METviewer

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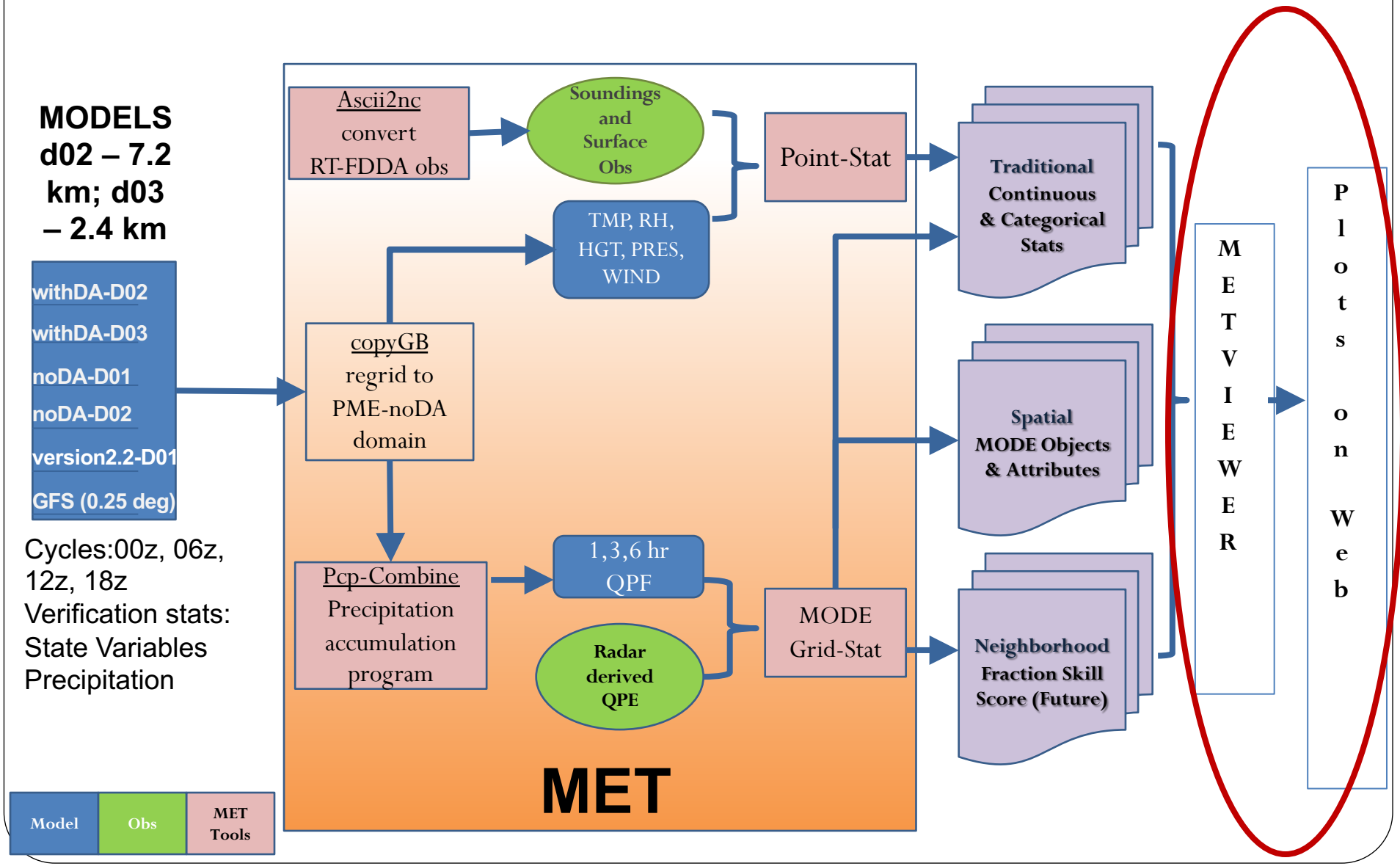
METplus Tutorial

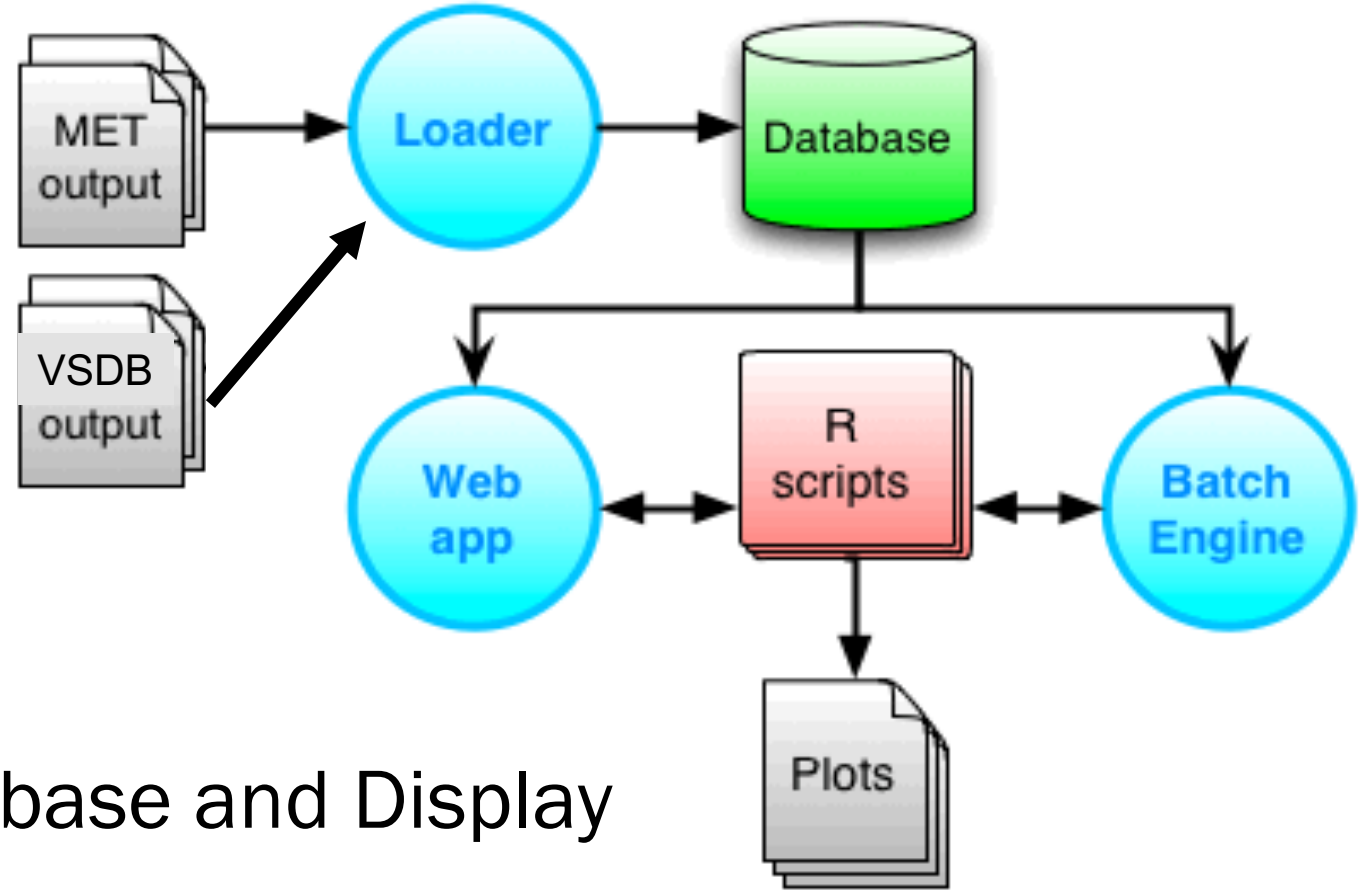
Jul 31 – August 2, 2019

Monterey, CA

Example Design of a Verification System



METviewer Components



Database and Display

METviewer

http://www.dtcenter.org/met/metviewer/metviewer1.jsp

Many plot options

Hit Generate Plot

Pick your variable

Pick your model

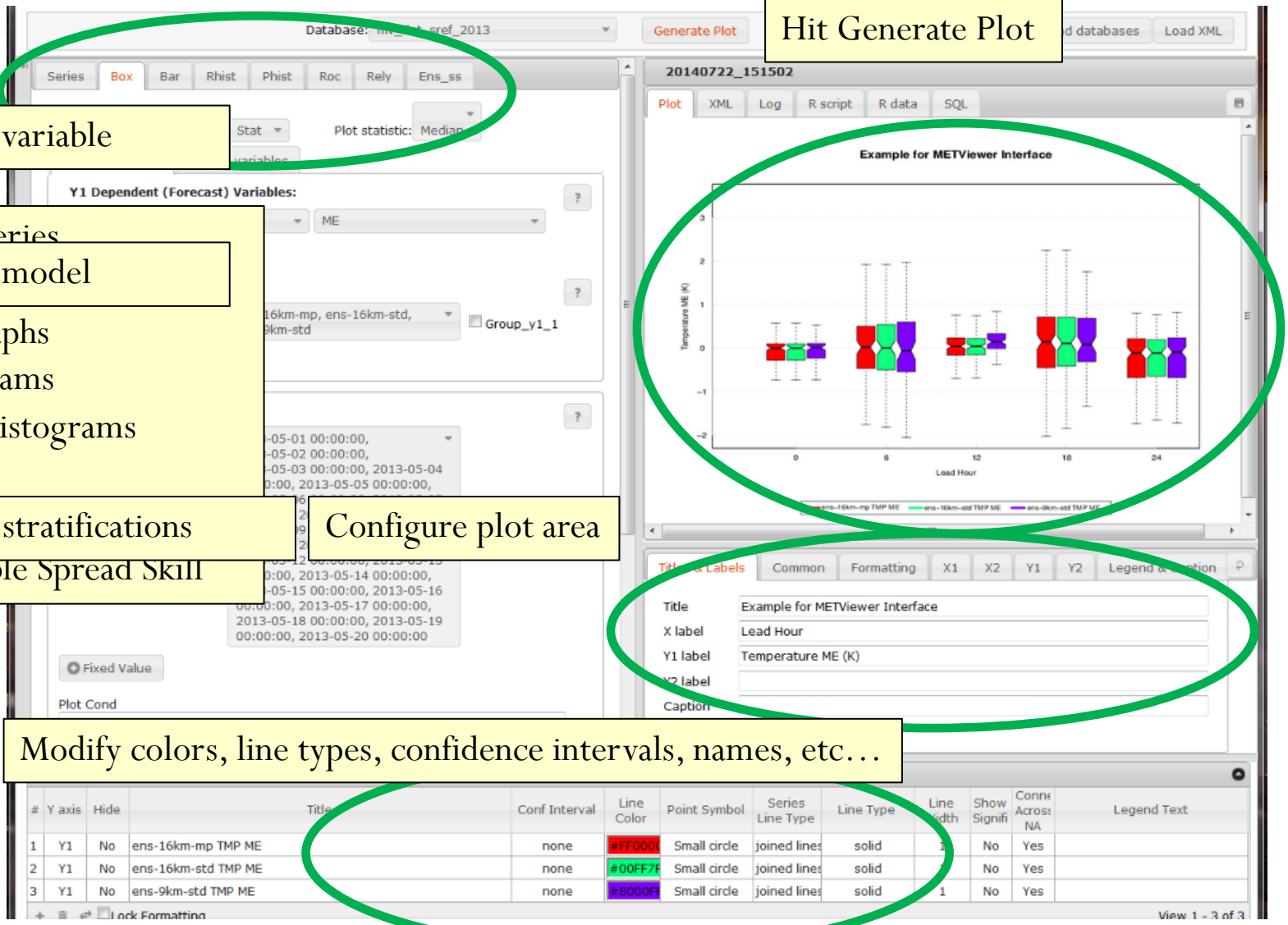
Bar Graphs
Histograms
Rank Histograms
ROC

Pick your stratifications

Ensemble Spread Skill

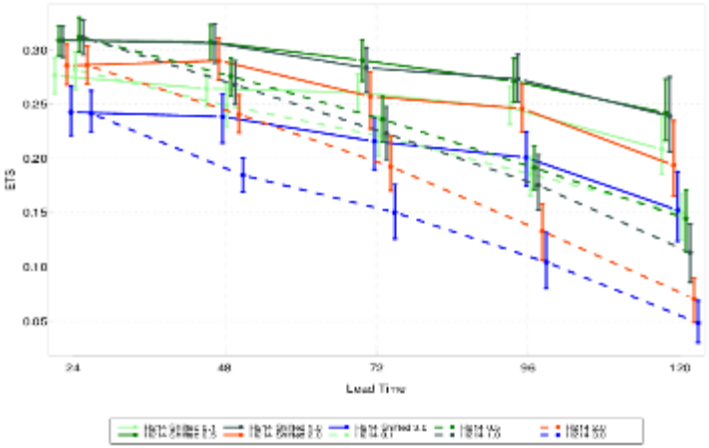
Configure plot area

Modify colors, line types, confidence intervals, names, etc…

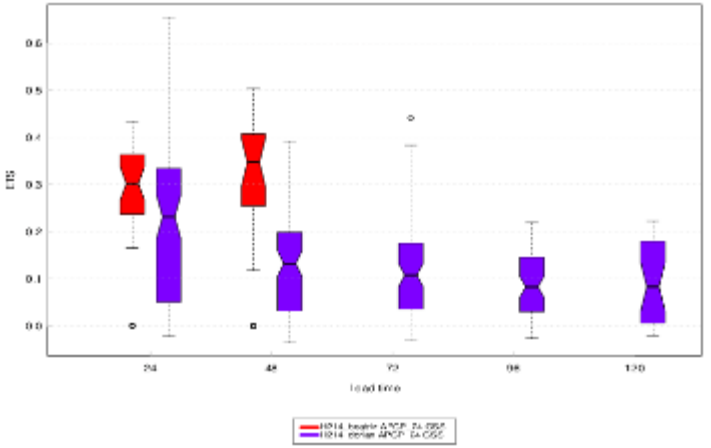


Examples of plots you can make

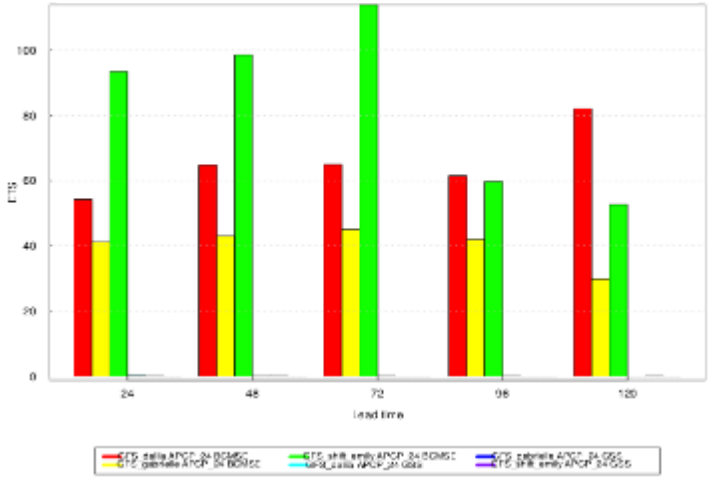
Time Series



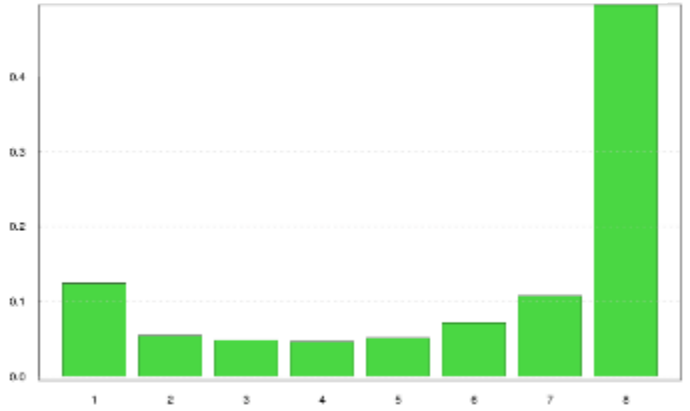
Box Plots



Bar Plots



Histograms



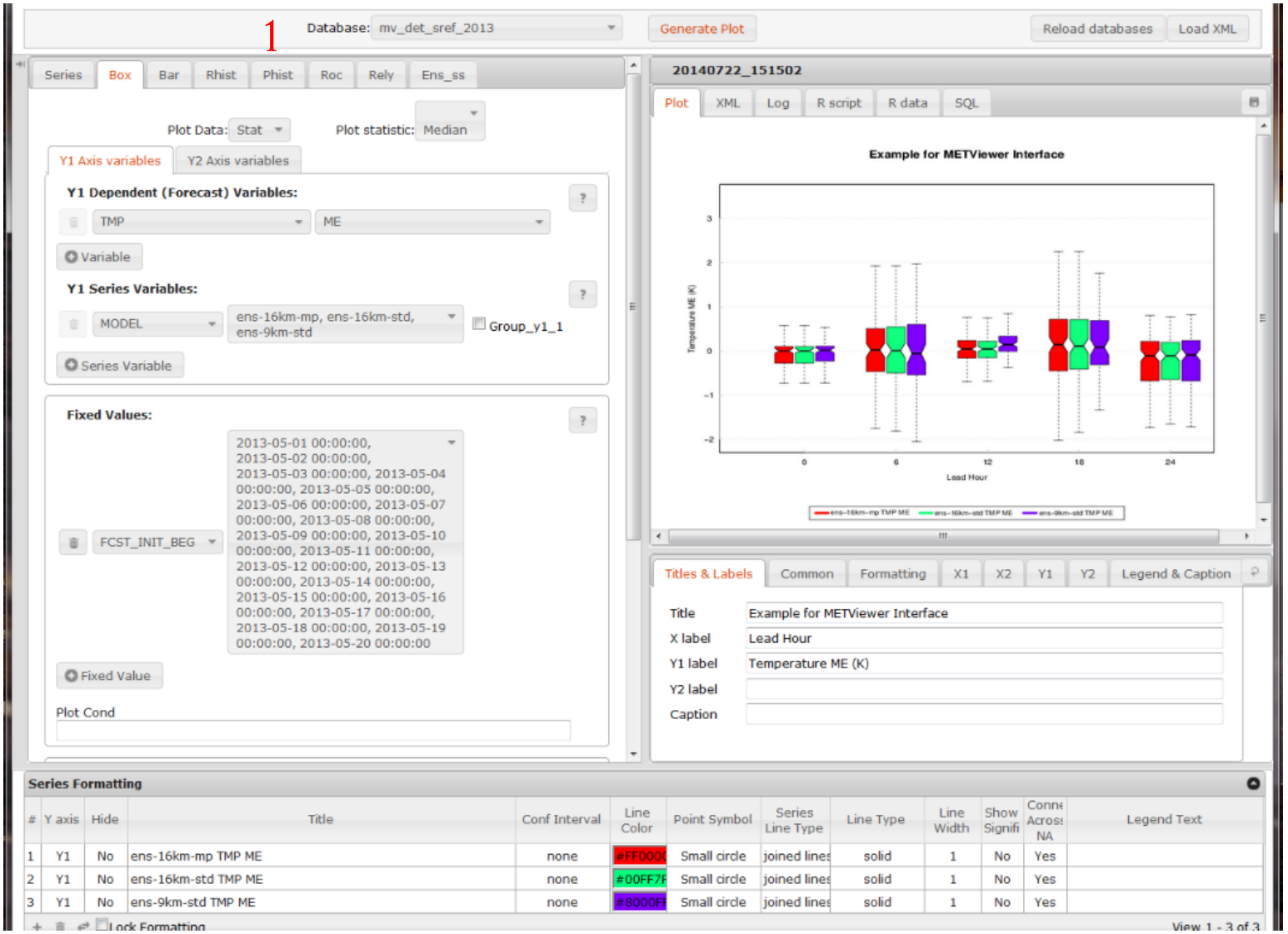
DTC's METviewer Instance

- http://www.dtcenter.org/met/metviewer.jsp

- Always Select :
  1. Database
  2. Plot Type
  3. Variable (Y1 Dependent variable)
  4. What the lines are (Y1 Series variable)
  5. Any stratifications like forecast levels and verification masking regions (FCST_LV, VX_MASK)
  6. X-axis (Independent variable)
  7. Aggregation Statistics: CTC (FHO) or SL1L2
  8. Whether you want to Mean or Median plotted

