Hydrologic Ensemble Forecasting Service (HEFS)

Seminar C

Review MEFP Diagnostics

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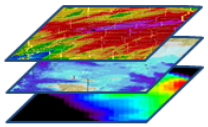
HEFS Training Workshop (5), Silver Spring, MD
February 25, 2014

HEFS Components

= Forecast tool (real-time/hindcast)

= Supporting tool

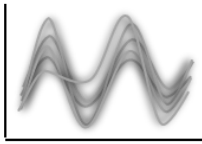
= Future capability



Raw weather and climate forecasts (GEFS, CFSv2,..)

MEFP: pre-processor

MEFP PE: parameters

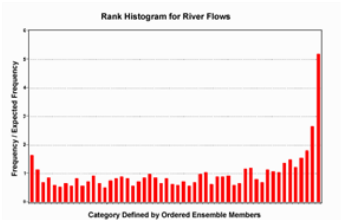


Unbiased forcing (basin scale)

(basin scale)

EVS: verification

Verification results

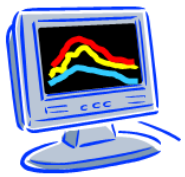


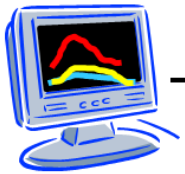
"Raw flow"

"Corrected flow"

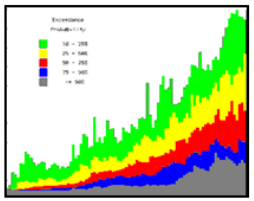
Data assimilator

Hydrologic Ensemble Processor





GraphGen: products



Ensemble products

Hydrologic data

EnsPost: post - processor

EnsPost PE: parameters

Content

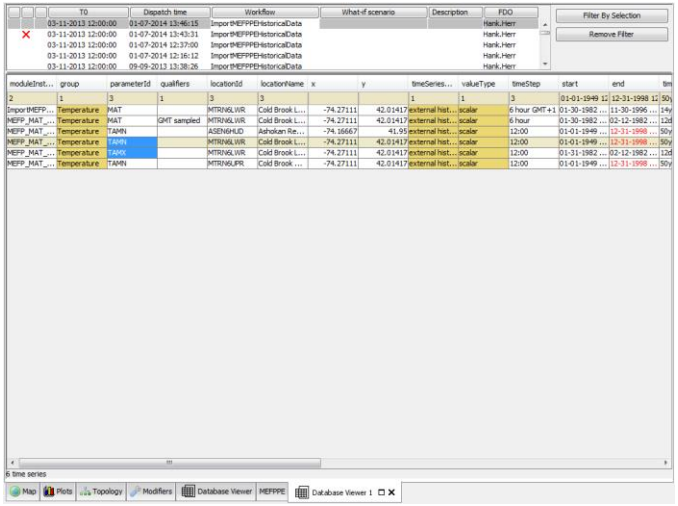
- **Overview of Diagnostics**
- **Time Series Diagnostics**
  - Why?
  - MEFPPE Tools
  - Tools for Fixing Data
- **Parameter Diagnostics**
  - Why?
  - MEFPPE Tools
- **Summary**
- **Exercise**

Overview of Diagnostics
Types of Diagnostics

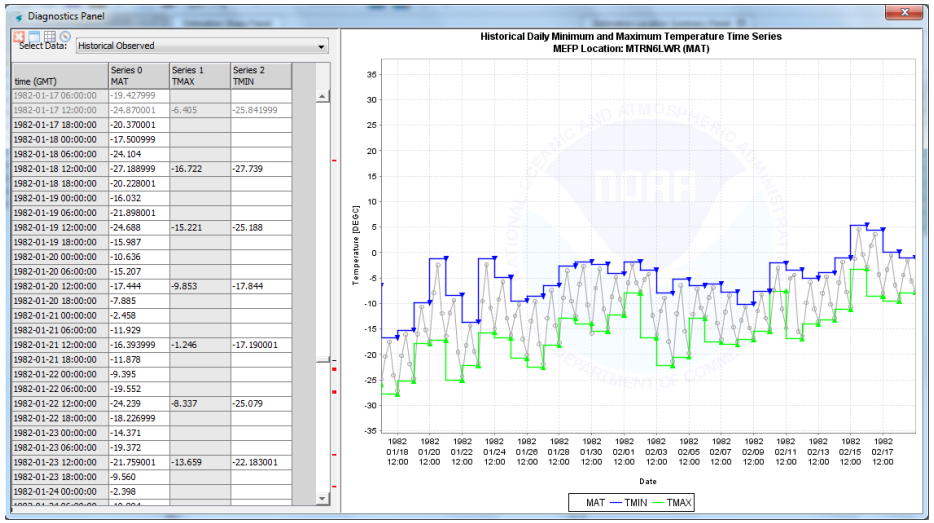
- **Two types of diagnostics currently available for MEFPPE**
  - Time series diagnostics
    - Used to examine historical time series, RFC archive forecasts, and GEFS/CFSv2 reforecasts
    - Identify bad/questionable data
    - Data correction is done outside of MEFPPE
  - Parameter diagnostics
    - Used to examine estimated parameters of the MEFP
    - Tweak estimation options
    - Determine best operational run settings
      - e.g., if a forecast source should be used and the number of forecast days to use for that source

Overview of Diagnostics
Tools for Diagnostics

- **Tools to examine data and parameters**
  - CHPS/FEWS Database Viewer
    - Only useful for historical MAP/MAT and transformed TAMN/TAMX data



  - MEFPPE Diagnostics Panel
    - Displays time series and parameter diagnostics
    - Accessible through buttons in the MEFPPE interface



Time Series Diagnostics

Why?

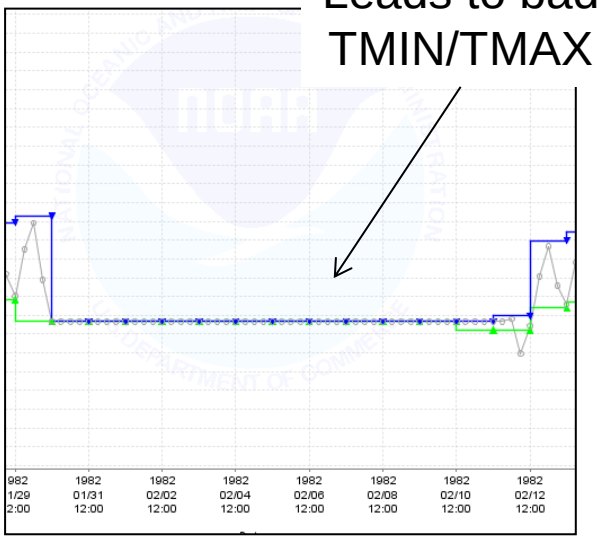
- **Bad input can lead to bad parameters and/or bad MEFP output**

MTRN6LWR Datacard Snippet

1828146	27.135	13.485	3.495	33.280	33.280	33.280
1828147	39.500	33.280	33.280	33.280		
2828148	33.585	33.280	33.280	33.280	33.280	33.280
2828149	33.280	33.280	36.708	33.280	33.280	33.280
2828150	33.280	33.280	33.280	33.280	33.280	33.280
2828151	33.280	33.280	33.280	33.280	4.869	33.280
2828152	33.280	33.280	-2.398	33.280	33.280	33.280
2828153	7.537	33.280	33.280	33.280	33.280	33.280
2828154	33.280	33.280	33.280	33.280	33.280	33.280

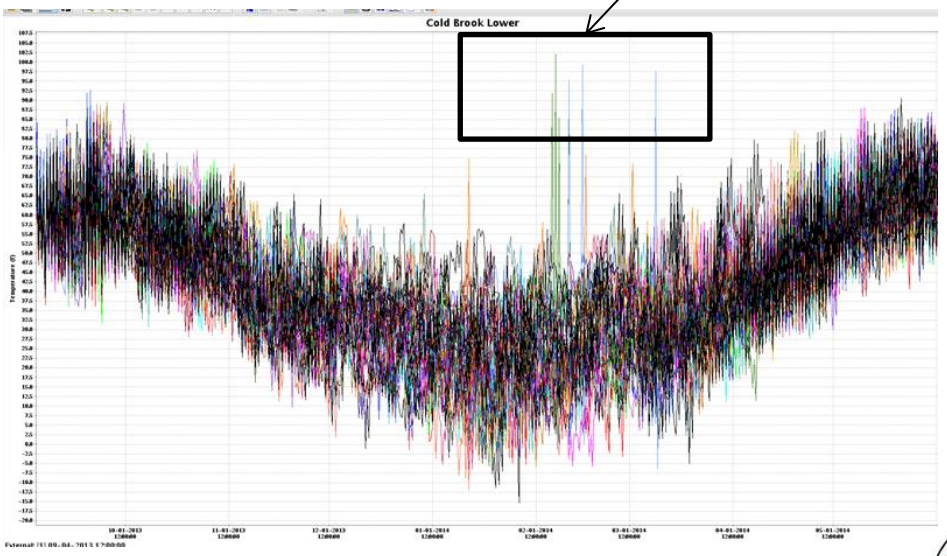
Many repeated 33.280 values
Does not fit diurnal pattern

Leads to bad TMIN/TMAX



MEFP Output

Unreasonable spikes



Time Series Diagnostics

Why?

