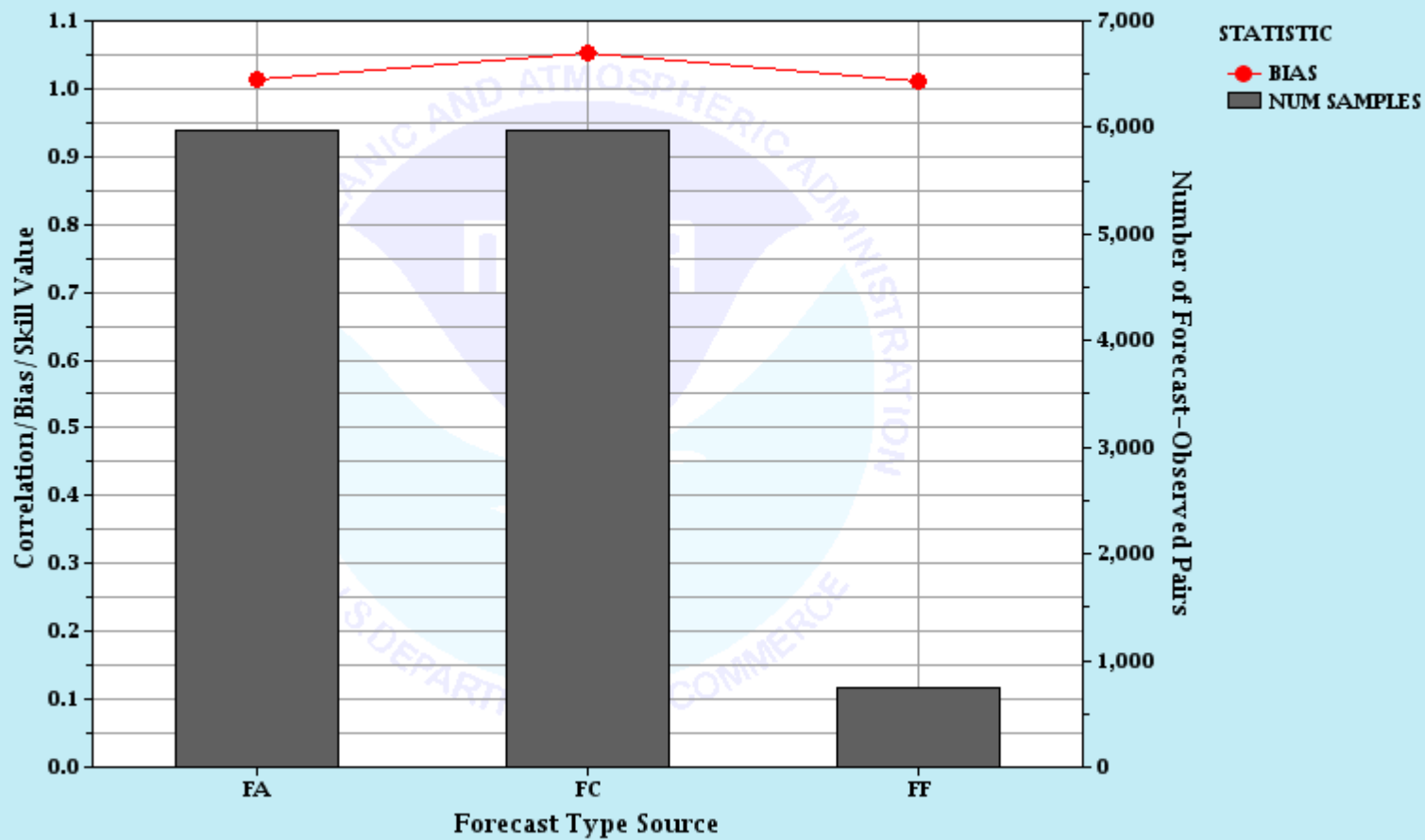
Plot of Instantaneous Height Error Statistics against Forecast Type Source for WGRFC
Time Period: 2008-03-01 00:00:00 GMT - 2008-03-31 23:59:59 GMT
Lead times: All lead times included
Locations: SOLT2





SOLT2 - Bias

Plot of Instantaneous Height Correlation, Bias, and/or Skill against Forecast Type Source for WGRFC
Time Period: 2008-03-01 00:00:00 GMT - 2008-03-31 23:59:59 GMT
Lead times: All lead times included
Locations: SOLT2





Fuji vs. Granny Smith (but at least they are both apples)

- SOLT₂ VAR with no mods had the lowest RMSE (NWSRFS had the highest)
- SOLT₂ NWSRFS had the bias closest to 1 (all three models over-simulated)
- Large sample size is still relevant and cannot be discarded



Conclusions...



- At this point VAR with mods (human intervention) shows improvement over VAR with no mods.
- Maybe it is not a fair comparison, but VAR (both with and without mods) performs better at the flood only forecast points (perhaps our hydrologists need to concentrate more on the falling limbs?)
- At daily points, VAR is beat by the human forecaster



My Experience with IVP...



- Use the `-m 512M` option
 - If not, you will exceed memory limits...often.
- Maybe this is unfair as WGRFC was a beta test site...
 - IVP GUI is *extremely* easy to negotiate...
 - Give me a stat, a site, a type source, and a time frame, and I can generate any graph you want...in about 20 minutes...
- AX is less than robust to be kind.



Questions...?



- WGRFC Verification Team –
 - Gregg Waller
 - greg.waller@noaa.gov
 - 817-831-3289 ext 217