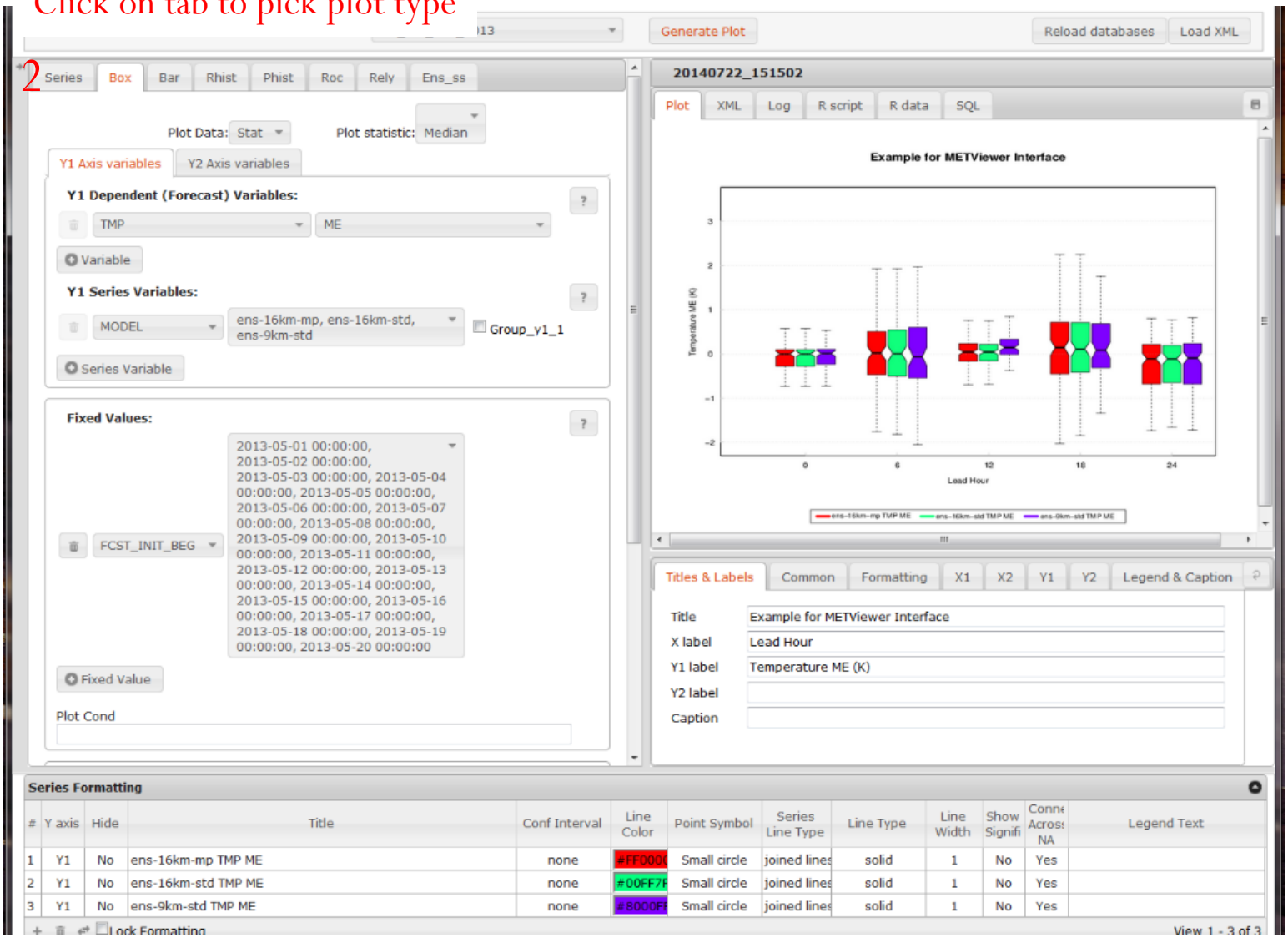
METviewer

Click on down arrow to pick database

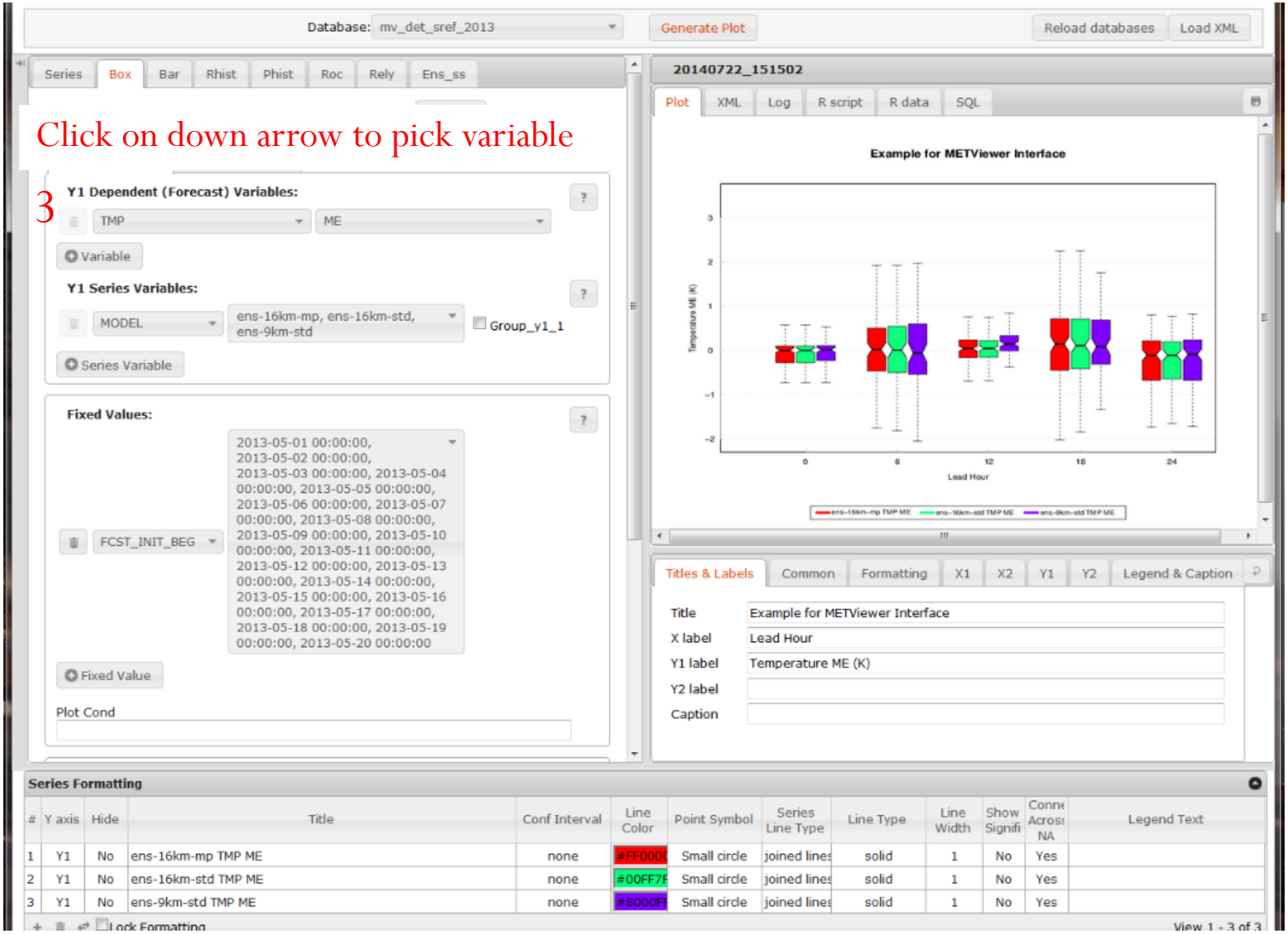


METviewer

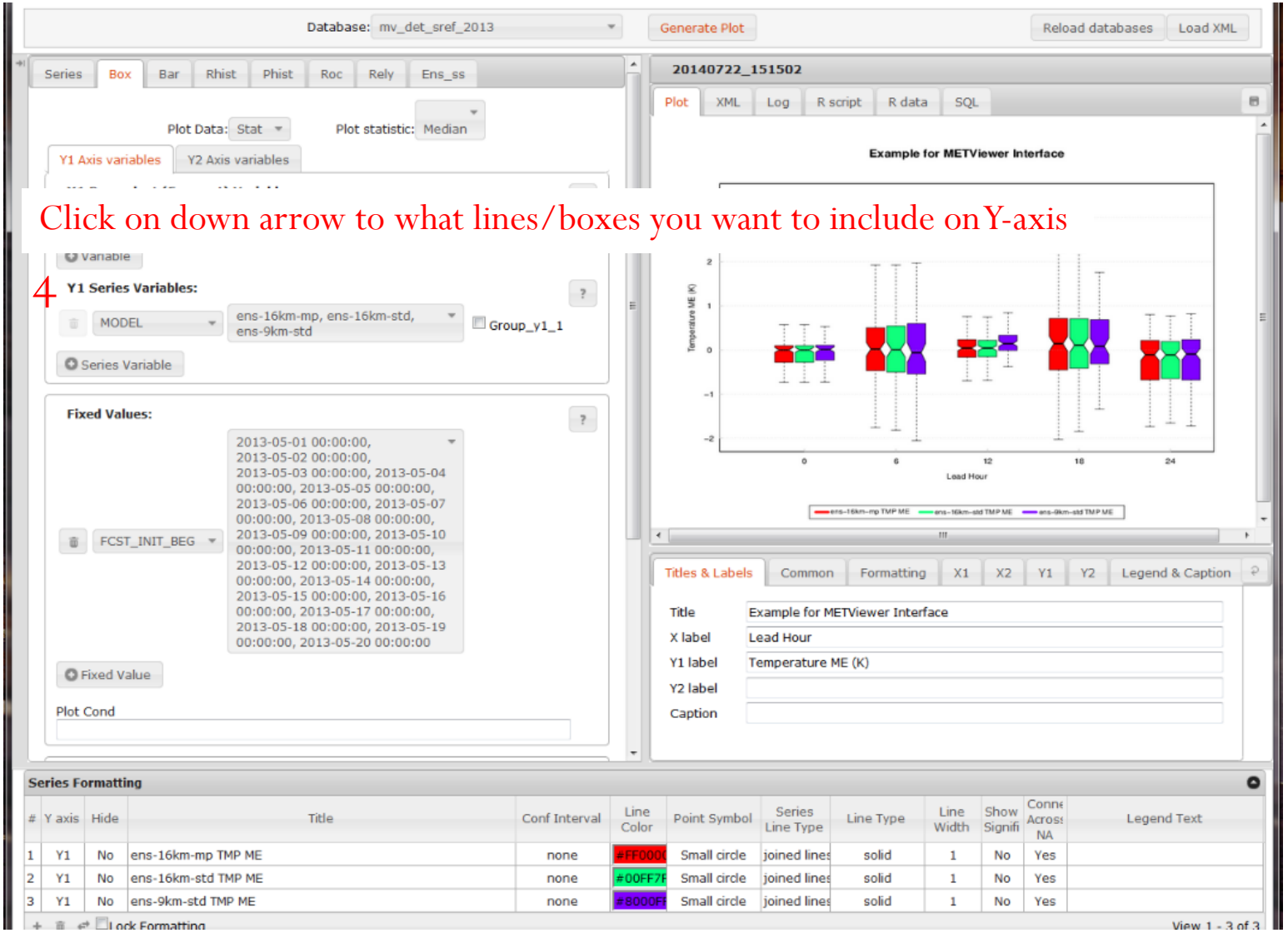
Click on tab to pick plot type



METviewer


Database: mv_det_sref_2013
Generate Plot
Reload databases
Load XML
Series
Box
Bar
Rhist
Phist
Roc
Rely
Ens_ss
Click on down arrow to pick variable
3
Y1 Dependent (Forecast) Variables:
TMP
ME
Variable
Y1 Series Variables:
MODEL
ens-16km-mp, ens-16km-std, ens-9km-std
Group_y1_1
Series Variable
Fixed Values:
FCST_INIT_BEG
Fixed Value
Plot Cond
20140722_151502
Plot
XML
Log
R script
R data
SQL
Example for METViewer Interface
Temperature ME (K)
Lead Hour
Titles & Labels
Common
Formatting
X1
X2
Y1
Y2
Legend & Caption
Title
Example for METViewer Interface
X label
Lead Hour
Y1 label
Temperature ME (K)
Y2 label
Caption
Series Formatting
| Y axis | Hide | Title | Conf Interval | Line Color | Point Symbol | Series Line Type | Line Type | Line Width | Show Signifi | Conne Across NA | Legend Text
1 | Y1 | No | ens-16km-mp TMP ME | none | Small circle | joined lines | solid | 1 | No | Yes
2 | Y1 | No | ens-16km-std TMP ME | none | Small circle | joined lines | solid | 1 | No | Yes
3 | Y1 | No | ens-9km-std TMP ME | none | Small circle | joined lines | solid | 1 | No | Yes
Lock Formatting
View 1 - 3 of 3

METviewer


Database: mv_det_sref_2013
Generate Plot
Reload databases
Load XML
Series
Box
Bar
Rhist
Phist
Roc
Rely
Ens_ss
Plot Data: Stat
Plot statistic: Median
Y1 Axis variables
Y2 Axis variables
Click on down arrow to what lines/boxes you want to include on Y-axis
4
Y1 Series Variables:
MODEL
ens-16km-mp, ens-16km-std, ens-9km-std
Group_y1_1
Series Variable
Fixed Values:
2013-05-01 00:00:00, 2013-05-02 00:00:00, 2013-05-03 00:00:00, 2013-05-04 00:00:00, 2013-05-05 00:00:00, 2013-05-06 00:00:00, 2013-05-07 00:00:00, 2013-05-08 00:00:00, 2013-05-09 00:00:00, 2013-05-10 00:00:00, 2013-05-11 00:00:00, 2013-05-12 00:00:00, 2013-05-13 00:00:00, 2013-05-14 00:00:00, 2013-05-15 00:00:00, 2013-05-16 00:00:00, 2013-05-17 00:00:00, 2013-05-18 00:00:00, 2013-05-19 00:00:00, 2013-05-20 00:00:00
FCST_INIT_BEG
Fixed Value
Plot Cond
20140722_151502
Plot
XML
Log
R script
R data
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Y1
Y2
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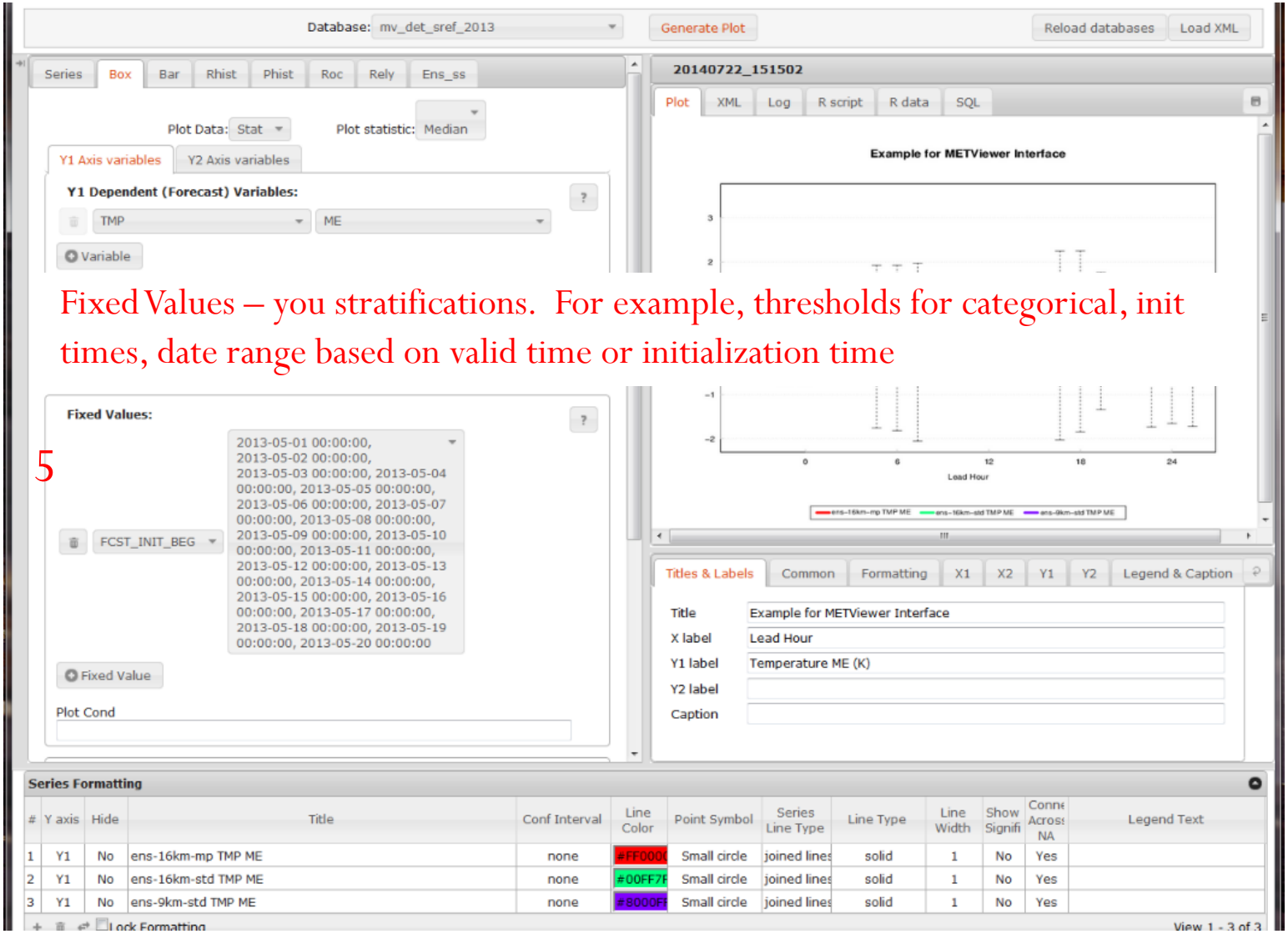
X label
Lead Hour
Y1 label
Temperature ME (K)
Y2 label
Caption
Series Formatting
| Y axis | Hide | Title | Conf Interval | Line Color | Point Symbol | Series Line Type | Line Type | Line Width | Show Signifi | Conne Across NA | Legend Text
1 | Y1 | No | ens-16km-mp TMP ME | none | #FF0000 | Small circle | joined lines | solid | 1 | No | Yes
2 | Y1 | No | ens-16km-std TMP ME | none | #00FF7F | Small circle | joined lines | solid | 1 | No | Yes
3 | Y1 | No | ens-9km-std TMP ME | none | #8000FF | Small circle | joined lines | solid | 1 | No | Yes
Lock Formatting
View 1 - 3 of 3