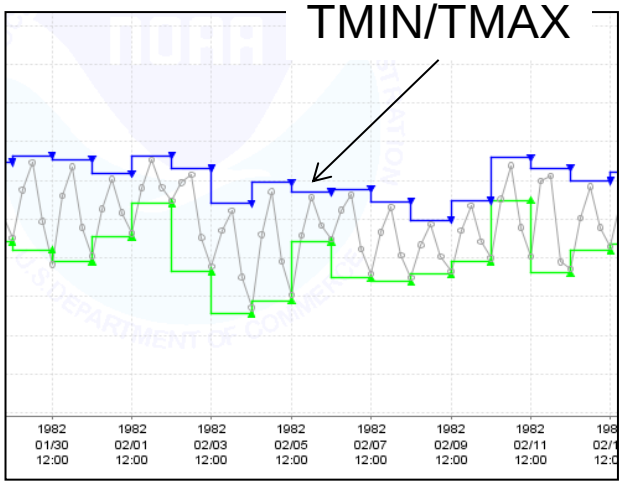
- **After fixing the bad input, MEFPPE/MEFP output becomes more reasonable**

MTRN6LWR Datacard Snippet

1828146	27.135	13.485	3.495	19.469	26.166	12.036
1828847	5.417	16.394	23.322	15.514		
2828148	10.707	21.242	27.728	21.349	18.255	22.532
2828149	24.357	9.755	3.070	11.340	15.978	0.550
2828150	-6.595	10.380	20.414	4.162	-3.521	10.214
2828151	19.079	12.559	9.330	16.076	19.620	7.120
2828152	1.337	10.990	16.736	5.610	0.384	8.048
2828153	12.795	5.378	1.866	11.441	17.117	8.858
2828154	4.936	18.668	26.480	12.085	5.312	22.893

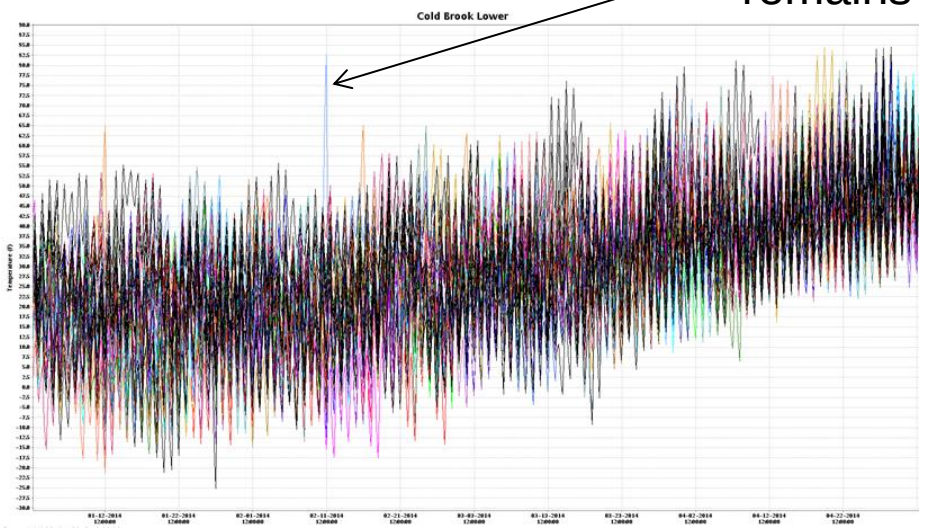
Copied from another year to fit the diurnal pattern

Reasonable TMIN/TMAX



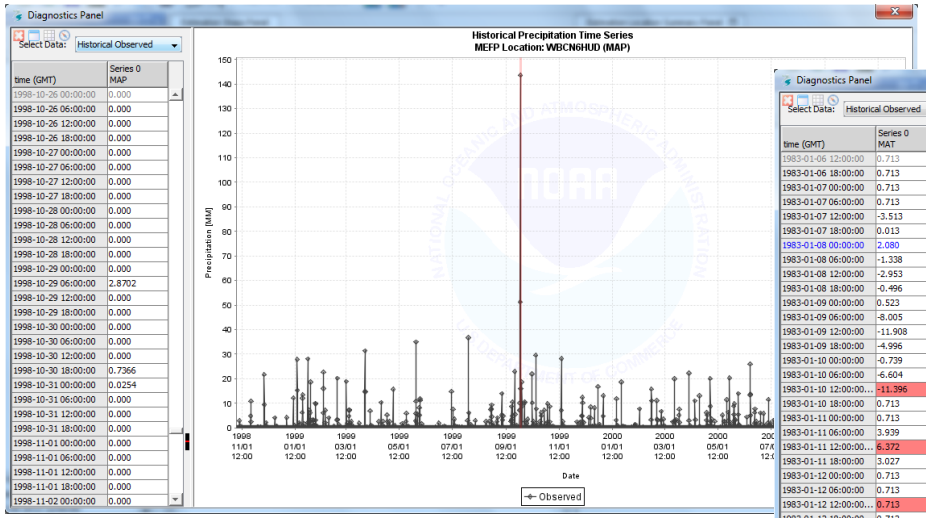
MEFP Output (zoomed in)

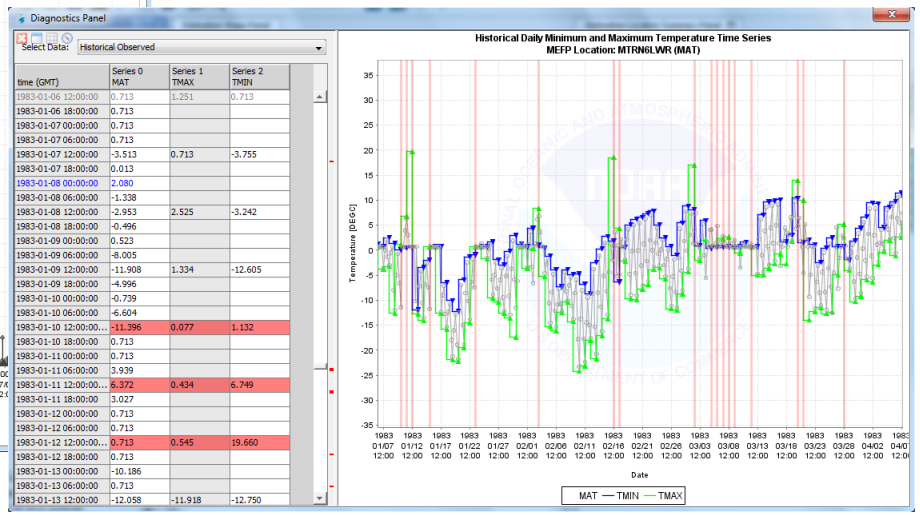
Only one spike remains



Time Series Diagnostics
MEFPPE Tools

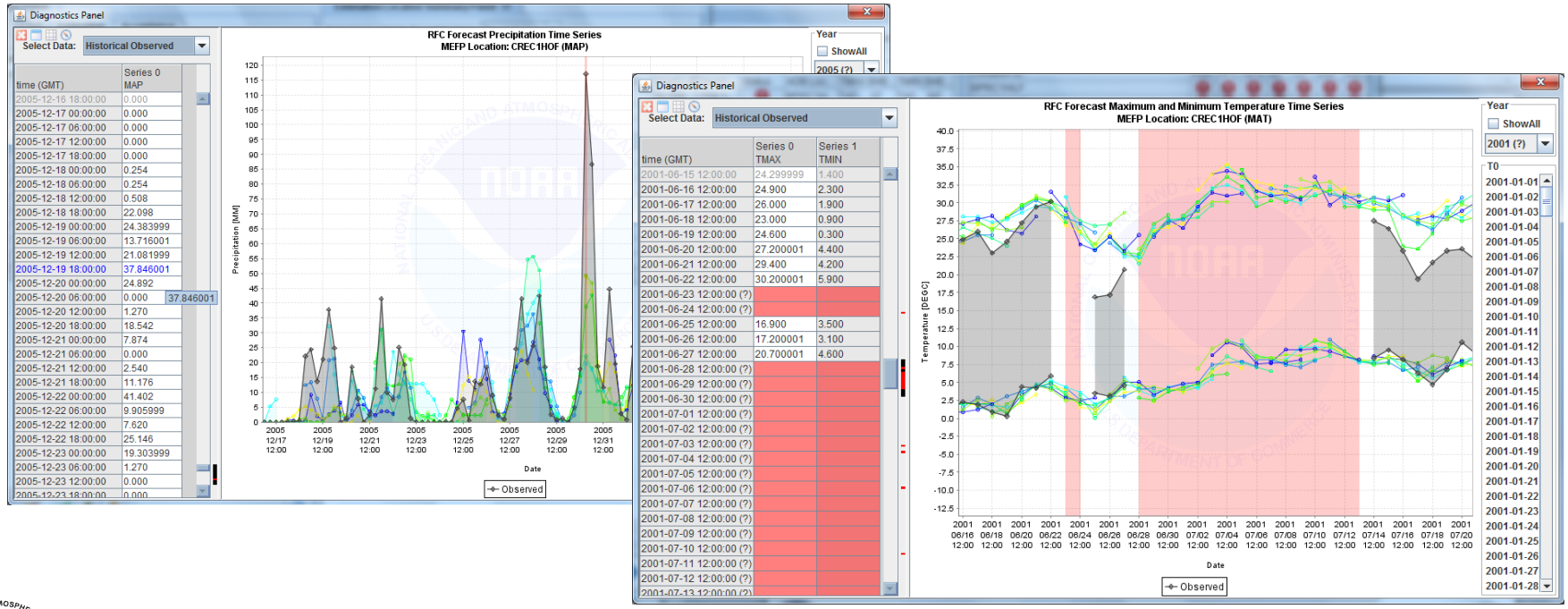
- **Time series diagnostics panel for historical data**
  - Automatic data quality checks
    - Missing data
    - Gross range (0 – 100 mm for precip, -100 – 100 degC for temperature)
    - Minimum temperature exceeds maximum temperature
    - Check results are stored in a file within the MEFPPE run area
  - Questionable data highlighted in **Diagnostics Panel**:





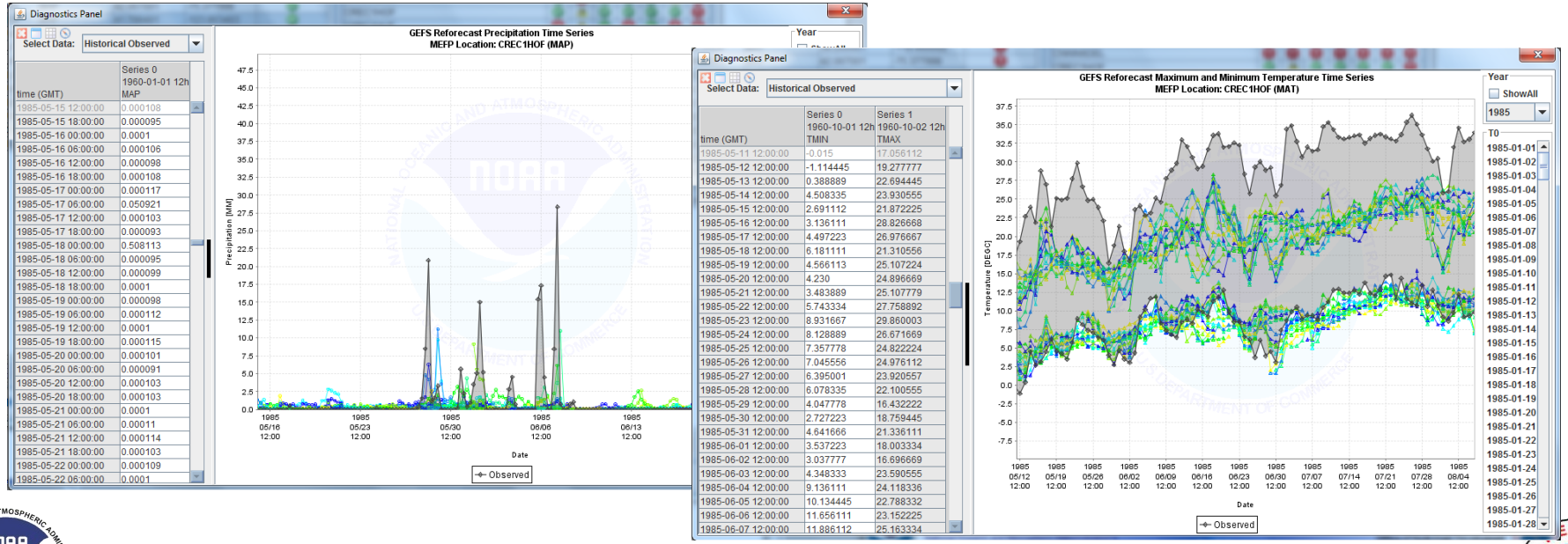
Time Series Diagnostics
MEFPPE Tools

- **Time series diagnostics panel for RFC archive forecasts and observations (if available)**
  - Automatic data quality checks
    - Same checks are performed as for historical data
  - Questionable data highlighted in **Diagnostics Panel**:



Time Series Diagnostics
MEFPPE Tools

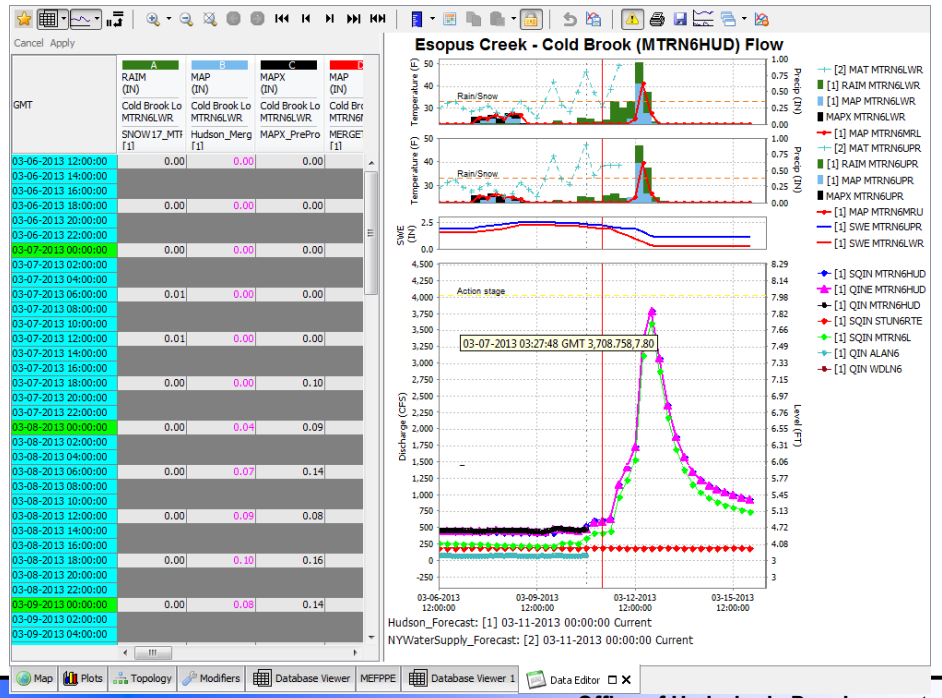
- **Time series diagnostics panel for GEFS/CFSv2 reforecasts**
  - No automatic data quality checks are performed
    - Basic QC was performed at OHD
    - Data should not be modified
  - Data can be viewed alongside historical data in **Diagnostics Panel**
    - Historical data is that provided as historical (typically datacard) data augmented by RFC observations if available