METviewer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Bar
Rhist
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Ens_ss
Plot Data: Stat
Plot statistic: Median
Y1 Axis variables
Y2 Axis variables
Y1 Dependent (Forecast) Variables:
TMP
ME
Variable
20140722_151502
Plot
XML
Log
R script
R data
SQL
Example for METViewer Interface
Fixed Values –
you stratifications.
For example, thresholds for categorical, init times, date range based on valid time or initialization time
Fixed Values:
5
2013-05-01 00:00:00, 2013-05-02 00:00:00, 2013-05-03 00:00:00, 2013-05-04 00:00:00, 2013-05-05 00:00:00, 2013-05-06 00:00:00, 2013-05-07 00:00:00, 2013-05-08 00:00:00, 2013-05-09 00:00:00, 2013-05-10 00:00:00, 2013-05-11 00:00:00, 2013-05-12 00:00:00, 2013-05-13 00:00:00, 2013-05-14 00:00:00, 2013-05-15 00:00:00, 2013-05-16 00:00:00, 2013-05-17 00:00:00, 2013-05-18 00:00:00, 2013-05-19 00:00:00, 2013-05-20 00:00:00
FCST_INIT_BEG
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| Y axis | Hide | Title | Conf Interval | Line Color | Point Symbol | Series Line Type | Line Type | Line Width | Show Signifi | Conne Across NA | Legend Text
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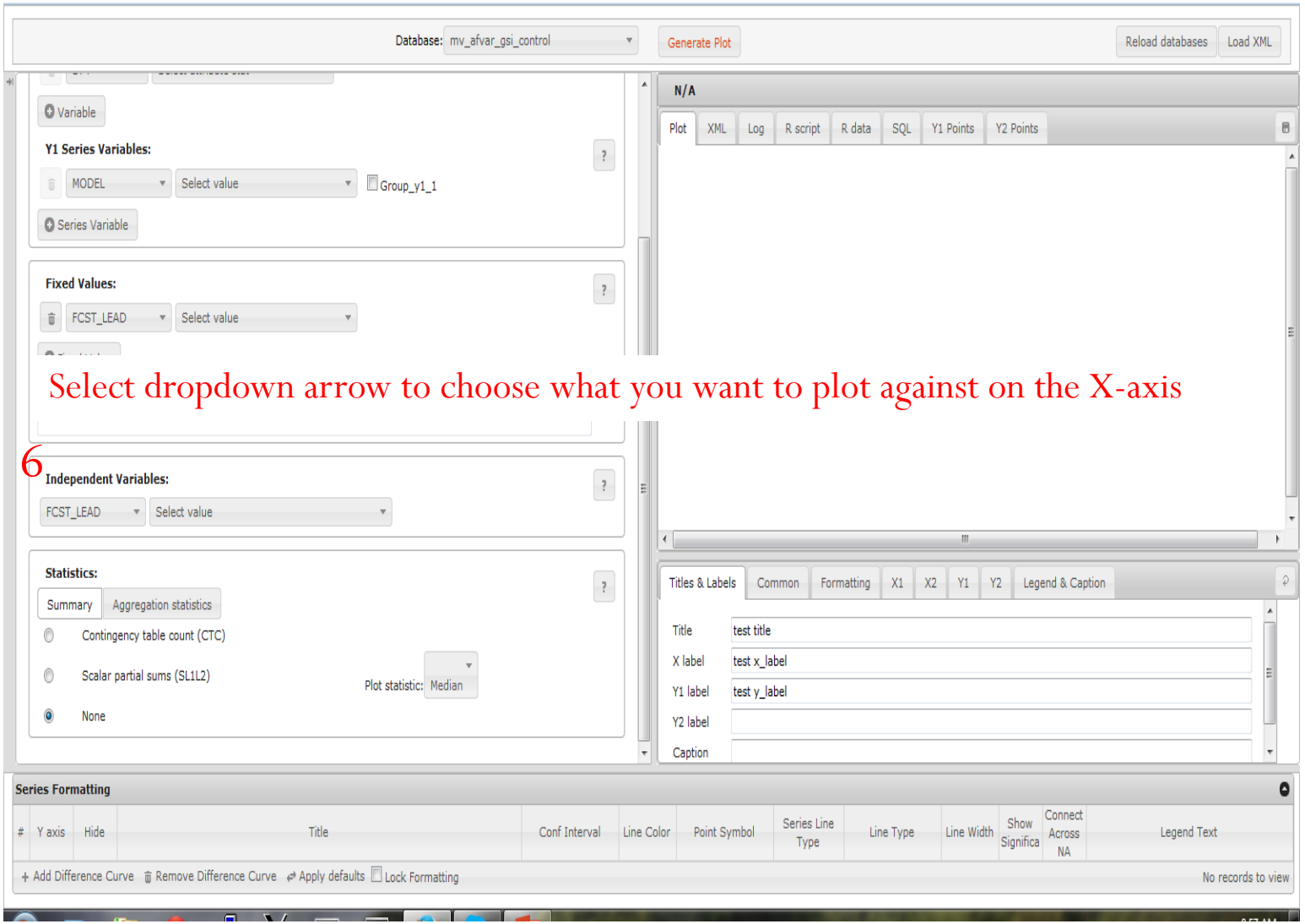
3 | Y1 | No | ens-9km-std TMP ME | none | #8000FF | Small circle | joined lines | solid | 1 | No | Yes
Lock Formatting
View 1 - 3 of 3

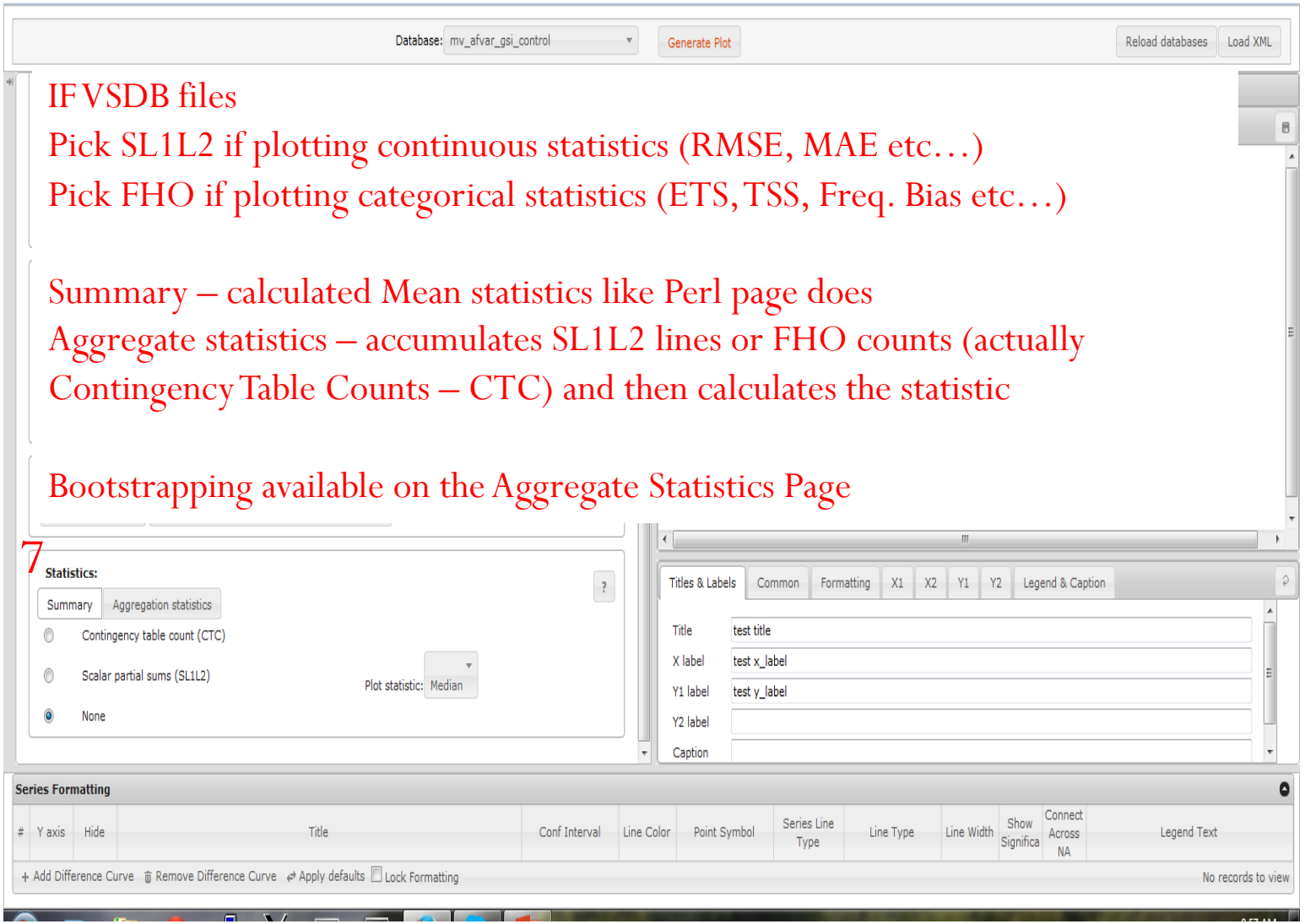
METviewer

Scrolled down to see remainder of page



METviewer

Scrolled down to see remainder of page



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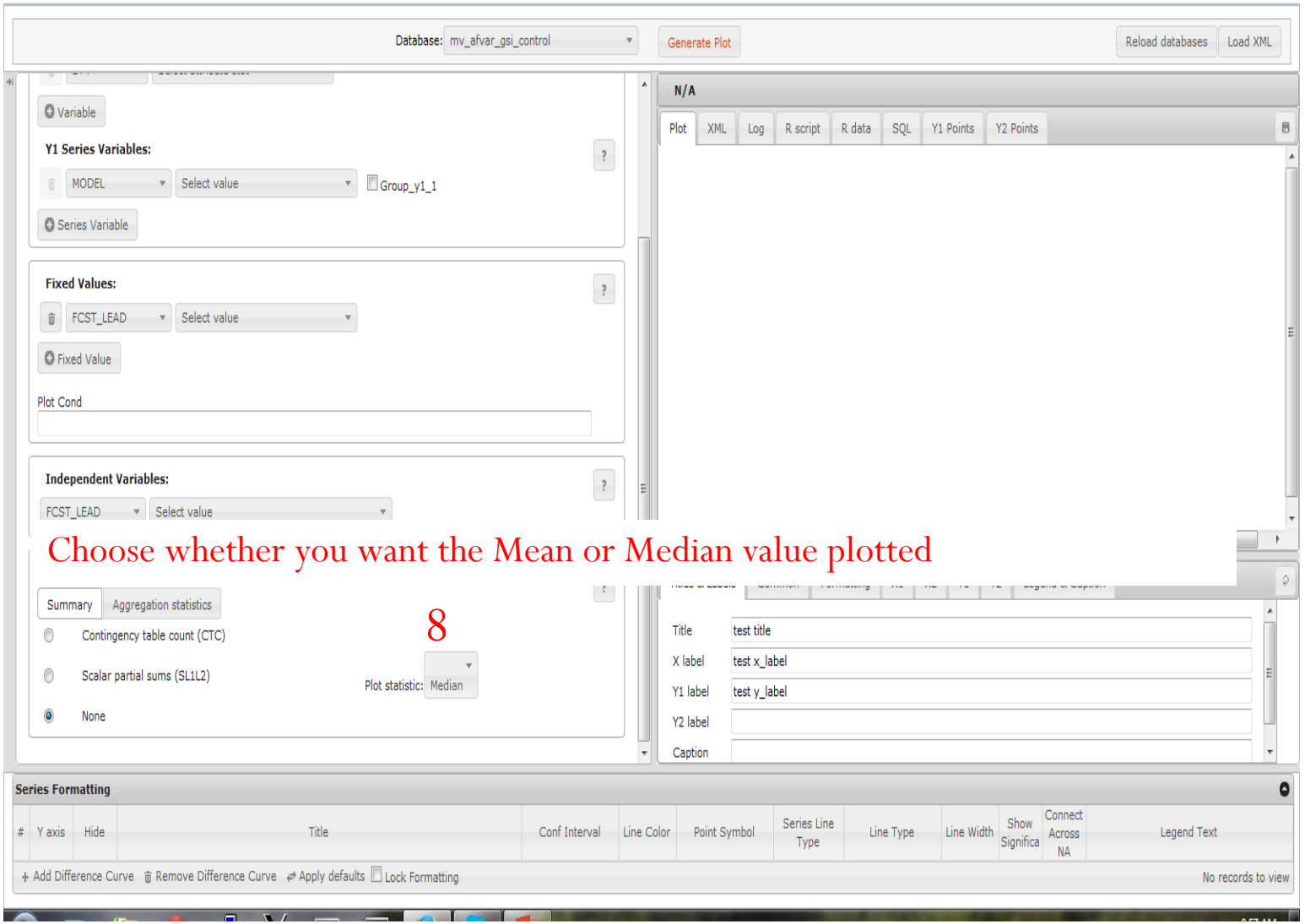
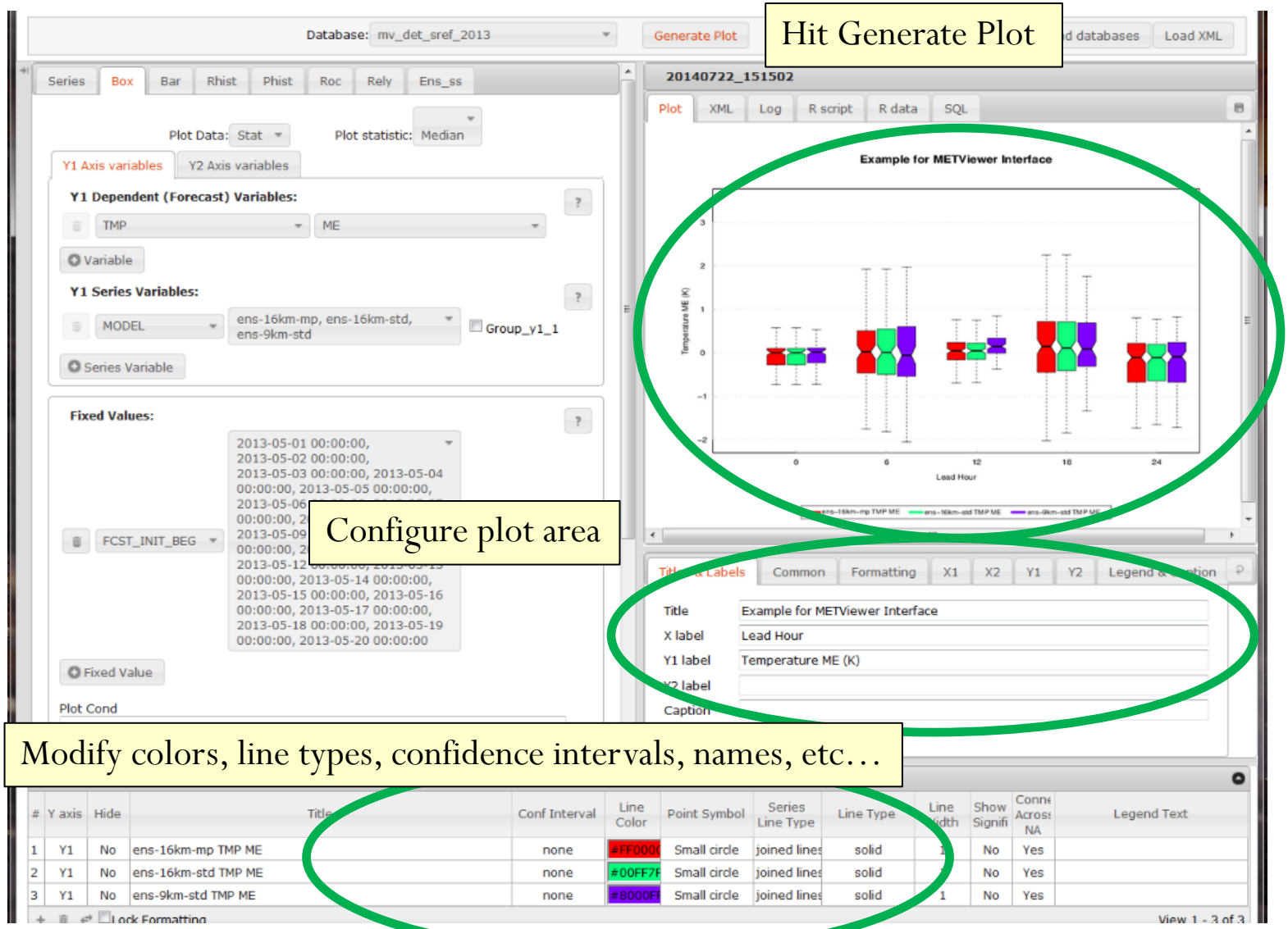


METviewer


Hit Generate Plot
Configure plot area
Modify colors, line types, confidence intervals, names, etc…
Database: mv_det_sref_2013
Generate Plot
Load XML
Series
Box
Bar
Rhist
Phist
Roc
Rely
Ens_ss
Plot Data: Stat
Plot statistic: Median
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X1
X2
Y1
Y2
Title
X label
Y1 label
Y2 label
Caption
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Lead Hour
Temperature ME (K)
| Y axis | Hide | Title | Conf Interval | Line Color | Point Symbol | Series Line Type | Line Type | Line Width | Show Signifi | Conne Across NA | Legend Text
1 | Y1 | No | ens-16km-mp TMP ME | none | #FF0000 | Small circle | joined lines | solid | | No | Yes
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3 | Y1 | No | ens-9km-std TMP ME | none | #8000FF | Small circle | joined lines | solid | 1 | No | Yes
Lock Formatting
View 1 - 3 of 3

METviewer

History of Plots
Database: mv_det_sref_2013
Generate Plot
Reload databases
Load XML
Series
Box
Bar
Rhist
Phist
Roc
Rely
Ens_ss
Plot Data: Stat
Plot statistic: Median
Y1 Axis variables
Y2 Axis variables
Y1 Dependent (Forecast) Variables:
TMP
ME
Variable
Y1 Series Variables:
MODEL
ens-16km-mp, ens-16km-std, ens-9km-std
Group_y1_1
Series Variable
Fixed Values:
FCST_INIT_BEG
2013-05-01 00:00:00, 2013-05-02 00:00:00, 2013-05-03 00:00:00, 2013-05-04 00:00:00, 2013-05-05 00:00:00, 2013-05-06 00:00:00, 2013-05-07 00:00:00, 2013-05-08 00:00:00, 2013-05-09 00:00:00, 2013-05-10 00:00:00, 2013-05-11 00:00:00, 2013-05-12 00:00:00, 2013-05-13 00:00:00, 2013-05-14 00:00:00, 2013-05-15 00:00:00, 2013-05-16 00:00:00, 2013-05-17 00:00:00, 2013-05-18 00:00:00, 2013-05-19 00:00:00, 2013-05-20 00:00:00
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Plot Cond
20140722_151502
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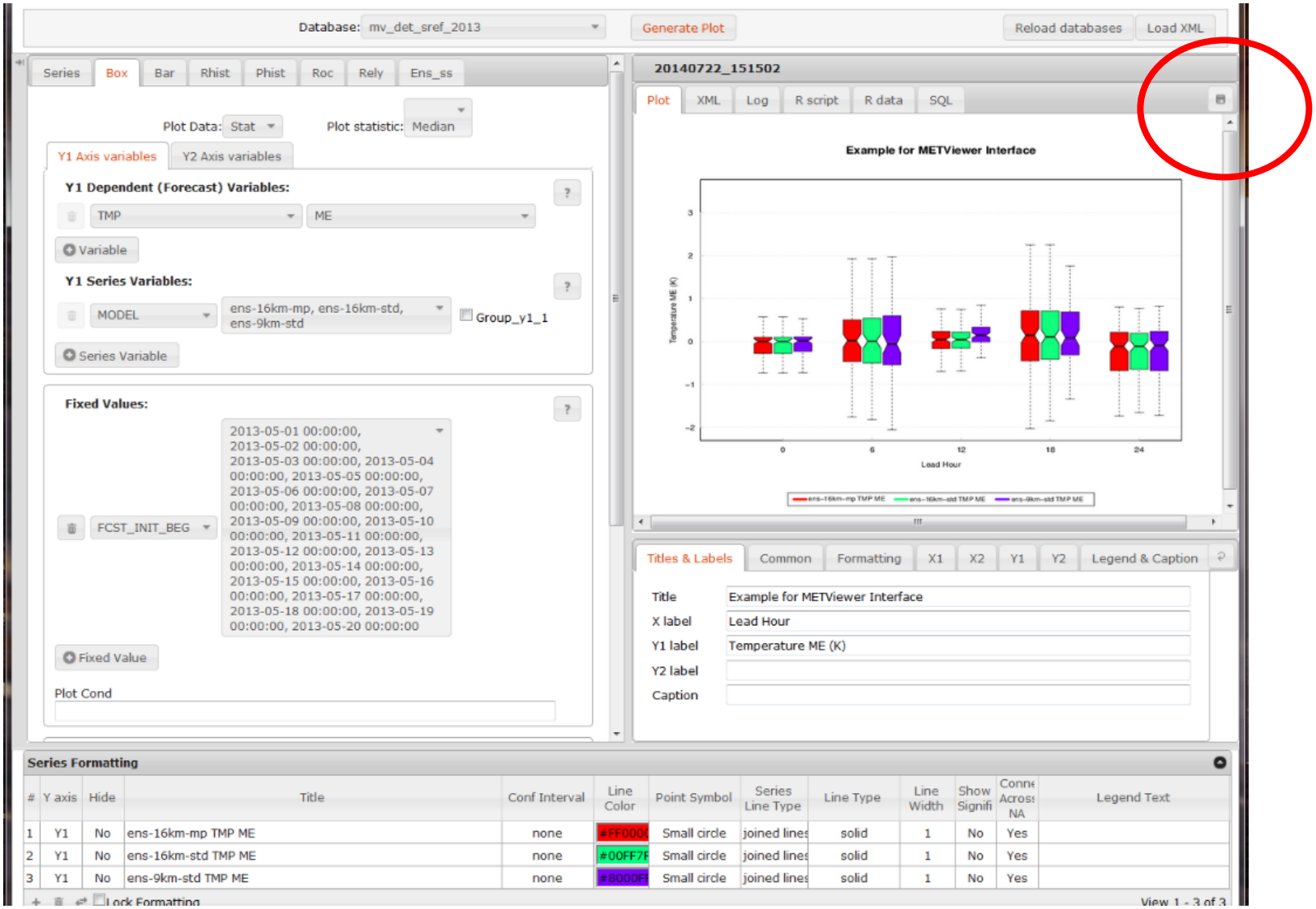
3 | Y1 | No | ens-9km-std TMP ME | none | #8000FF | Small circle | joined lines | solid | 1 | No | Yes
Lock Formatting
View 1 - 3 of 3