Time Series Diagnostics
Tools for Fixing Data

- **Tools to fix bad data**
  - Manual editing
    - Historical Data:
      - Edit datacard data, re-import, and reacquire data from PI-service
    - RFC data:
      - Edit RFC files directly via text editor and re-import the files
      - Change data in archive database, use IVP to rebuild pairs, and perform RFC step again
  - FEWS Data Editor
    - Historical data only
    - Requires configuration
    - Reacquire data from PI-service via MEFPPE

```
$ IDENTIFIER=MTRN6LWR      DESCRIPTION=
$ PERIOD OF RECORD=01/1949 THRU 01/1999
$ SYMBOL FOR MISSING DATA=-999.00   SYMBOL FOR ACCUMULATED DATA=-998.00
$ TYPE=MAT    UNITS=DEGF   DIMENSIONS=      DATA TIME INTERVAL= 6 HOURS
$ OUTPUT FORMAT=(3A4,2I2,I4,6F10.3)
DATACARD     MAT      DEGF  6   MTRN6LWR      MTRN6LWR
 1  1949 12   1998  6   F10.3
        149   1    17.093   20.678   22.794   18.902   17.071   22.640
        149   2    25.885   20.678   18.216   23.202   25.861   17.003
        149   3    12.901   24.238   31.244   25.089   22.081   32.773
        149   4    39.241   32.893   29.816   38.129   42.728   31.429
        149   5    26.160   34.960   40.412   32.931   29.369   37.438
```

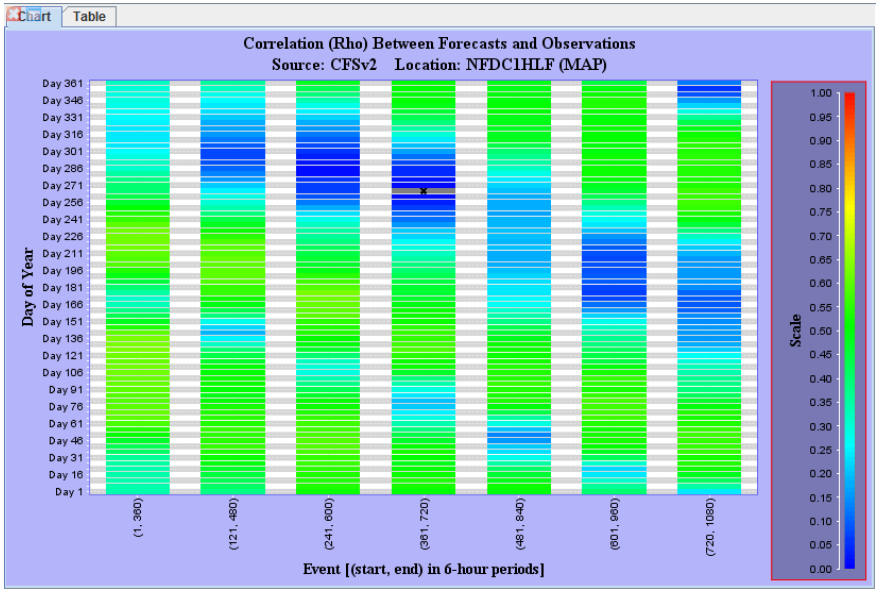


Parameter Diagnostics

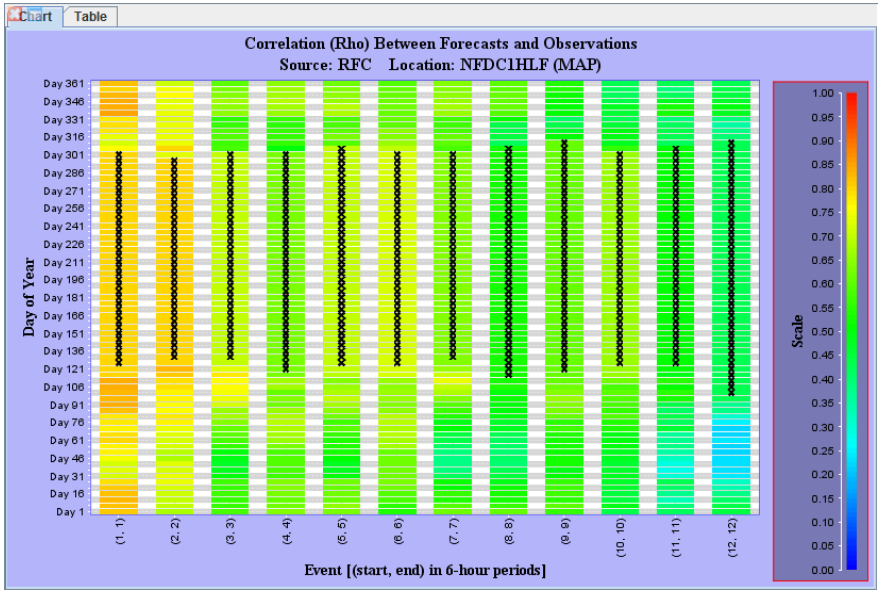
Why?

- **Identify/confirm expected patterns**
  - Seasonal and lead time patterns are expected in most cases

Patterns in correlation visible by season
(y-axis: day of year source: CFSv2)