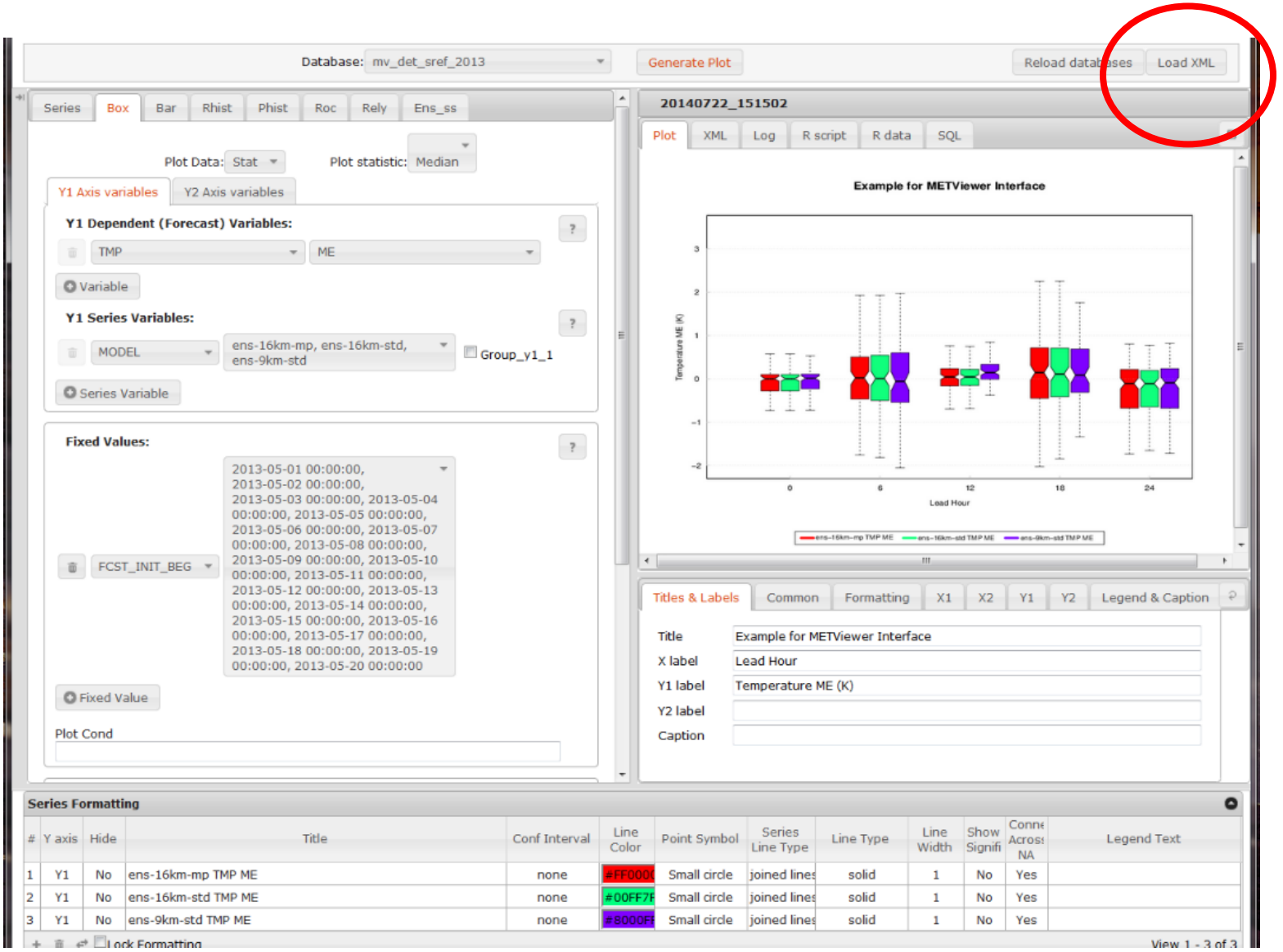
METviewer

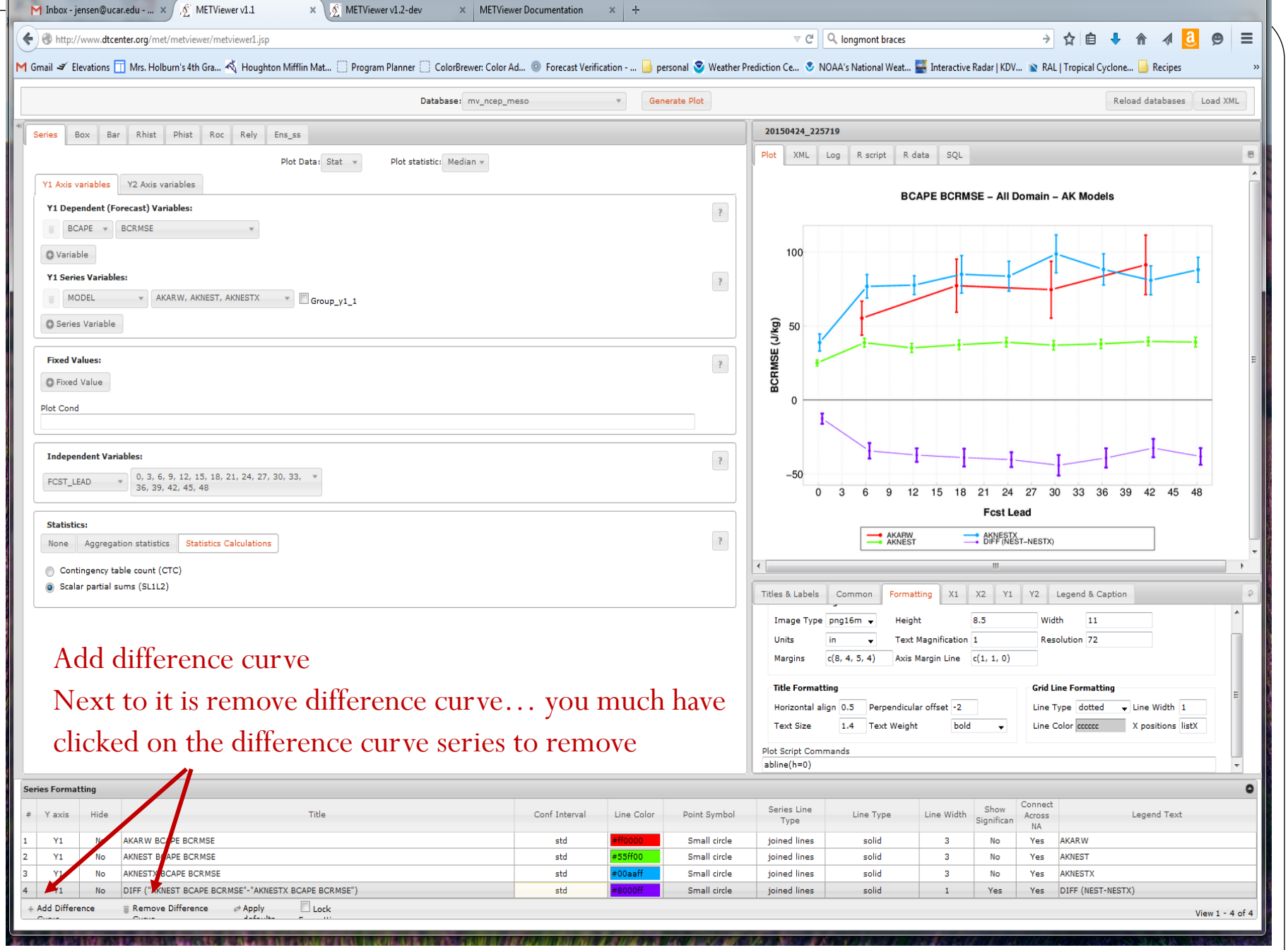
Save Plots, Save XML, Save Data based on which tab is selected



METviewer

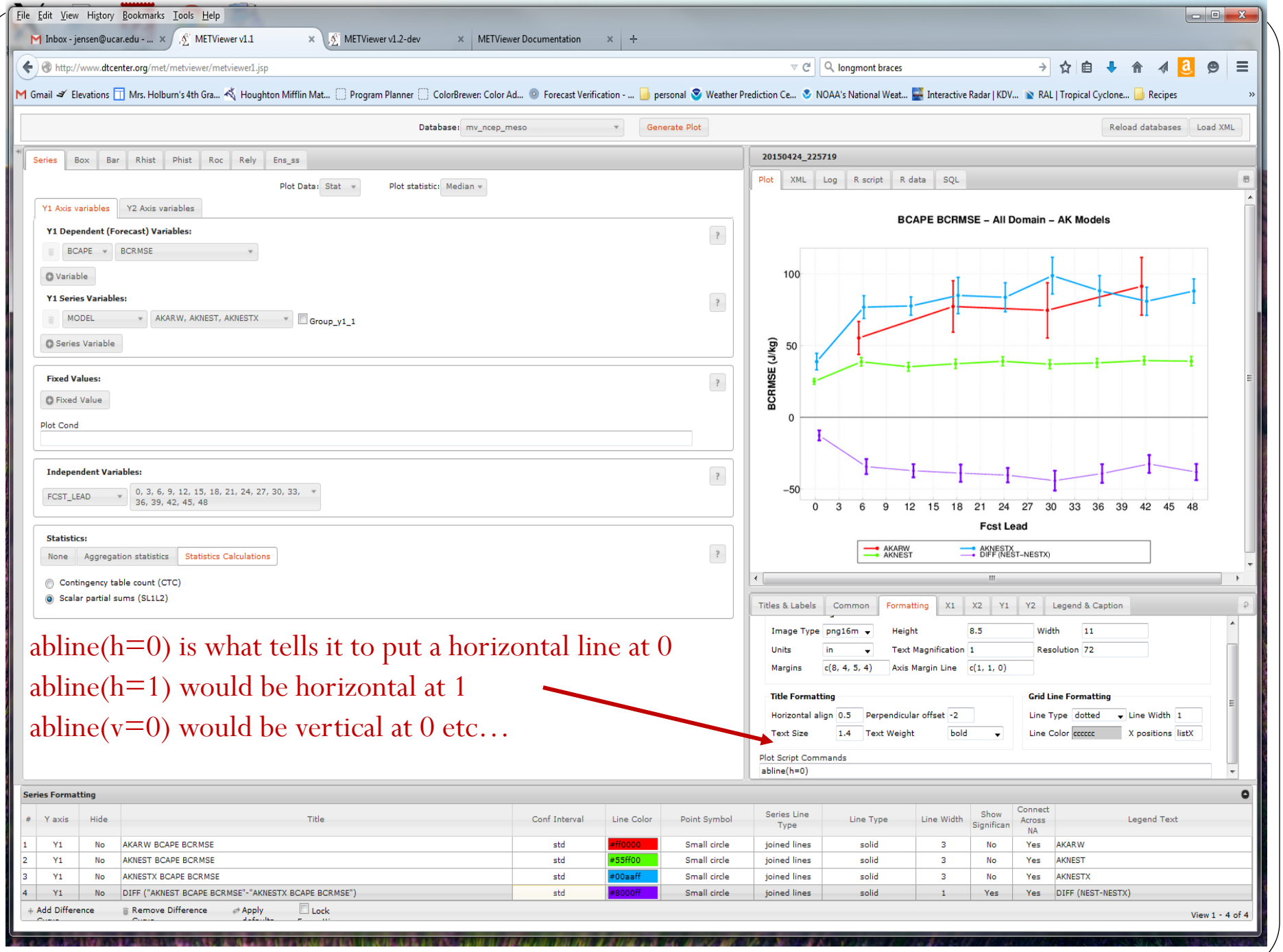
Upload XML scripts from your system

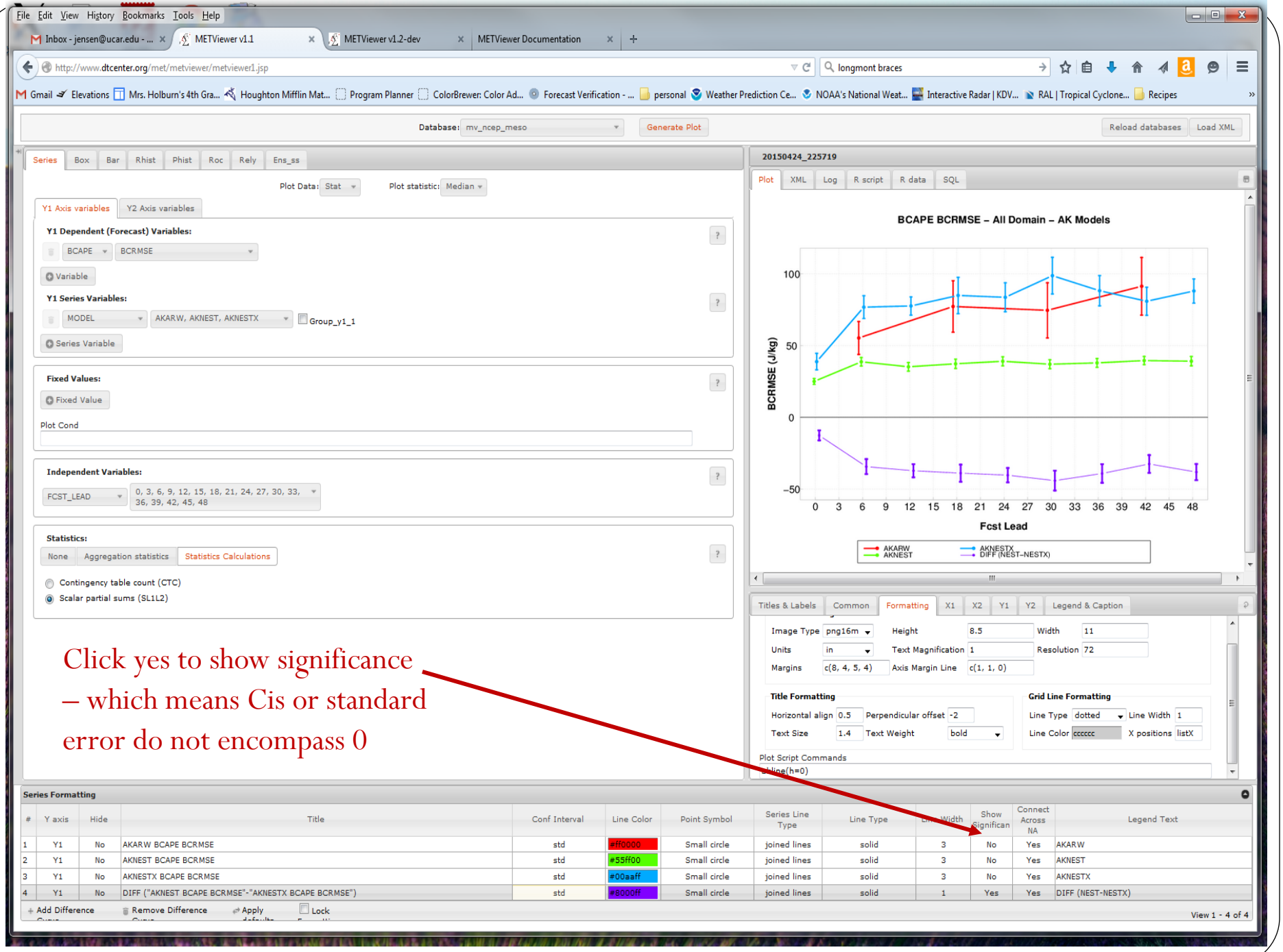




Add difference curve

Next to it is remove difference curve… you much have clicked on the difference curve series to remove


File Edit View History Bookmarks Tools Help
Inbox - jensen@ucar.edu - ...
METViewer v1.1
METViewer v1.2-dev
METViewer Documentation
http://www.dtcenter.org/met/metviewer/metviewer1.jsp
longmont braces
Gmail Elevations Mrs. Holburn's 4th Gra... Houghton Mifflin Mat... Program Planner ColorBrewer: Color Ad... Forecast Verification - ... personal Weather Prediction Ce... NOAA's National Weat... Interactive Radar | KDV... RAL | Tropical Cyclone... Recipes
Database: mv_ncep_meso
Generate Plot
Reload databases
Load XML
Series Box Bar Rhist Phist Roc Rely Ens_ss
Plot Data: Stat
Plot statistic: Median
Y1 Axis variables
Y2 Axis variables
Y1 Dependent (Forecast) Variables:
BCAPE
BCRMSE
Variable
Y1 Series Variables:
MODEL
AKARW, AKNEST, AKNESTX
Group_y1_1
Series Variable
Fixed Values:
Fixed Value
Plot Cond
Independent Variables:
FCST_LEAD
0, 3, 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42, 45, 48
Statistics:
None
Aggregation statistics
Statistics Calculations
Contingency table count (CTC)
Scalar partial sums (SL1L2)
20150424_225719
Plot
XML
Log
R script
R data
SQL
BCAPE BCRMSE – All Domain – AK Models
BCRMSE (J/kg)
100
50
0
−50
0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48
Fcst Lead
AKARW
AKNEST
AKNESTX
DIFF (NEST−NESTX)
Titles & Labels
Common
Formatting
X1
X2
Y1
Y2
Legend & Caption
Image Type png16m
Height 8.5
Width 11
Units in
Text Magnification 1
Resolution 72
Margins c(8, 4, 5, 4)
Axis Margin Line c(1, 1, 0)
Title Formatting
Horizontal align 0.5
Perpendicular offset -2
Text Size 1.4
Text Weight bold
Grid Line Formatting
Line Type dotted
Line Width 1
Line Color cccccc
X positions listX
Plot Script Commands
abline(h=0)
abline(h=0) is what tells it to put a horizontal line at 0
abline(h=1) would be horizontal at 1
abline(v=0) would be vertical at 0 etc…
Series Formatting
Y axis Hide Title Conf Interval Line Color Point Symbol Series Line Type Line Type Line Width Show Significan Connect Across NA Legend Text
1 Y1 No AKARW BCAPE BCRMSE std #ff0000 Small circle joined lines solid 3 No Yes AKARW
2 Y1 No AKNEST BCAPE BCRMSE std #55ff00 Small circle joined lines solid 3 No Yes AKNEST
3 Y1 No AKNESTX BCAPE BCRMSE std #00aaff Small circle joined lines solid 3 No Yes AKNESTX
4 Y1 No DIFF ("AKNEST BCAPE BCRMSE"-"AKNESTX BCAPE BCRMSE") std #8000ff Small circle joined lines solid 1 Yes Yes DIFF (NEST-NESTX)
Add Difference
Remove Difference
Apply
Lock
View 1 - 4 of 4


File Edit View History Bookmarks Tools Help
Inbox - jensen@ucar.edu - ...
METViewer v1.1
METViewer v1.2-dev
METViewer Documentation
http://www.dtcenter.org/met/metviewer/metviewer1.jsp
longmont braces
Gmail Elevations Mrs. Holburn's 4th Gra... Houghton Mifflin Mat... Program Planner ColorBrewer: Color Ad... Forecast Verification - ... personal Weather Prediction Ce... NOAA's National Weat... Interactive Radar | KDV... RAL | Tropical Cyclone... Recipes
Database: mv_ncep_meso
Generate Plot
Reload databases
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Series Box Bar Rhist Phist Roc Rely Ens_ss
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Plot statistic: Median
Y1 Axis variables
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Group_y1_1
Series Variable
Fixed Values:
Fixed Value
Plot Cond
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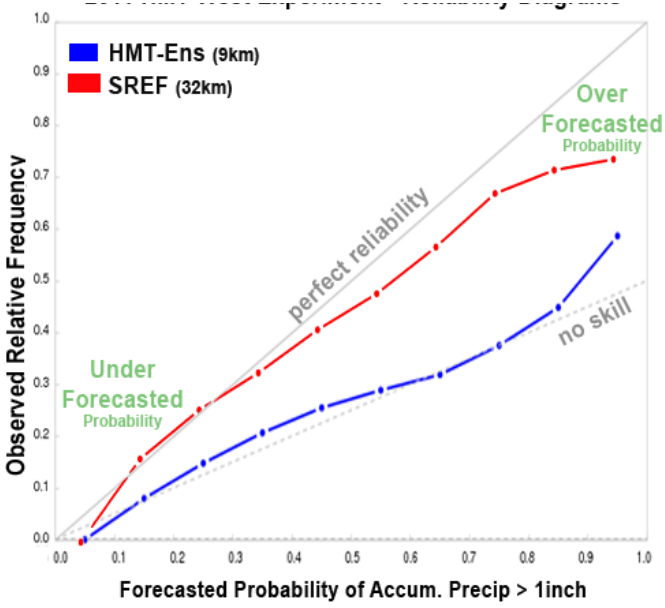
Aggregation statistics
Statistics Calculations
Contingency table count (CTC)
Scalar partial sums (SL1L2)
20150424_225719
Plot XML Log R script R data SQL
BCAPE BCRMSE – All Domain – AK Models
BCRMSE (J/kg)
100
50
0
−50
0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48
Fcst Lead
AKARW
AKNEST
AKNESTX
DIFF (NEST−NESTX)
Titles & Labels Common Formatting X1 X2 Y1 Y2 Legend & Caption
Image Type png16m
Height 8.5
Width 11
Units in
Text Magnification 1
Resolution 72
Margins c(8, 4, 5, 4)
Axis Margin Line c(1, 1, 0)
Title Formatting
Horizontal align 0.5
Perpendicular offset -2
Text Size 1.4
Text Weight bold
Grid Line Formatting
Line Type dotted
Line Width 1
Line Color cccccc
X positions listX
Plot Script Commands
abline(h=0)
Click yes to show significance – which means Cis or standard error do not encompass 0
Series Formatting
Y axis Hide Title Conf Interval Line Color Point Symbol Series Line Type Line Type Line Width Show Significan Connect Across NA Legend Text
1 Y1 No AKARW BCAPE BCRMSE std #ff0000 Small circle joined lines solid 3 No Yes AKARW
2 Y1 No AKNEST BCAPE BCRMSE std #55ff00 Small circle joined lines solid 3 No Yes AKNEST
3 Y1 No AKNESTX BCAPE BCRMSE std #00aaff Small circle joined lines solid 3 No Yes AKNESTX
4 Y1 No DIFF ("AKNEST BCAPE BCRMSE"-"AKNESTX BCAPE BCRMSE") std #8000ff Small circle joined lines solid 1 Yes Yes DIFF (NEST-NESTX)
Add Difference
Remove Difference
Apply
Lock
View 1 - 4 of 4

MET Probability Output (line-types)

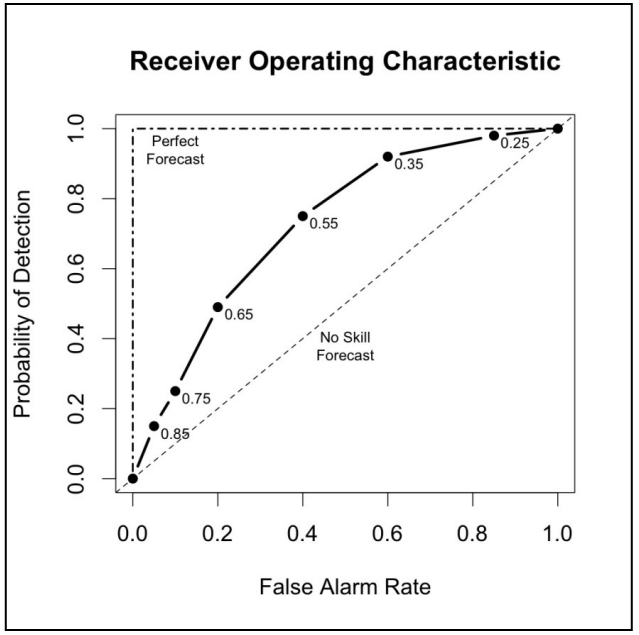
- Output written to MET .stat file and, if desired, to individual text files:
  - PCT – Probability Contingency Table Counts
  - PSTD – Probability Contingency Table Scores
    - Brier Score, Reliability, Resolution, Uncertainty, Area Under ROC
  - PJC – Joint/Continuous Statistics of Probabilistic Variables
    - Calibration, Refinement, Likelihood, Base Rate, Reliability points
  - PRC – ROC Curve Points for Probabilistic Variables
  - ECLV – Economic Cost Loss Value

We will use these data for the Verification Exercise

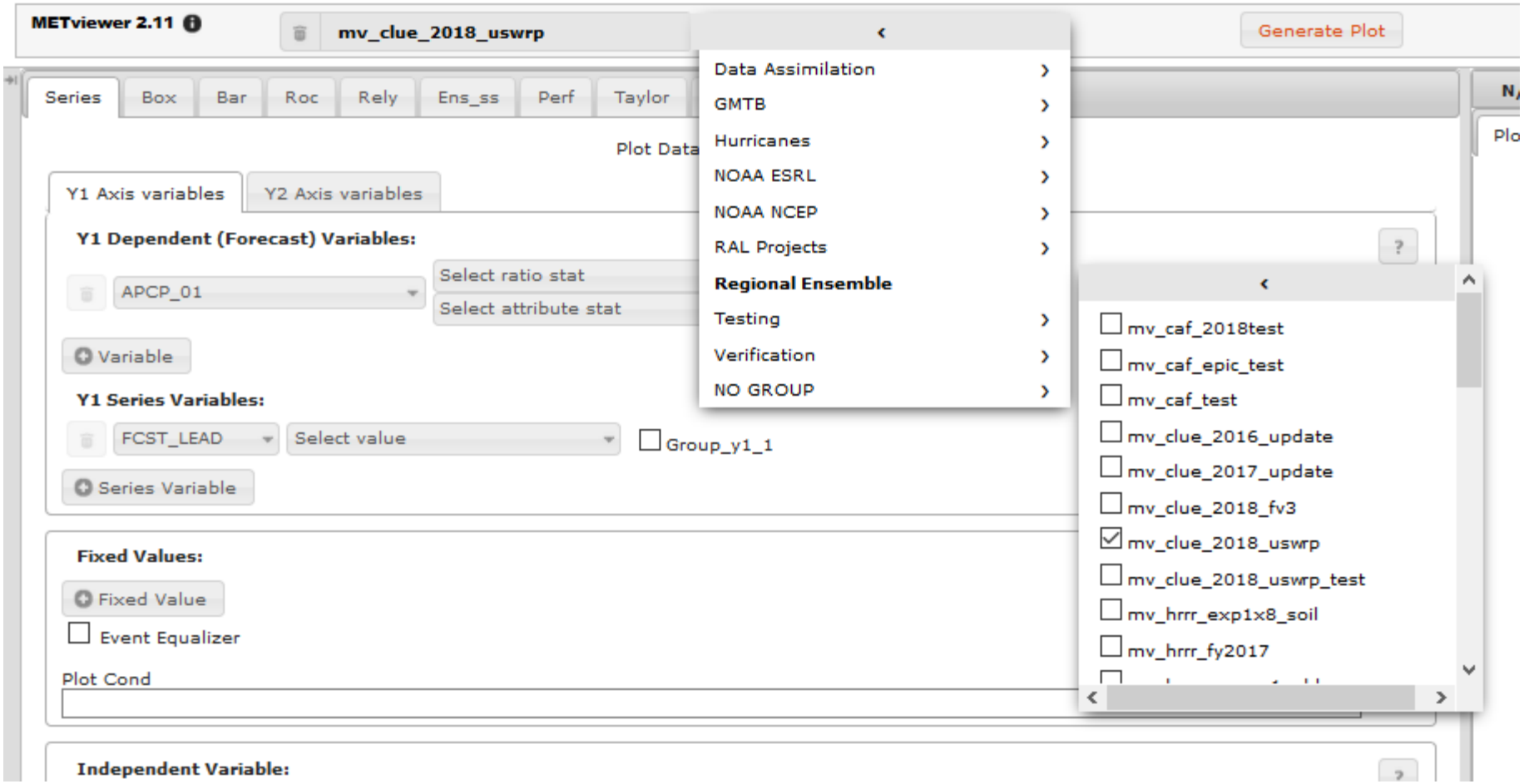
PJC



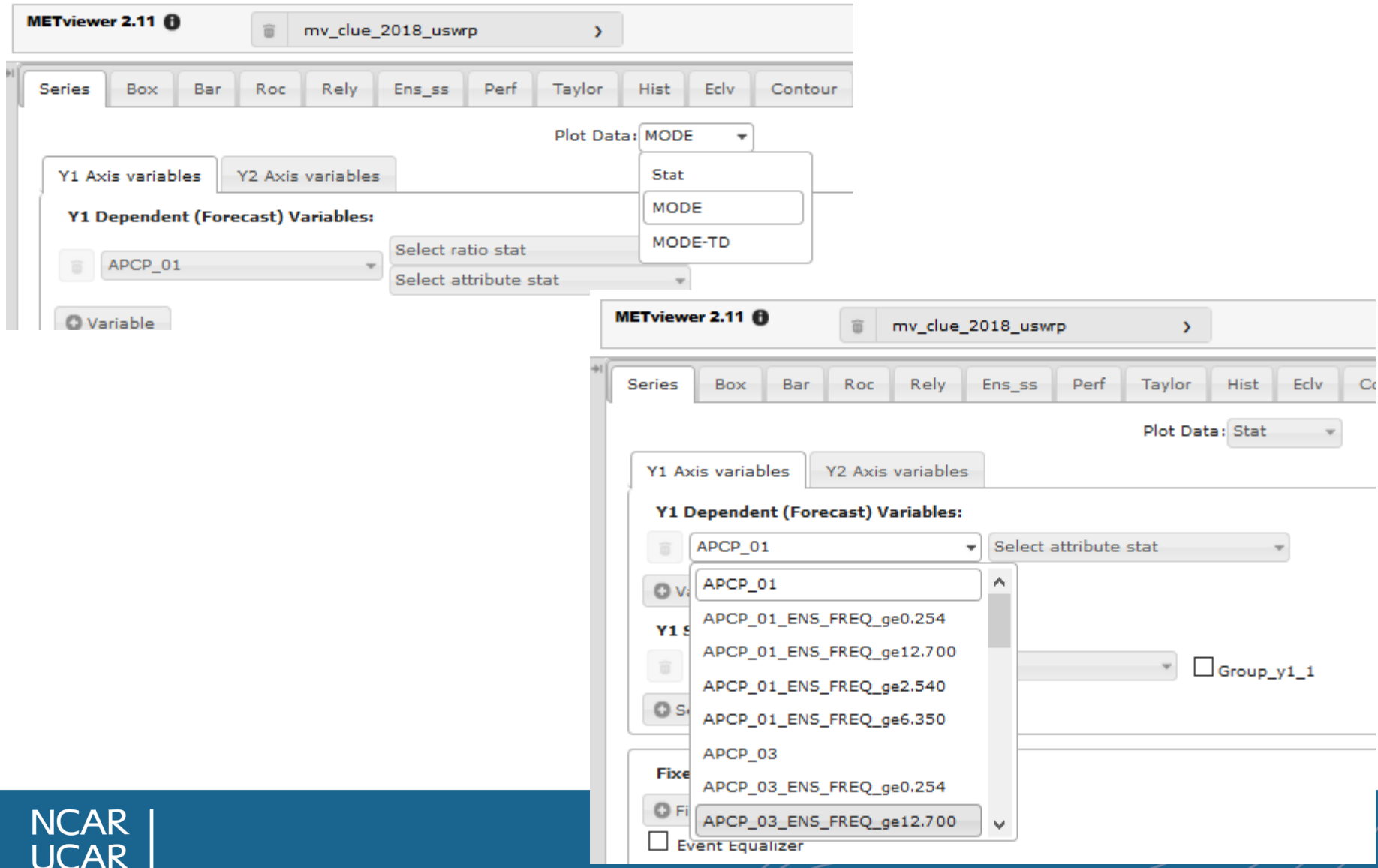
PRC



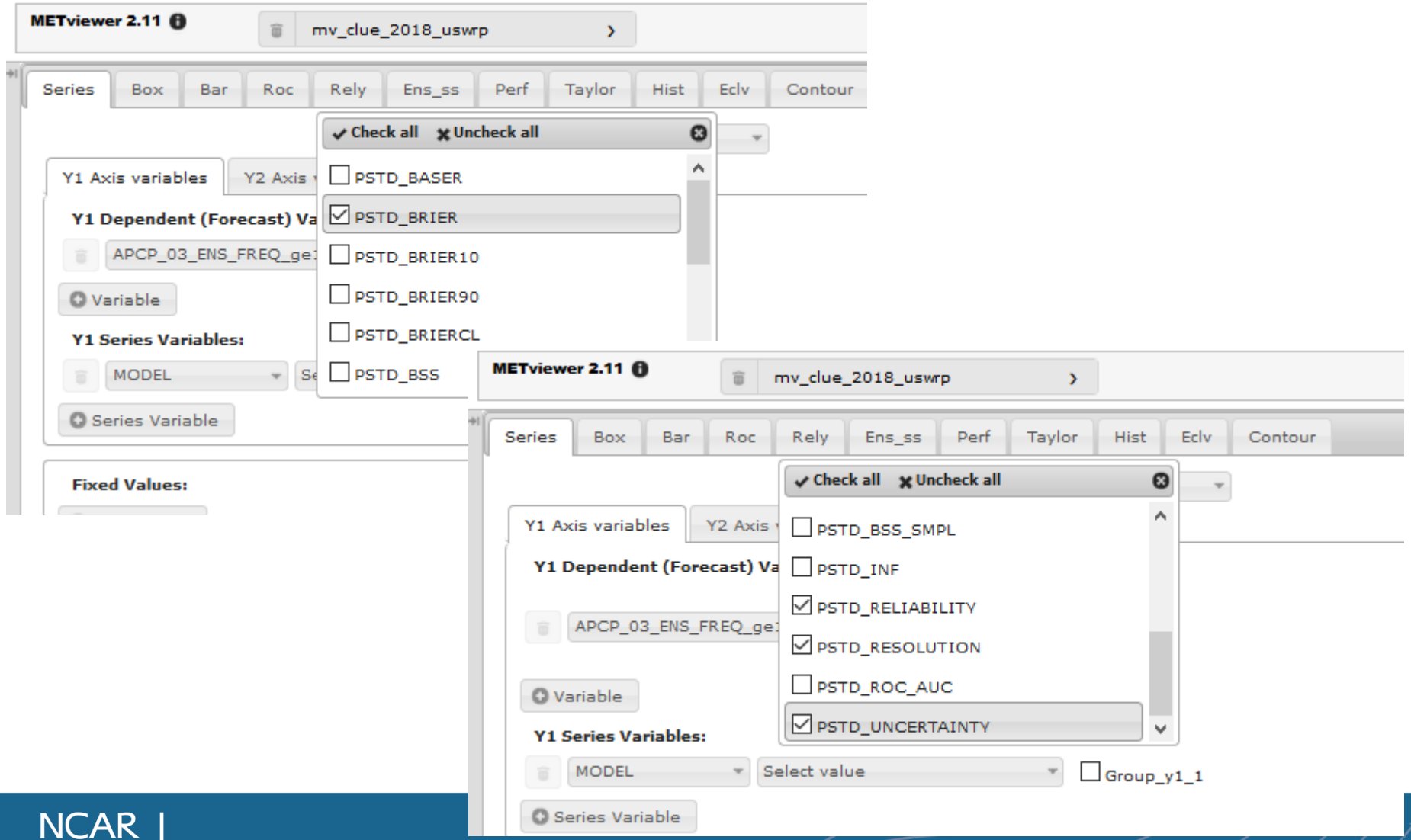
Let's plot Brier Score and Decomposition



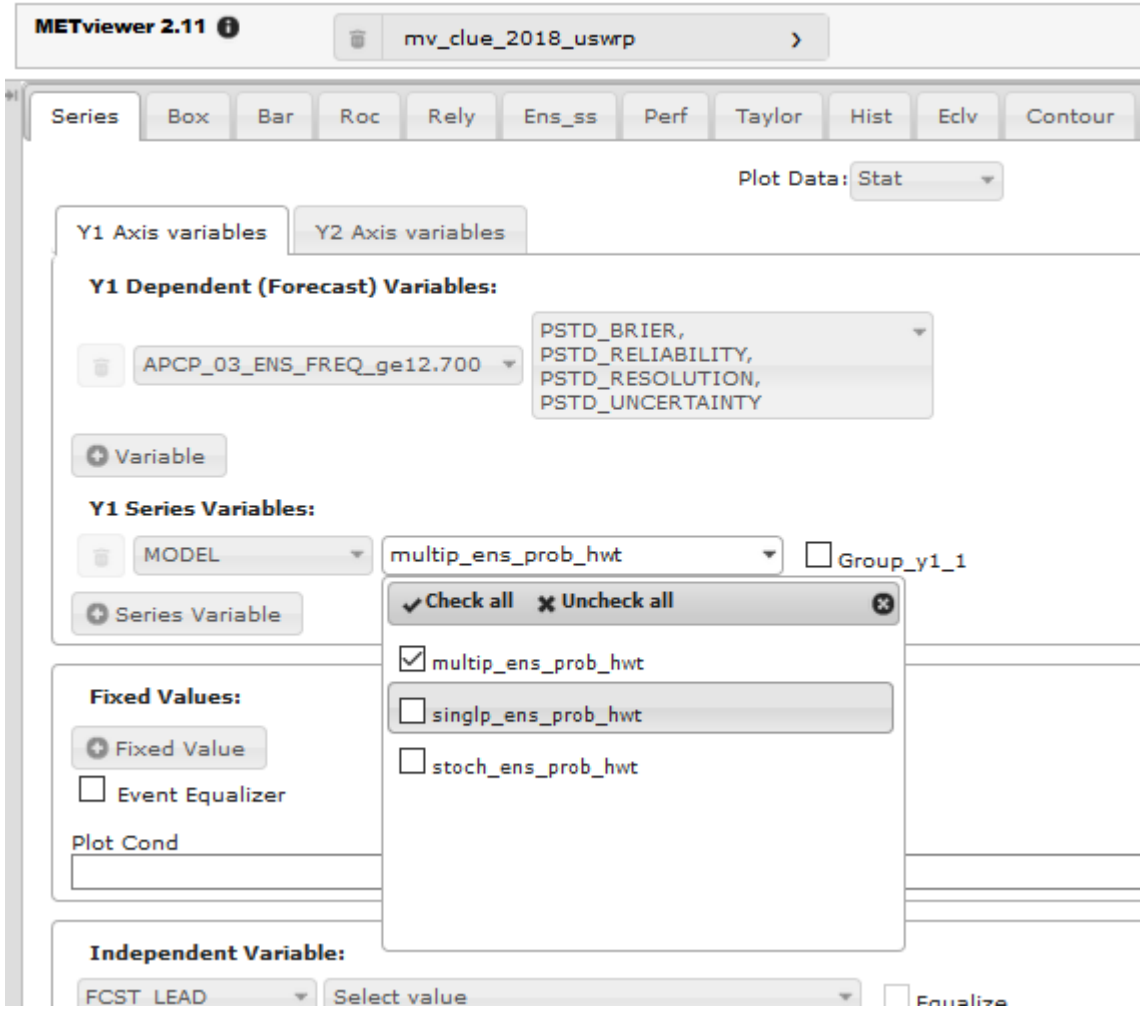
Let's plot Brier Score and Decomposition