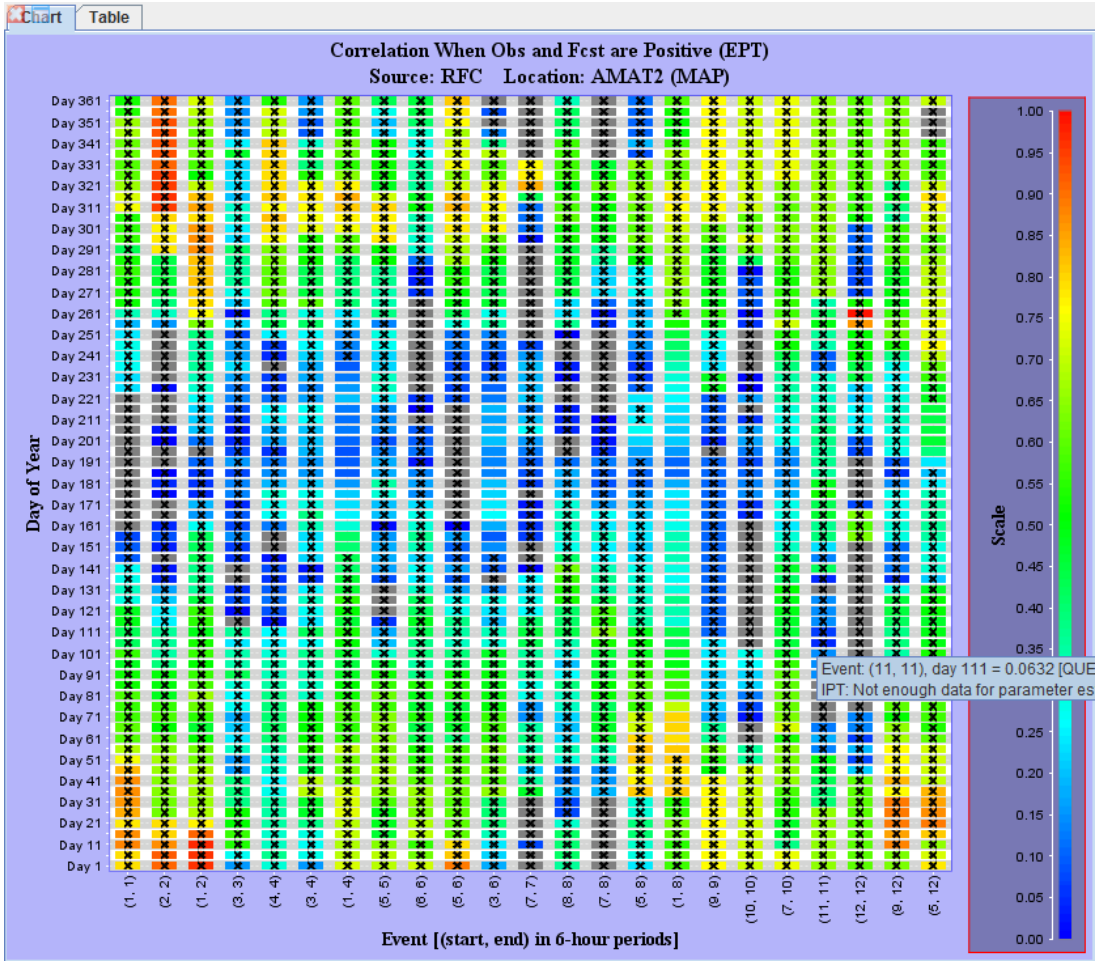


Correlation decreases with lead time
(x-axis: events with dur = 1 source: RFC)



Parameter Diagnostics
Why?

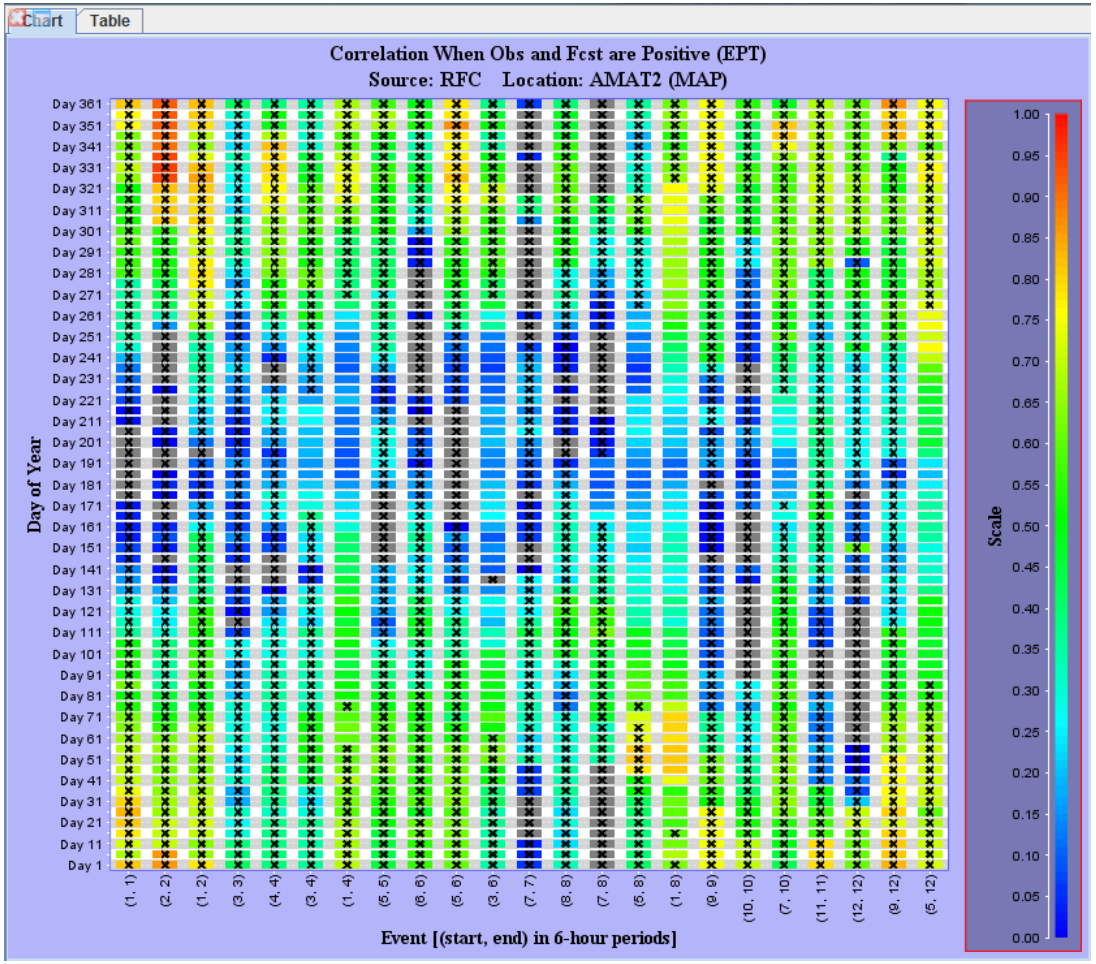
- **Handle sample size issues**
  - Modify estimation option to increase maximum data window width



max = 61 days

Parameter Diagnostics
Why?

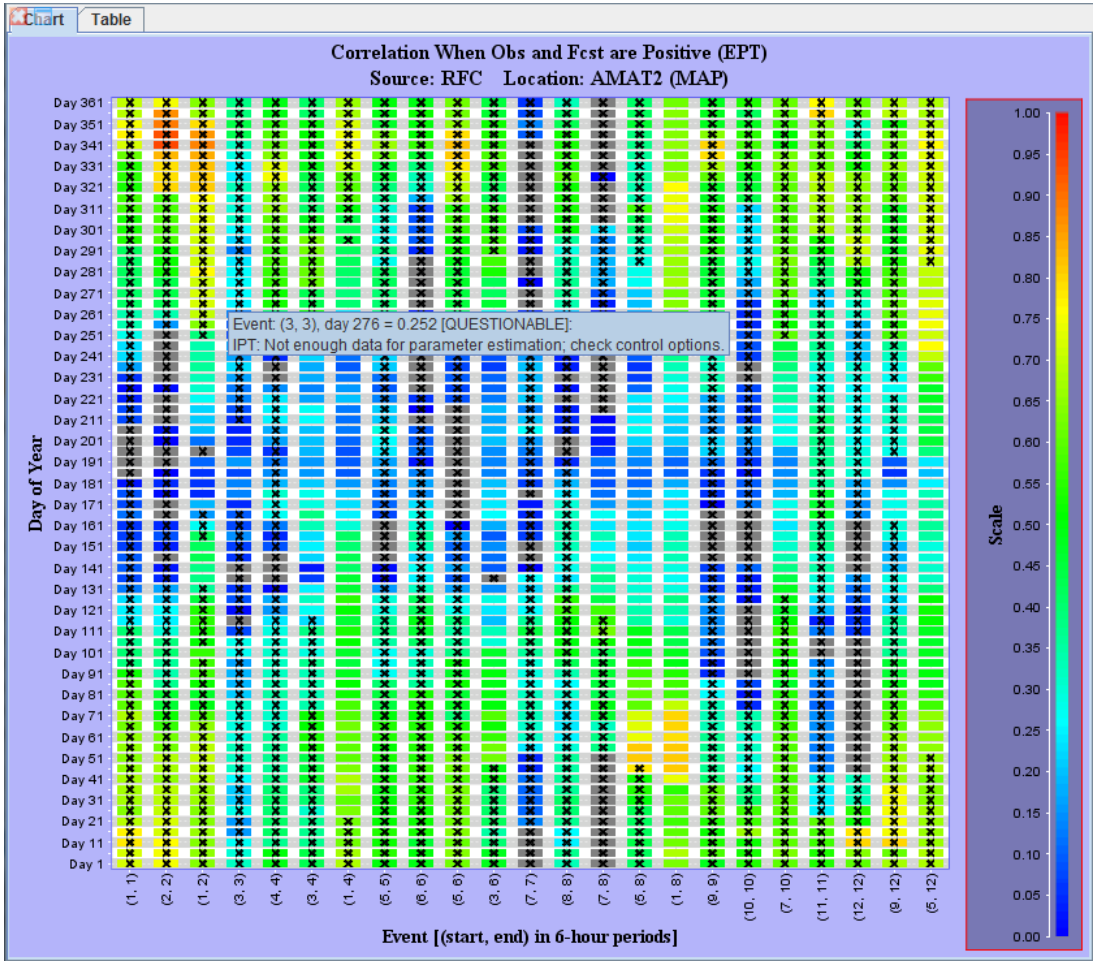
- **Handle sample size issues**
  - Modify estimation option to increase maximum data window width



max = 91 days

Parameter Diagnostics
Why?

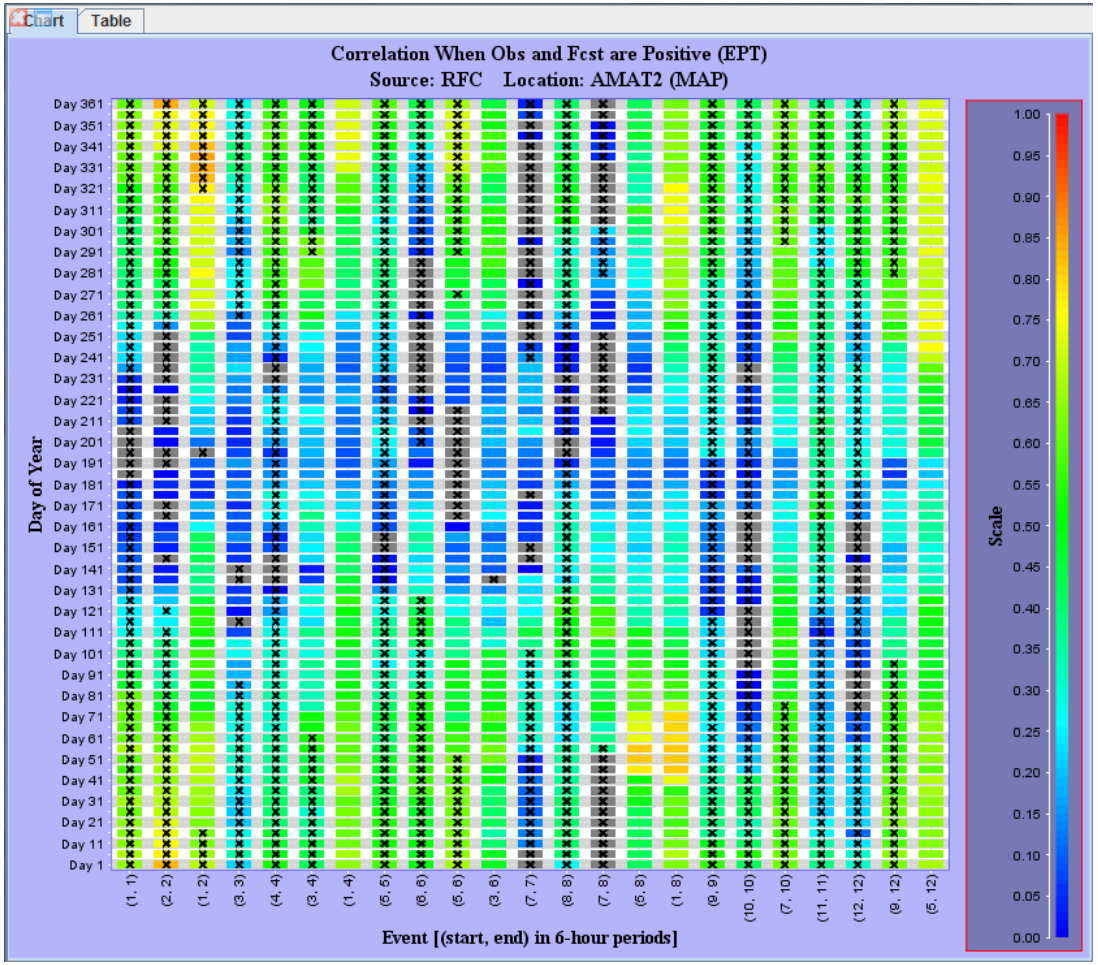
- **Handle sample size issues**
  - Modify estimation option to increase maximum data window width



max = 121 days

Parameter Diagnostics
Why?

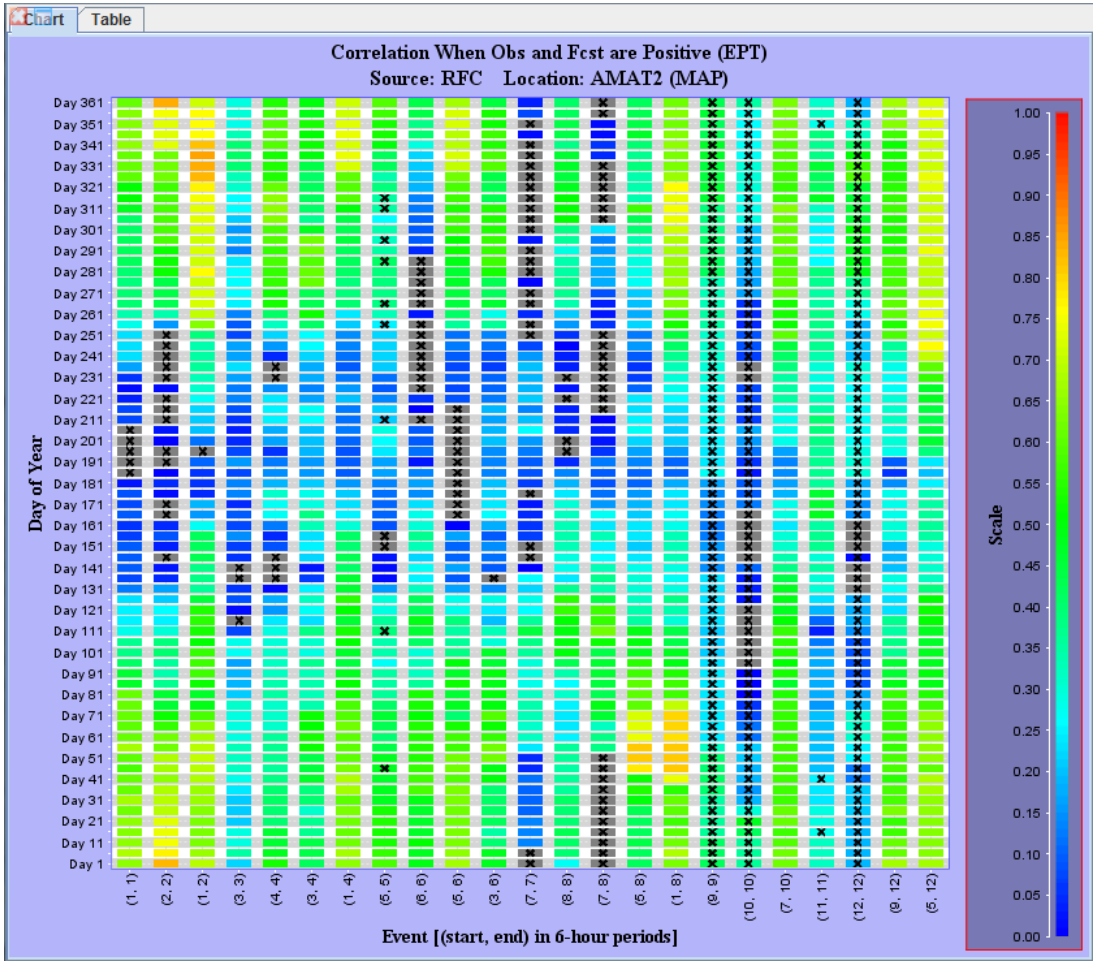
- **Handle sample size issues**
  - Modify estimation option to increase maximum data window width



max = 181 days

Parameter Diagnostics
Why?