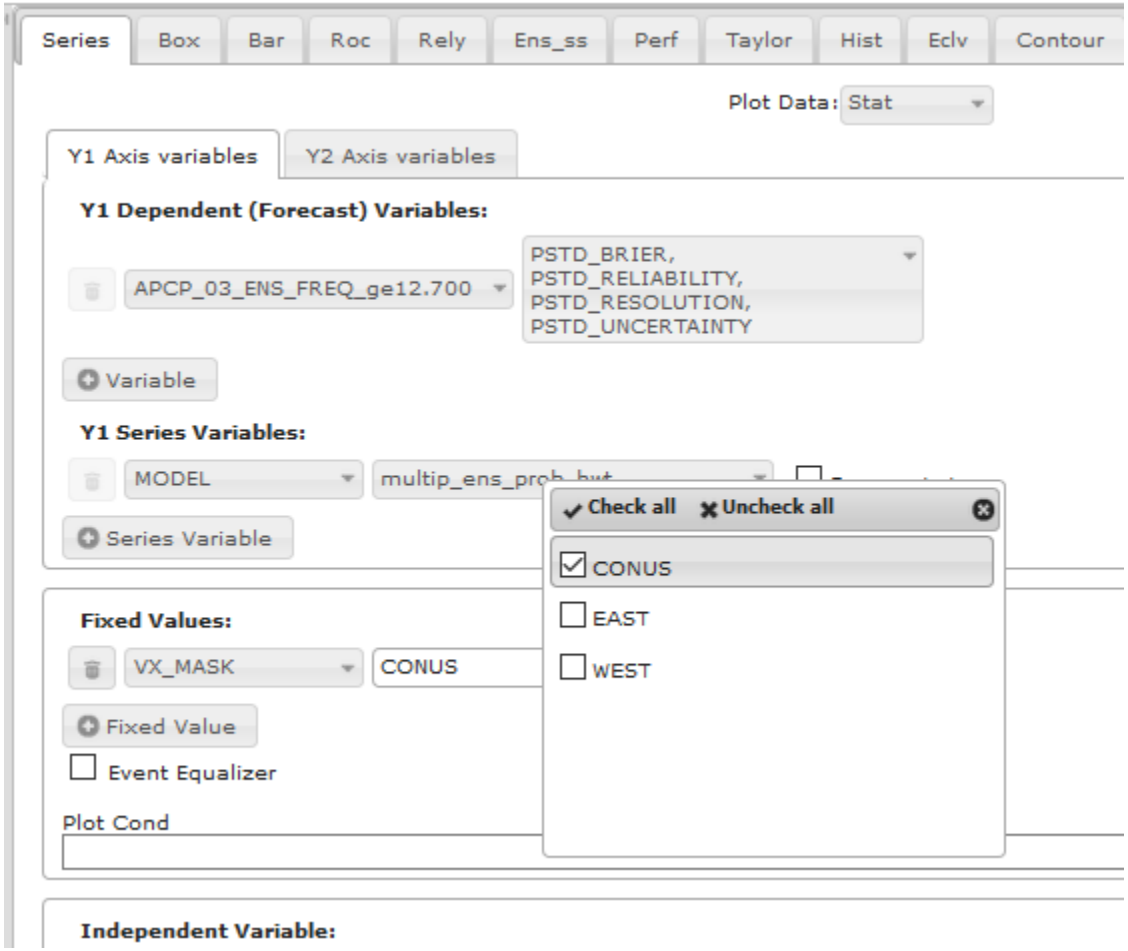
Let's plot Brier Score and Decomposition



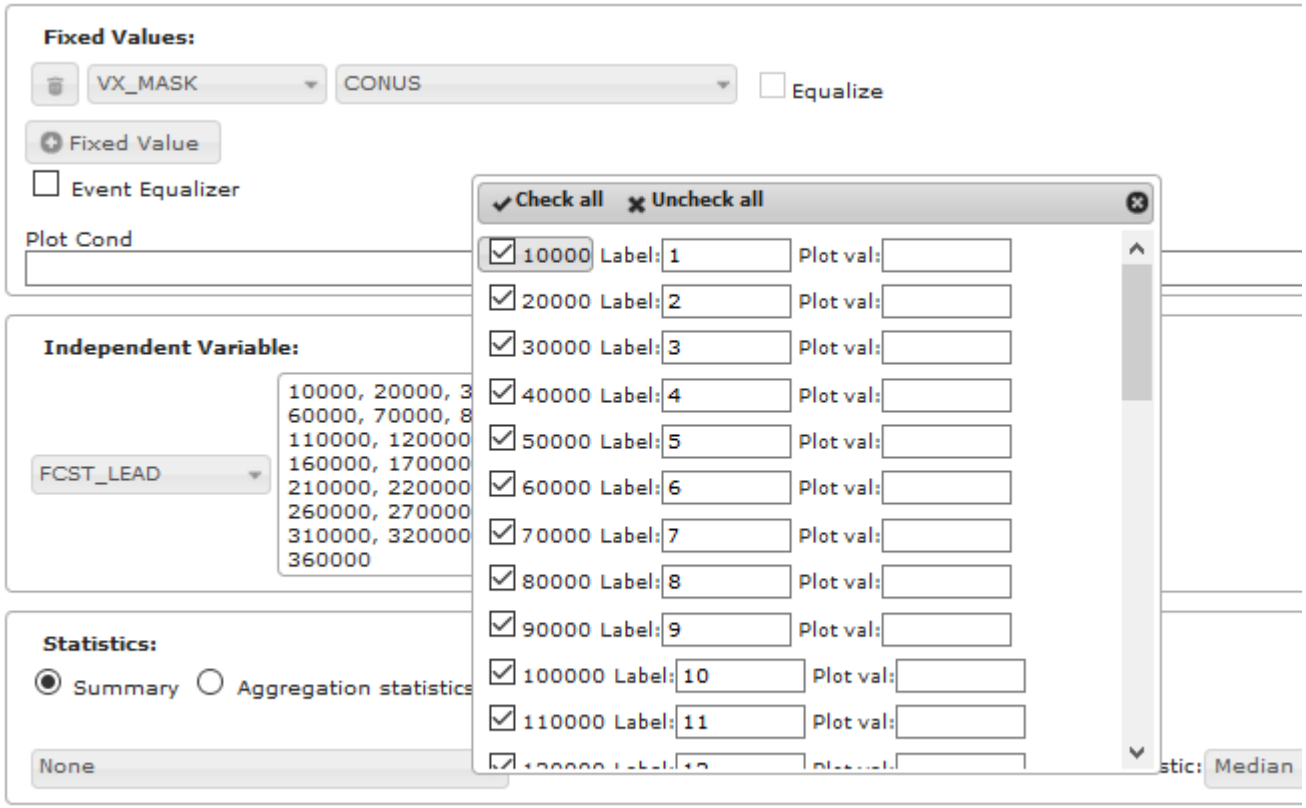
Let's plot Brier Score and Decomposition



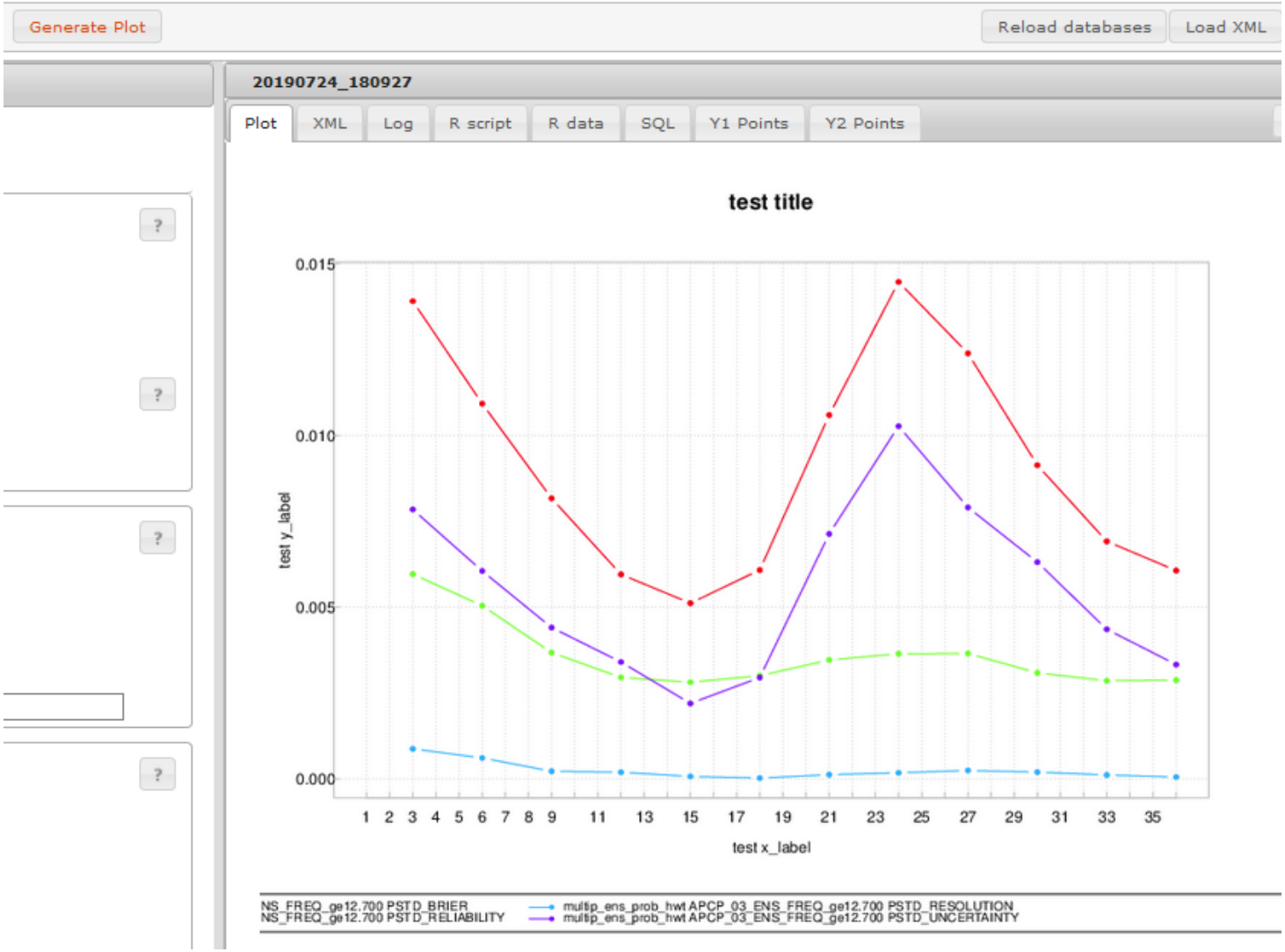
Let's plot Brier Score and Decomposition



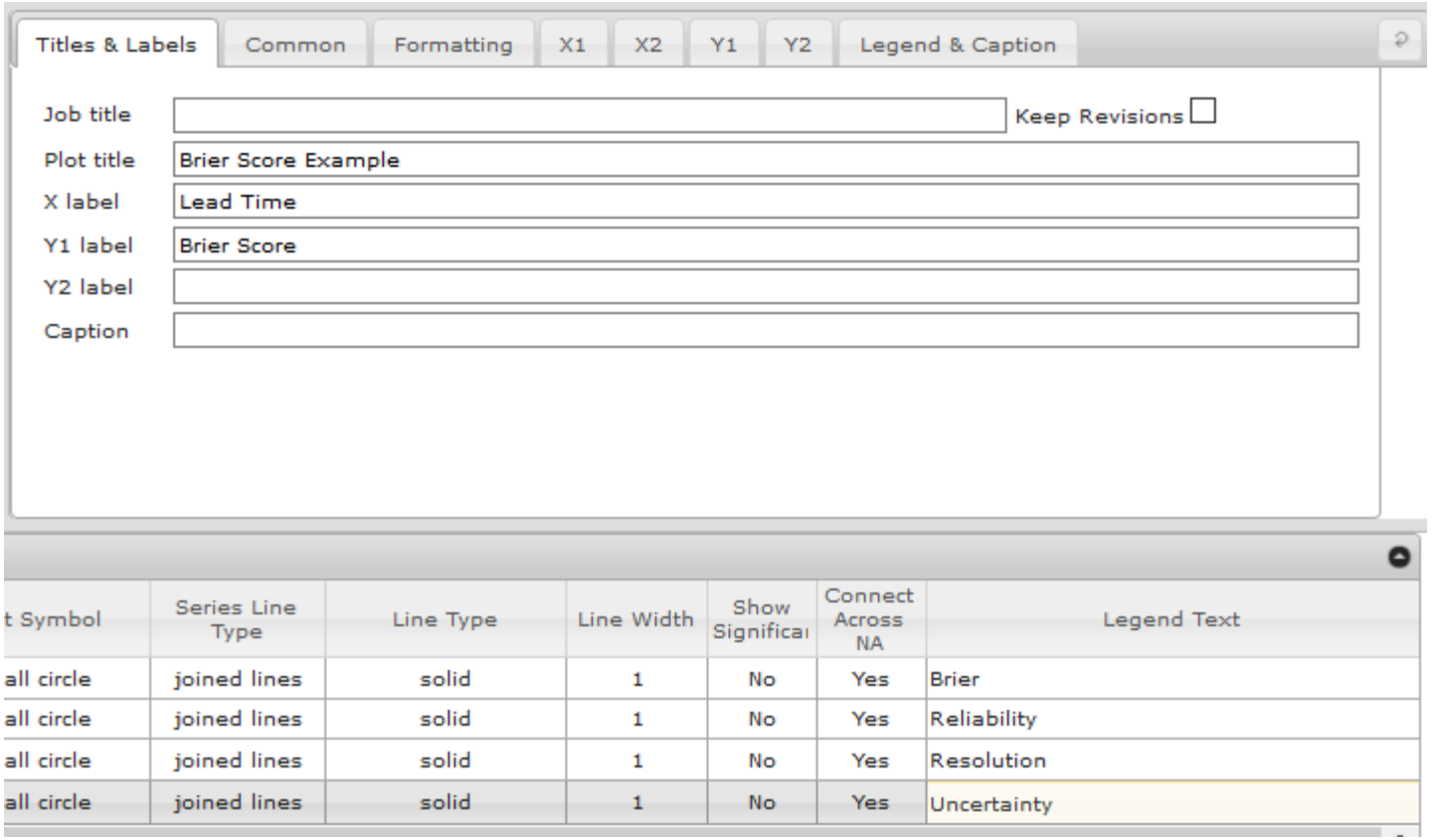
Let's plot Brier Score and Decomposition



Let's plot Brier Score and Decomposition

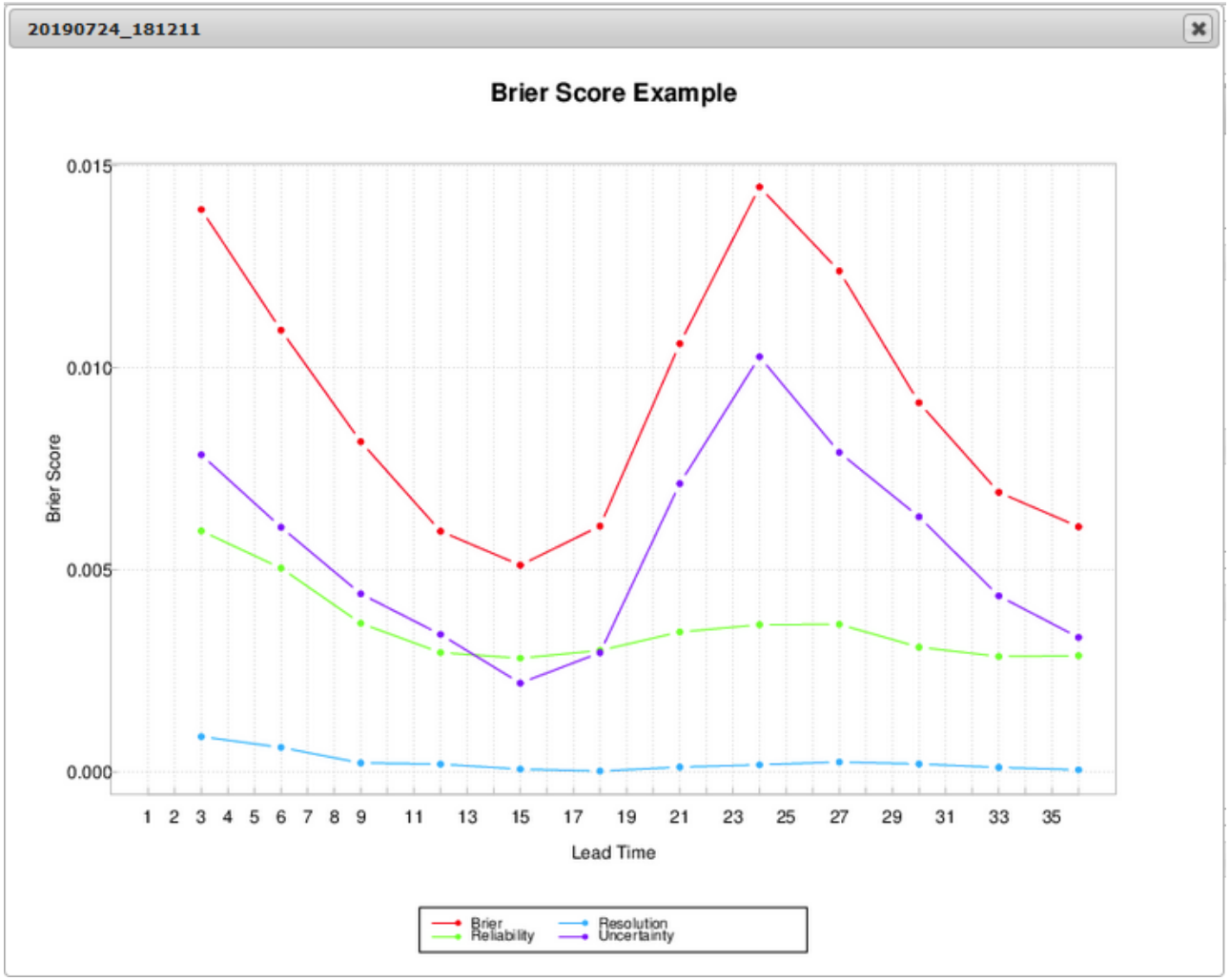


Let's plot Brier Score and Decomposition



t Symbol	Series Line Type	Line Type	Line Width	Show Significa	Connect Across NA	Legend Text
all circle	joined lines	solid	1	No	Yes	Brier
all circle	joined lines	solid	1	No	Yes	Reliability
all circle	joined lines	solid	1	No	Yes	Resolution
all circle	joined lines	solid	1	No	Yes	Uncertainty

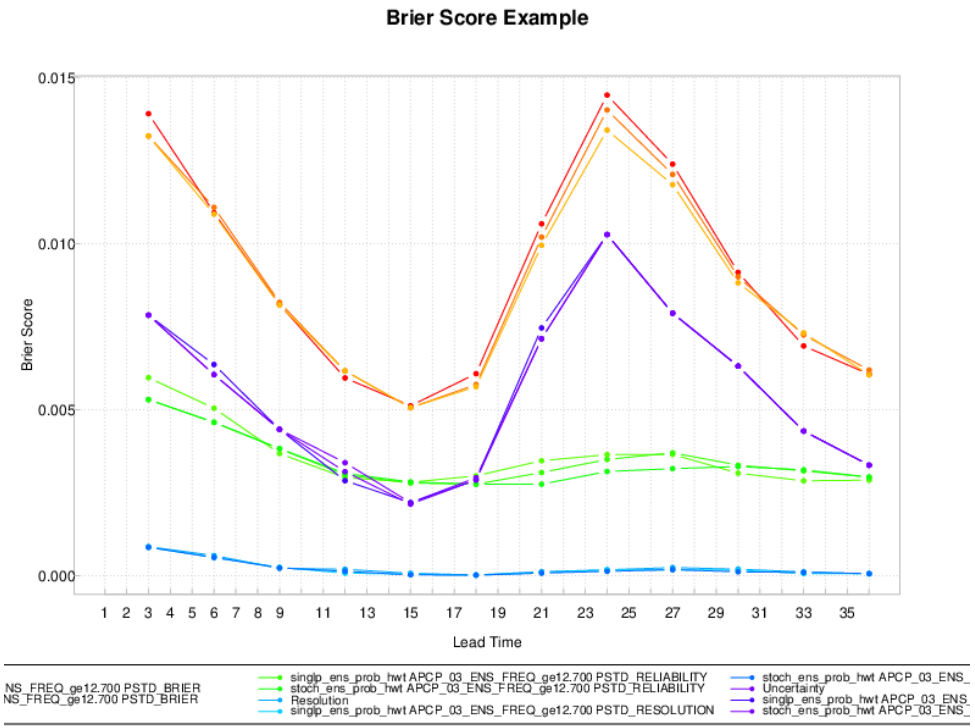
Let's plot Brier Score and Decomposition



us?

Explore a little. Can we compare several models?

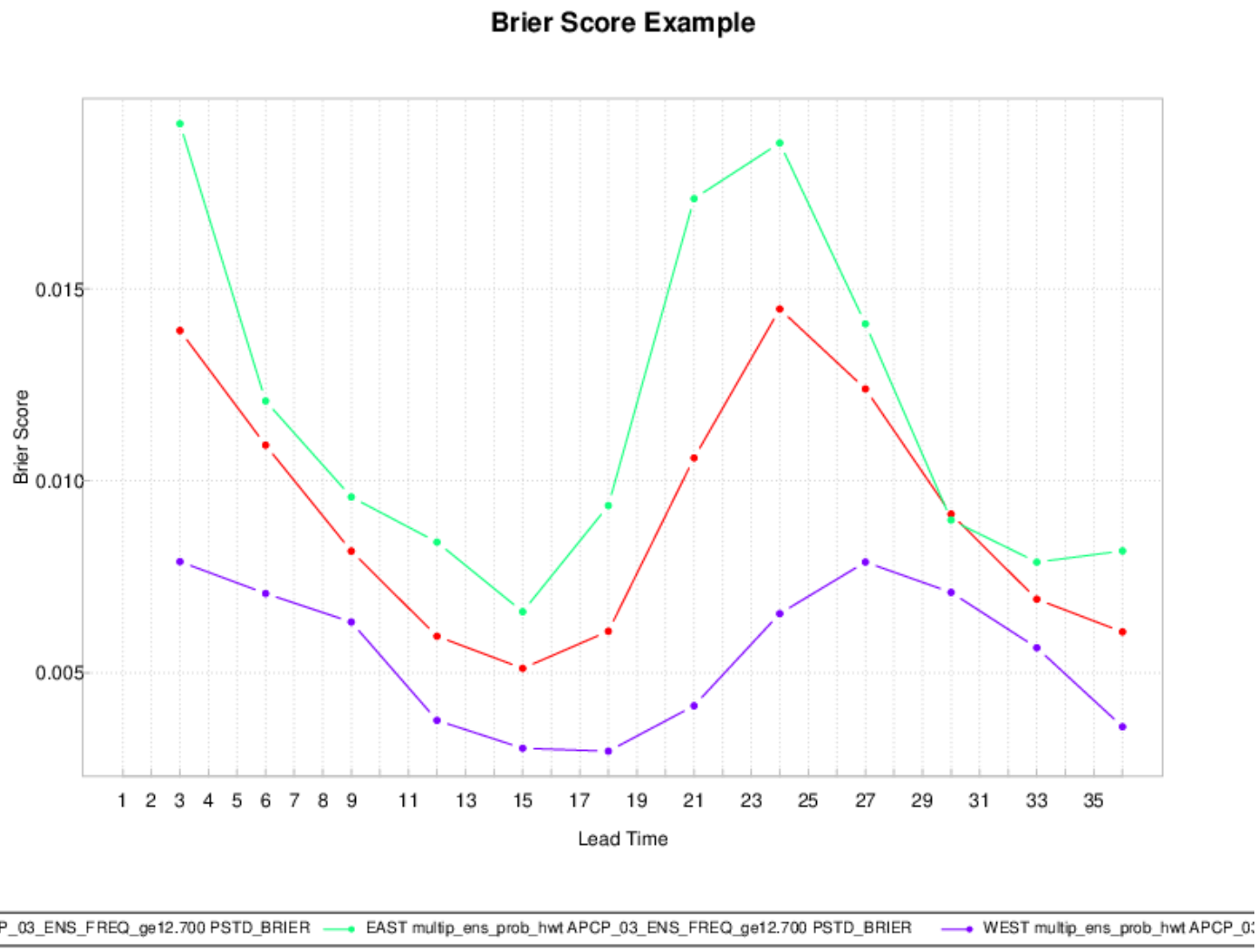
Add the two other models



East vs. West?

Explore a little

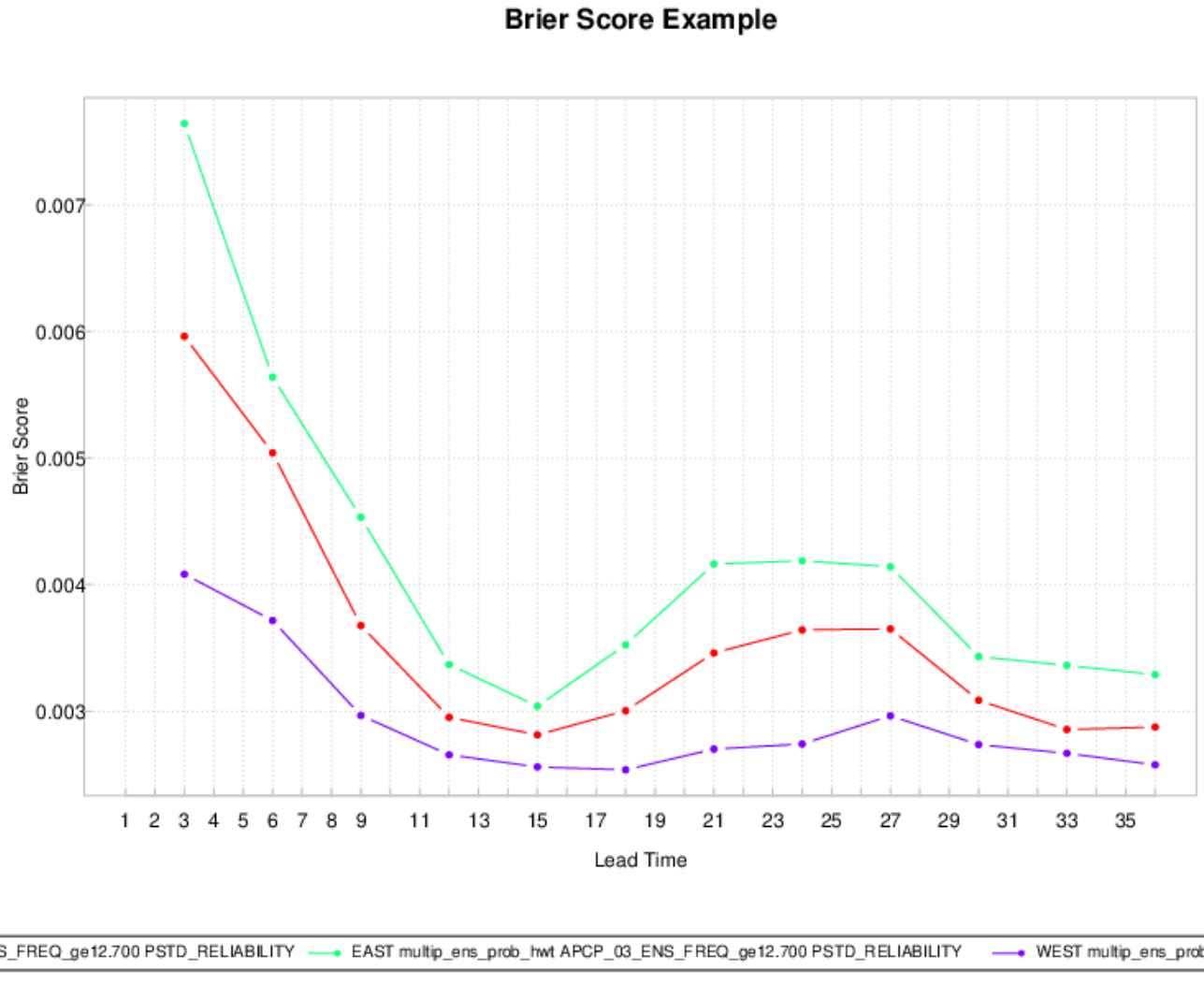
Select only Brier Score (Deselect All then select Brier Score)
Remove two models
Add Y1 Series Variable and select
VX_Mask -> CON
Remove Fixed
Value entry



Explore a little

Do scores change if stratified East vs. West?

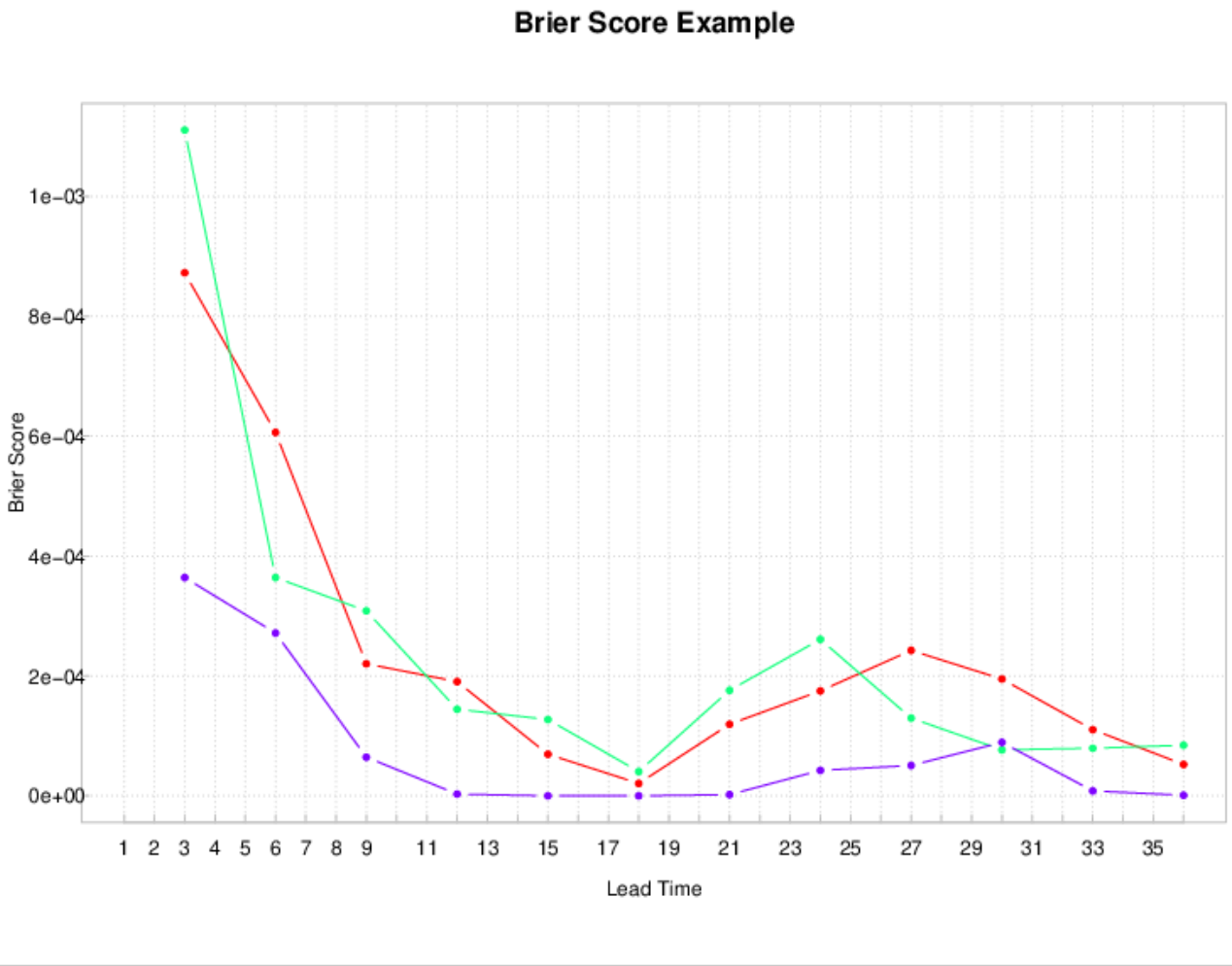
Select only Reliabil



Explore a little

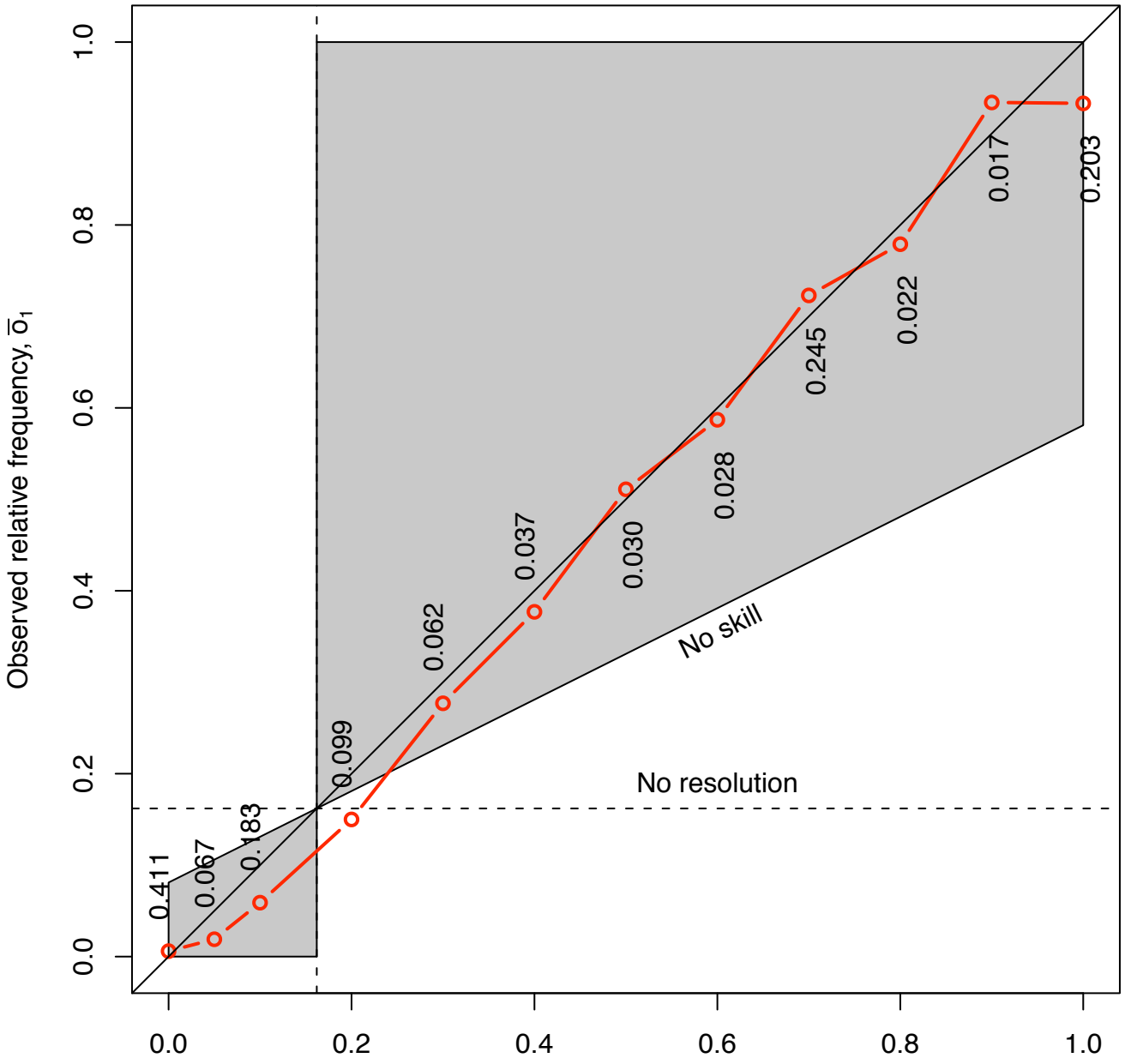
Do score
East vs.

Select only Resoluti



Reliability (Attribute) diagram

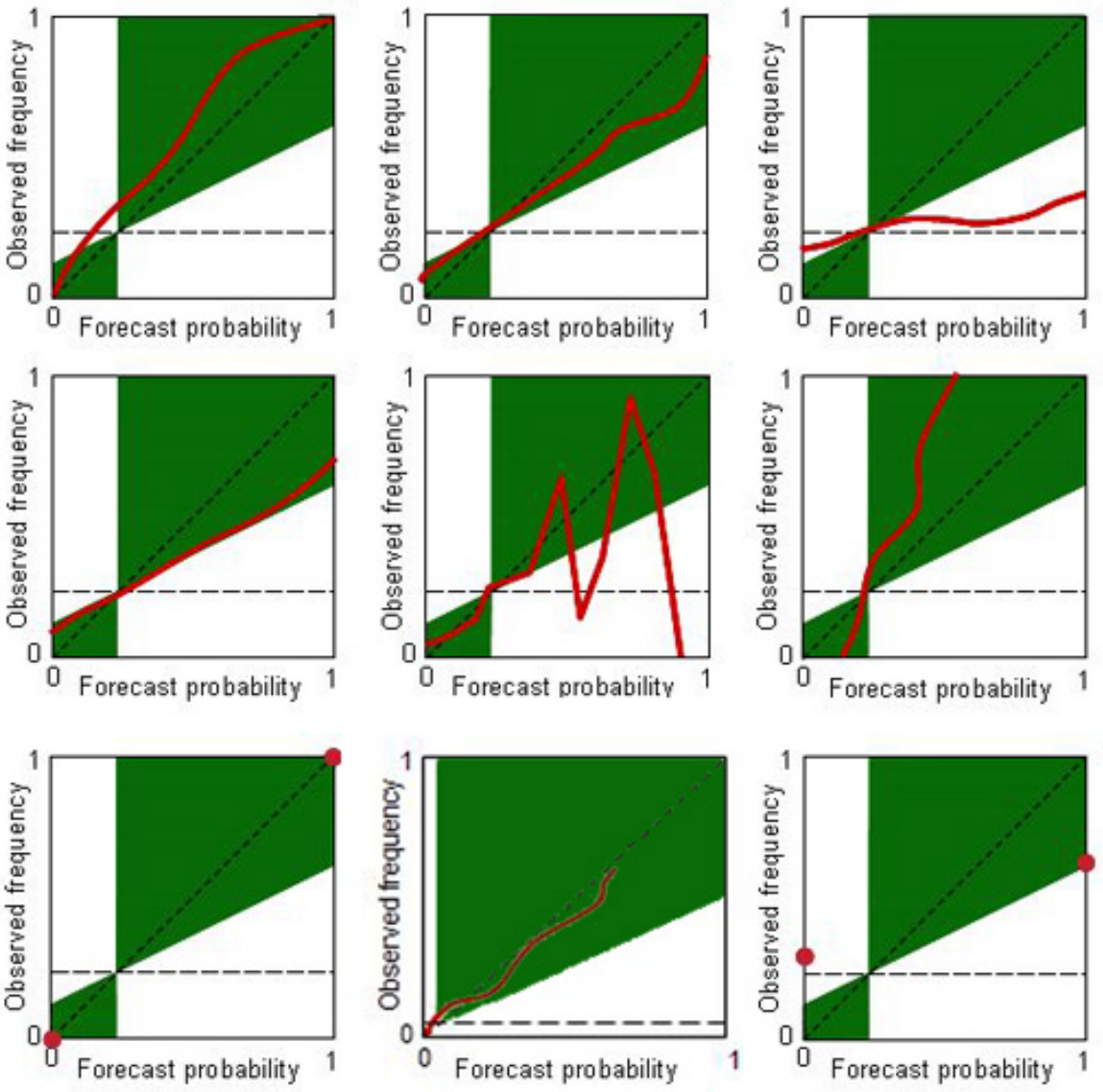
- Analogous to the scatter plot- same intuition holds.
- Data must be binned!
- Hides how much data is represented by each
- Expresses conditional probabilities.
- Confidence intervals can illustrate the problems with small sample sizes.