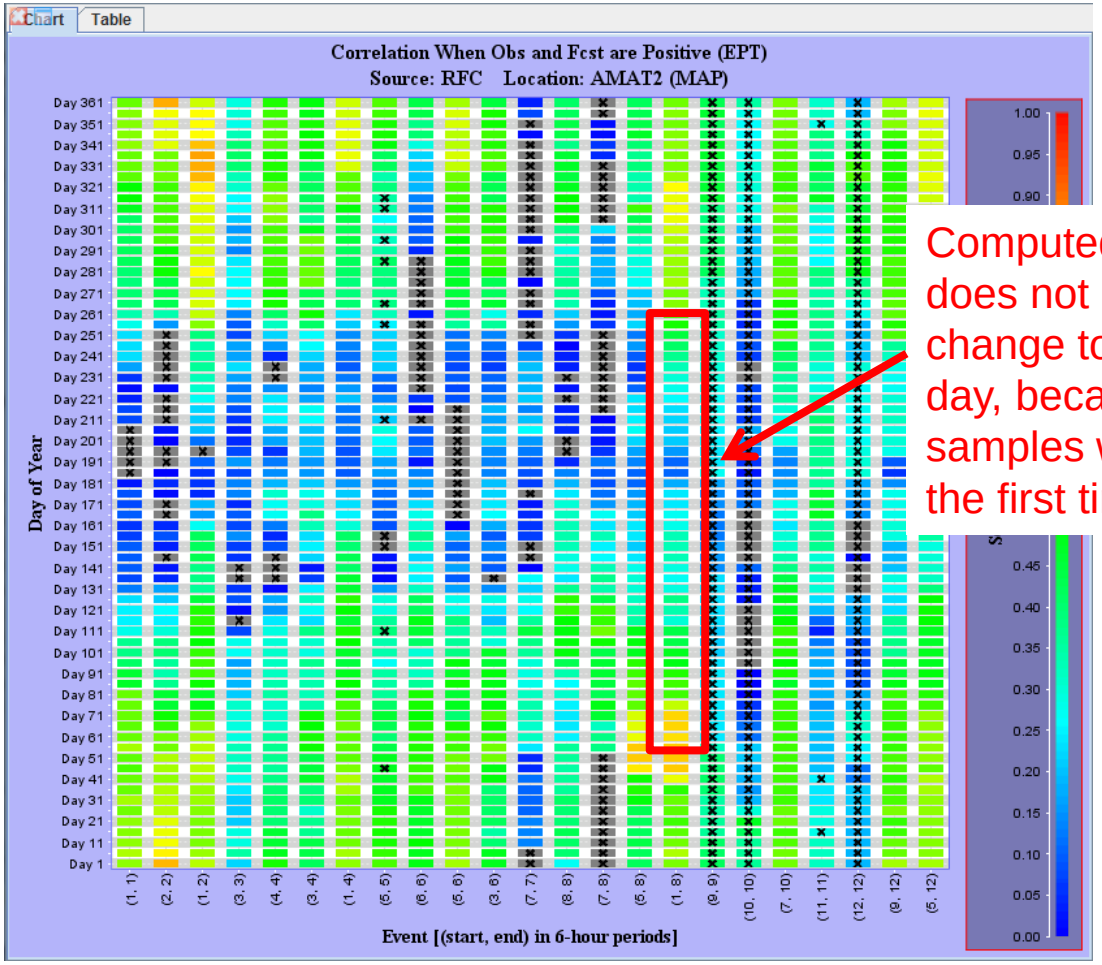
- **Handle sample size issues**
  - Modify estimation option to increase maximum data window width



max = 365 days

Parameter Diagnostics
Why?

- **Handle sample size issues**
  - Modify estimation option to increase maximum data window width



max = 365 days

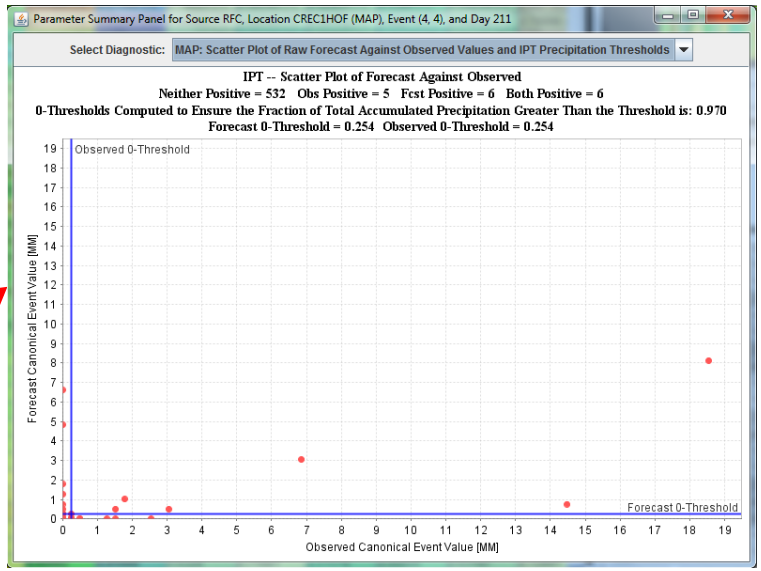
Computed correlation does not change with change to max # of day, because enough samples were found the first time

Parameter Diagnostics
Why?

- **Identify issues with forecast source**
  - Identify when computed correlations may not be reliable due to insufficient sample sizes
    - Look for rapid, inexplicable/unexpected changes in color

(3,3)	(4,4)	(3,4)	(1
0.7939 (?)	0.47093 (?)	0.74238 (?)	0.
0.87086 (?)	0.39187 (?)	0.72321 (?)	0.
0.86684 (?)	0.17086 (?)	0.74623 (?)	0.
0.81111 (?)	0.01307 (?)	0.68669 (?)	0.
0.70289 (?)	-0.19988 (?)	0.63861 (?)	0.
0.56471 (?)	-0.04961 (?)	0.59981 (?)	0.
0.56952 (?)	0.12934 (?)	0.73918 (?)	0.
0.54517 (?)	0.17099 (?)	0.55405 (?)	0.
0.67835 (?)	0.43634 (?)	0.67897 (?)	
0.51792 (?)	0.43634 (?)	0.68263 (?)	0.
0.51792 (?)	0.78513 (?)	0.42368 (?)	0.
0.51792 (?)	0.84021 (?)	0.51566 (?)	0.
0.4837 (?)	0.78478 (?)	0.58436 (?)	0
0.38917 (?)	0		
0.46796 (?)	0		
0.43646 (?)	0.66471 (?)	0.49145 (?)	0.

Event: (4, 4), day 211 = 0.84
IPT: Not enough data for pa

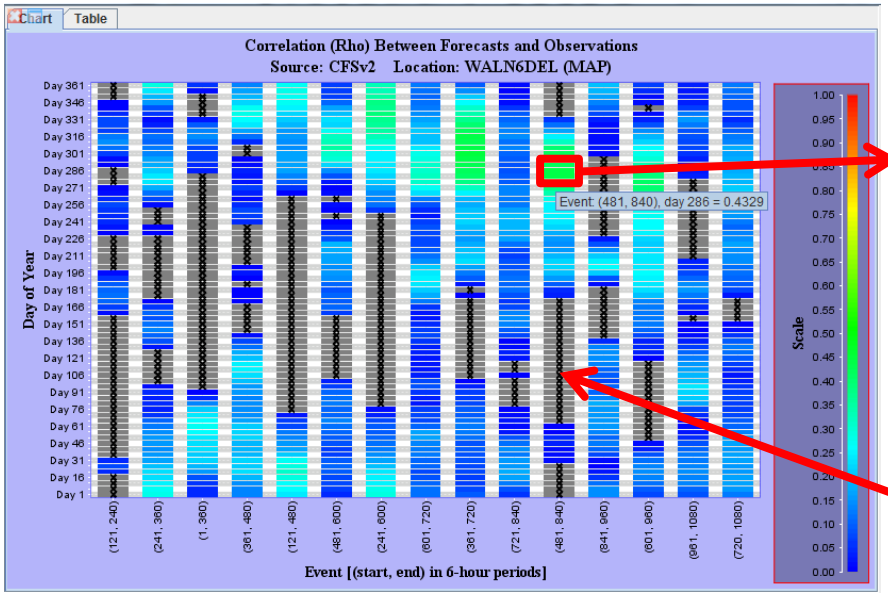


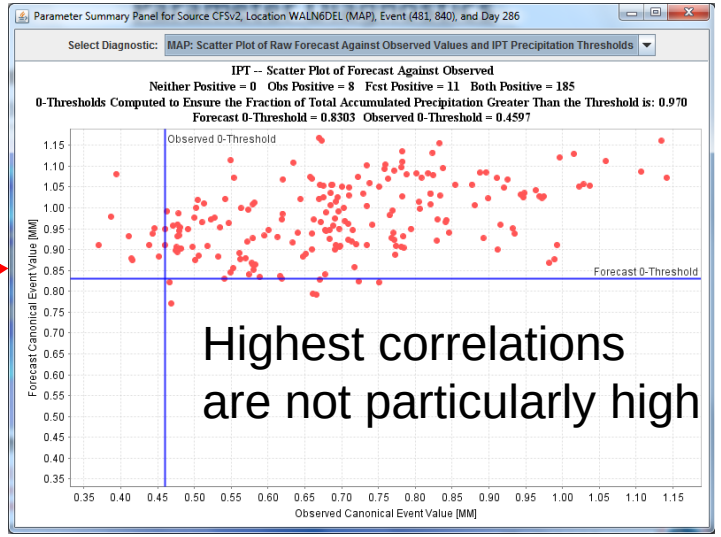
Only 6 pairs used to compute correlation

With so few pairs used to compute the correlation, should the parameters be used?

Parameter Diagnostics
Why?

- **Identify problems with forecast source**
  - Identify when a source may not be skillful and should not be used





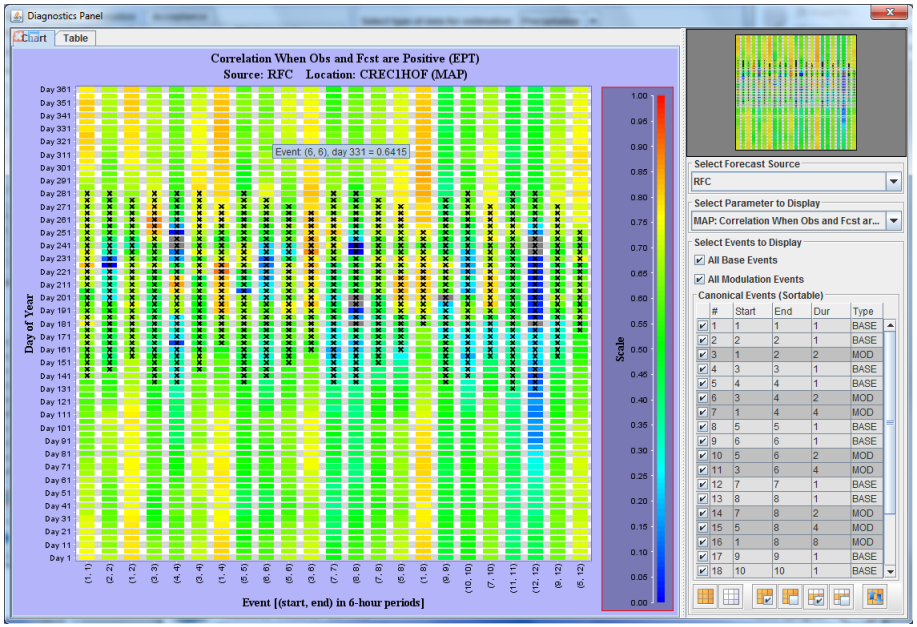
Questionable values are all negative correlations

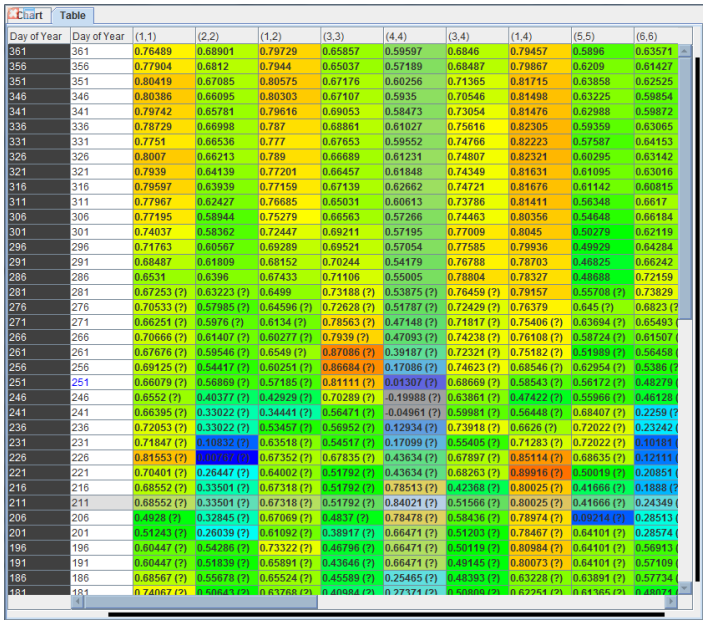
With such low correlations, should the forecast source be used only at certain times of the year? Should it be used at all?

NOTE: The MEFPPE computed correlation coefficient is not necessarily an accurate measure of skill. To get a true sense of the skill of the forecast source, a verification study can be performed or additional more informative diagnostics may be added to MEFPPE in the future.

Parameter Diagnostics
MEFPPE Tools

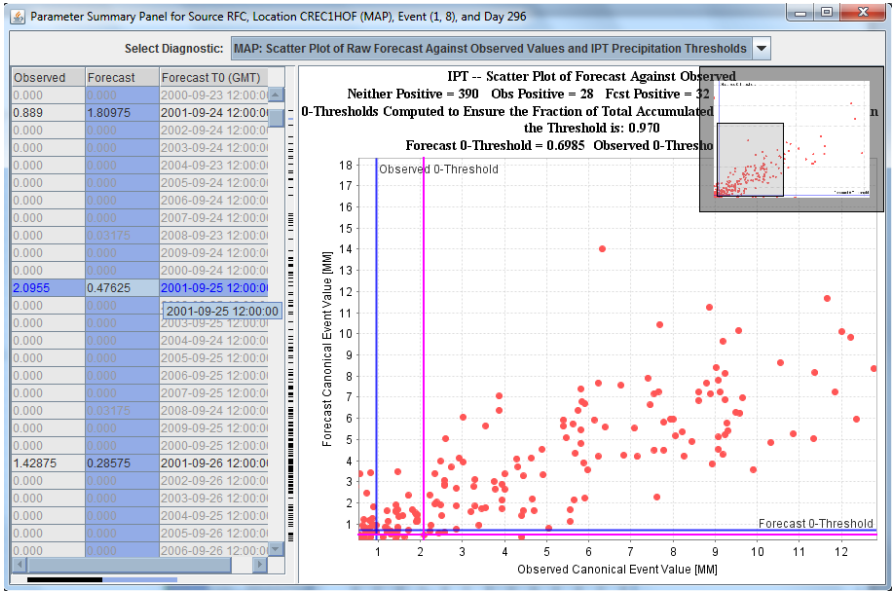
- **Block plot parameter display**
  - Questionable parameters indicated by an ‘X’
  - Chart and table views available
    - User selectable source, parameters, and sortable canonical events
    - Zoom-capable
    - Color coded blocks correspond to table cells





Parameter Diagnostics
MEFPPE Tools

- **Canonical event value (fcst, obs) pair scatter plot**
  - Precipitation defining thresholds displayed
  - (Re)forecast T0 associated with pair is shown, allowing for outliers to be identified in historical data and reforecasts
  - Points/table cells can be selected to pinpoint the value
  - Zoom capable



Summary

- **Time series diagnostic tools are not likely to undergo further enhancements unless requested by RFCs**
  - If requested, the change would likely not be made available until after the rollout to the RFCs
  - Comments/Recommendations?
    - Mention it during this training
    - May need a FogBugz issue
- **Parameter diagnostic tools are still open to changes**
  - No changes planned for the Spring 2014 release
  - Exercises focus on how to use these tools to make decisions about parameter estimation options and operational run-time properties
  - Comments/Recommendations?
    - Mention it during this training
    - May need a FogBugz issue

Questions?

Exercise 2

- **Examine the parameters for CREC1HOF (CNRFC) and AMAT2 (ABRFC)**
  - Answer as many of the questions as you can