Reliability diagram plots observed frequency of event vs probability forecasted for event;

Attribute diagram adds lines to show how connected line (reliability) relates to Resolution and skill

Reliability Diagram Exercise



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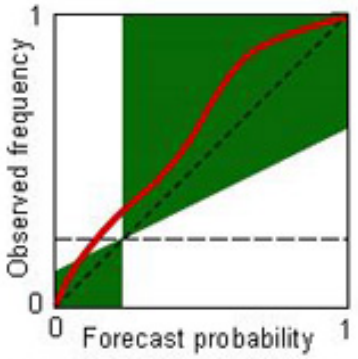
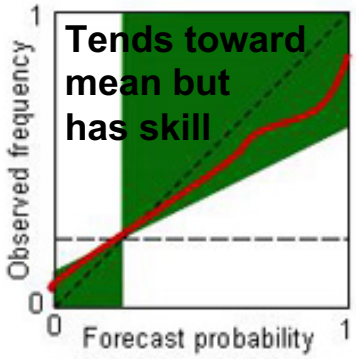
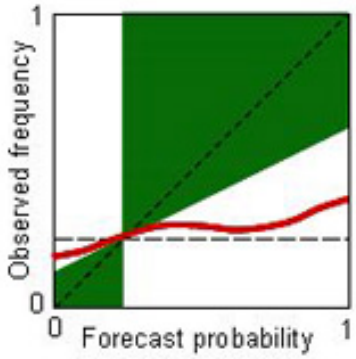
Reliability Diagram Exercise

Probabilities underforecast

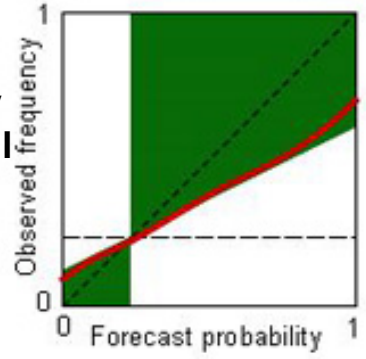


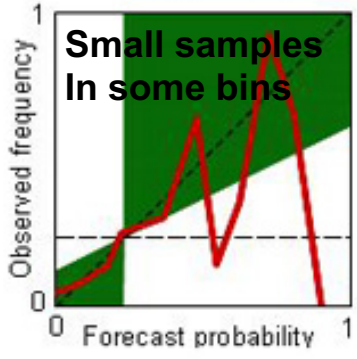


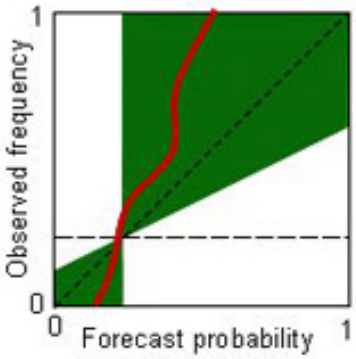


No resolution

Essentially no skill

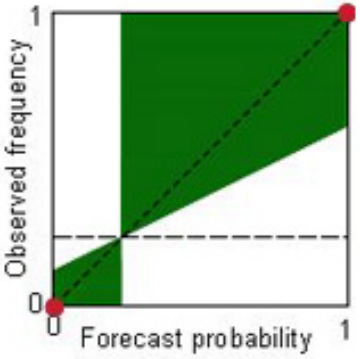


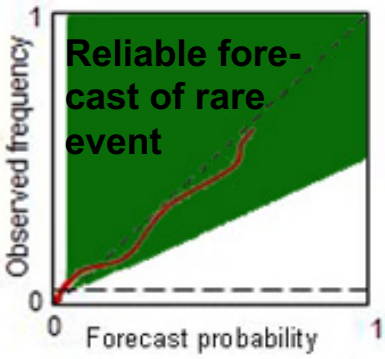


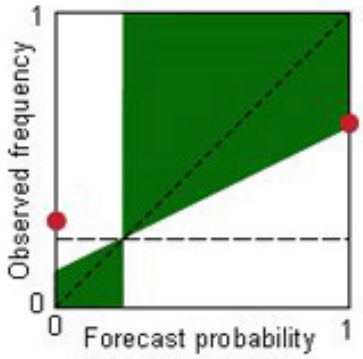


Over-resolved forecast

Perfect forecast



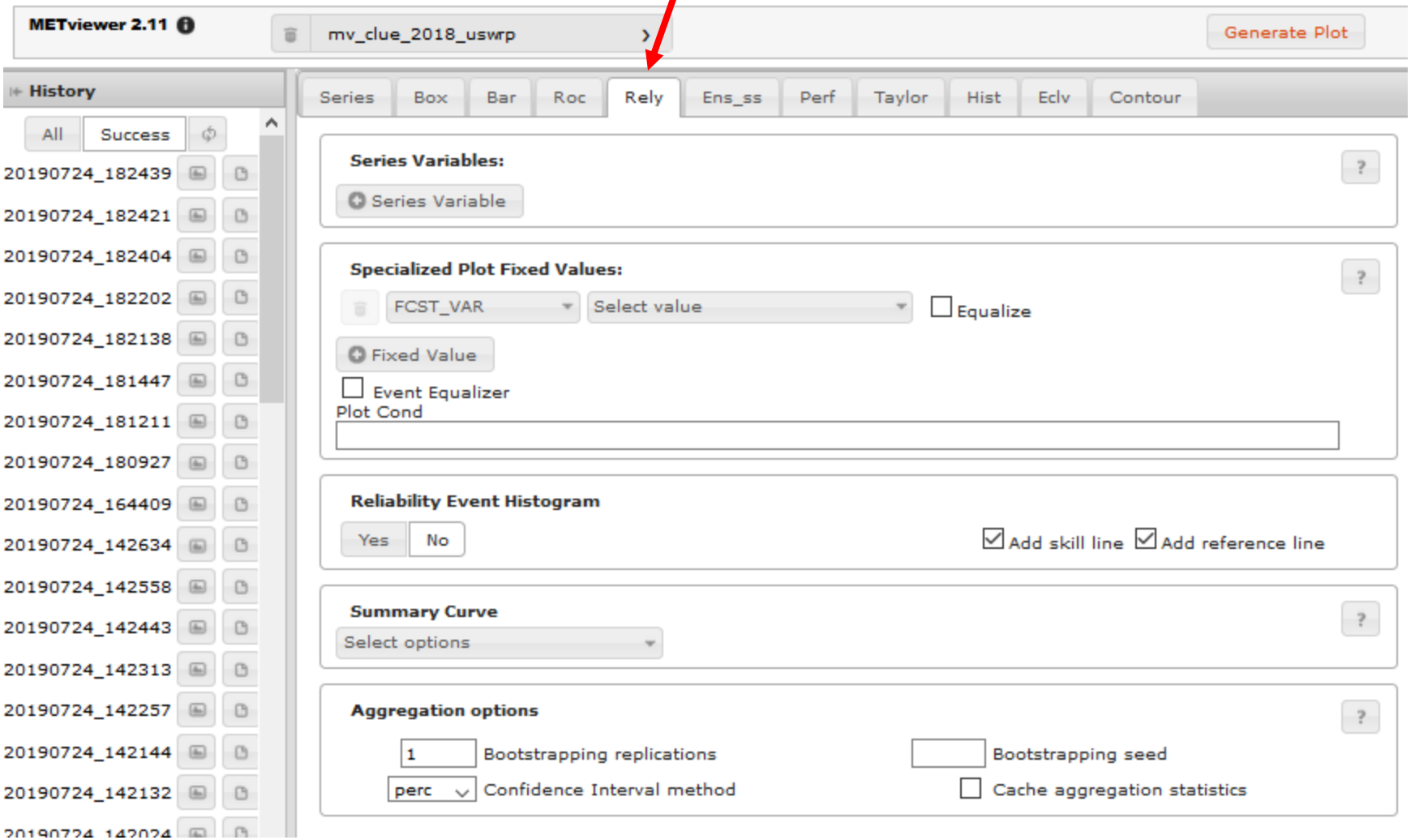




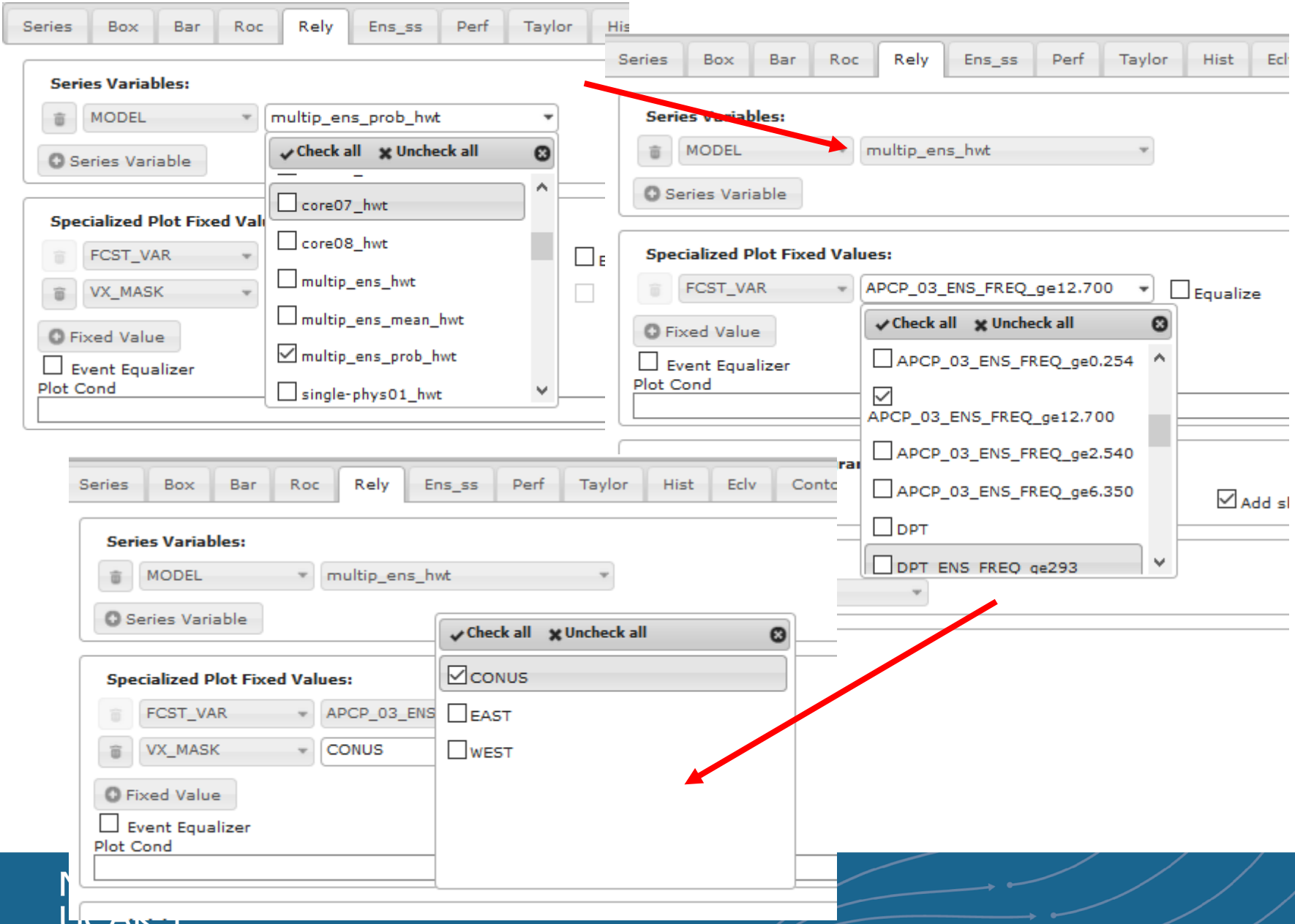
Typical categorical forecast

NCAR | UCAR

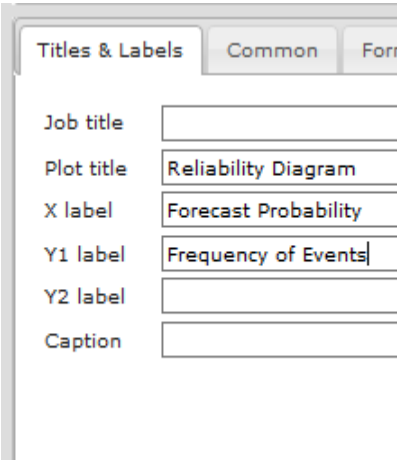
Select Rely Tab

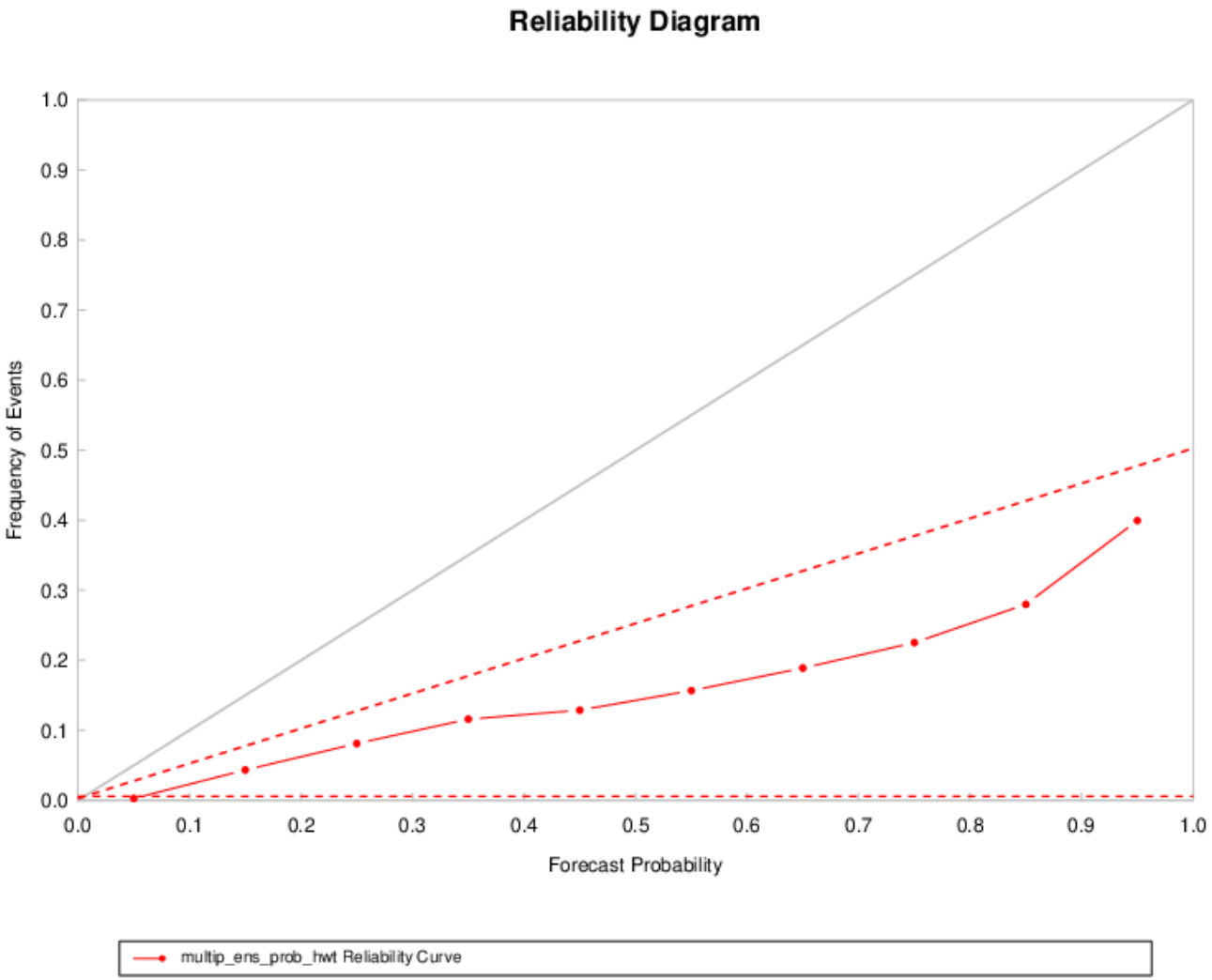


Select Model, Fcst Var and Region



Generate Plot





Does the reliability change with different ensemble compositions (multip, singlep, stocachastic)?

Add the other two modes_ens_prob_hwt to the MODEL list

Does the reliability change with different thresholds?

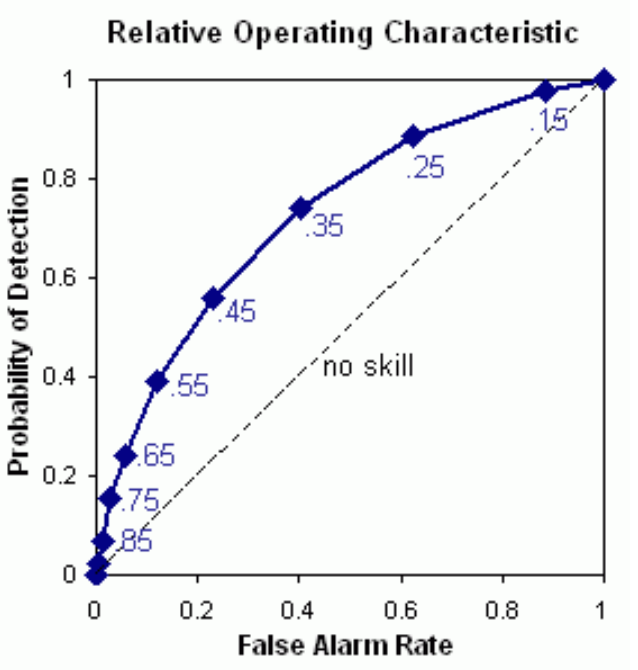
Change to a different thresholds to the FCST_VAR drop-down

Does reliability change with different regions?

Move VX_MASTK to Series Variables and Add East, West

Explore a little

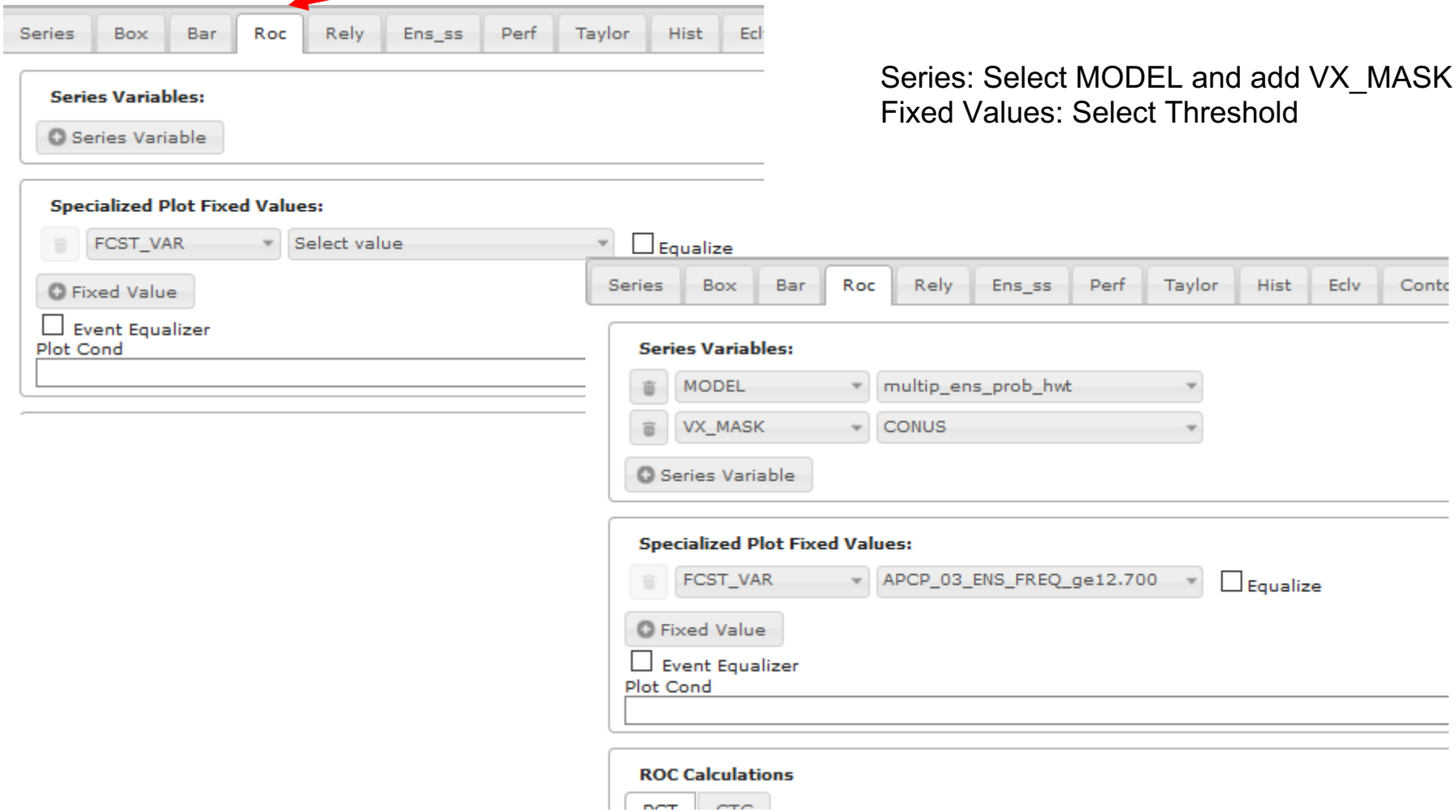
Interpretation of ROC



- Close to upper left corner – *good resolution*
- Close to diagonal – *little skill*
- **Area under curve** ("ROC area") is a useful summary measure of forecast skill
- **Perfect**: ROC area = 1
- **No skill**: ROC area = 0.5
- ROC skill score ROCS = 2(ROCarea-0.5)
- *Not sensitive to bias.*

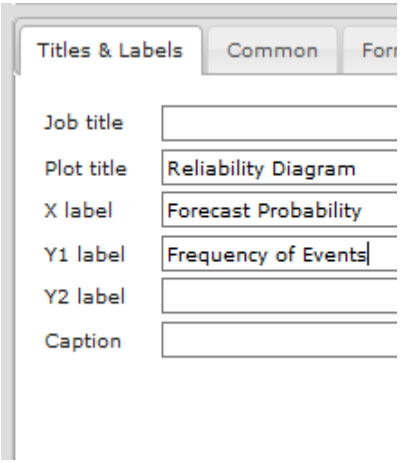
- ROC is **conditioned on the observations** (i.e., given that Y occurred, what was the corresponding forecast?)
- Reliability and ROC diagrams are good companions

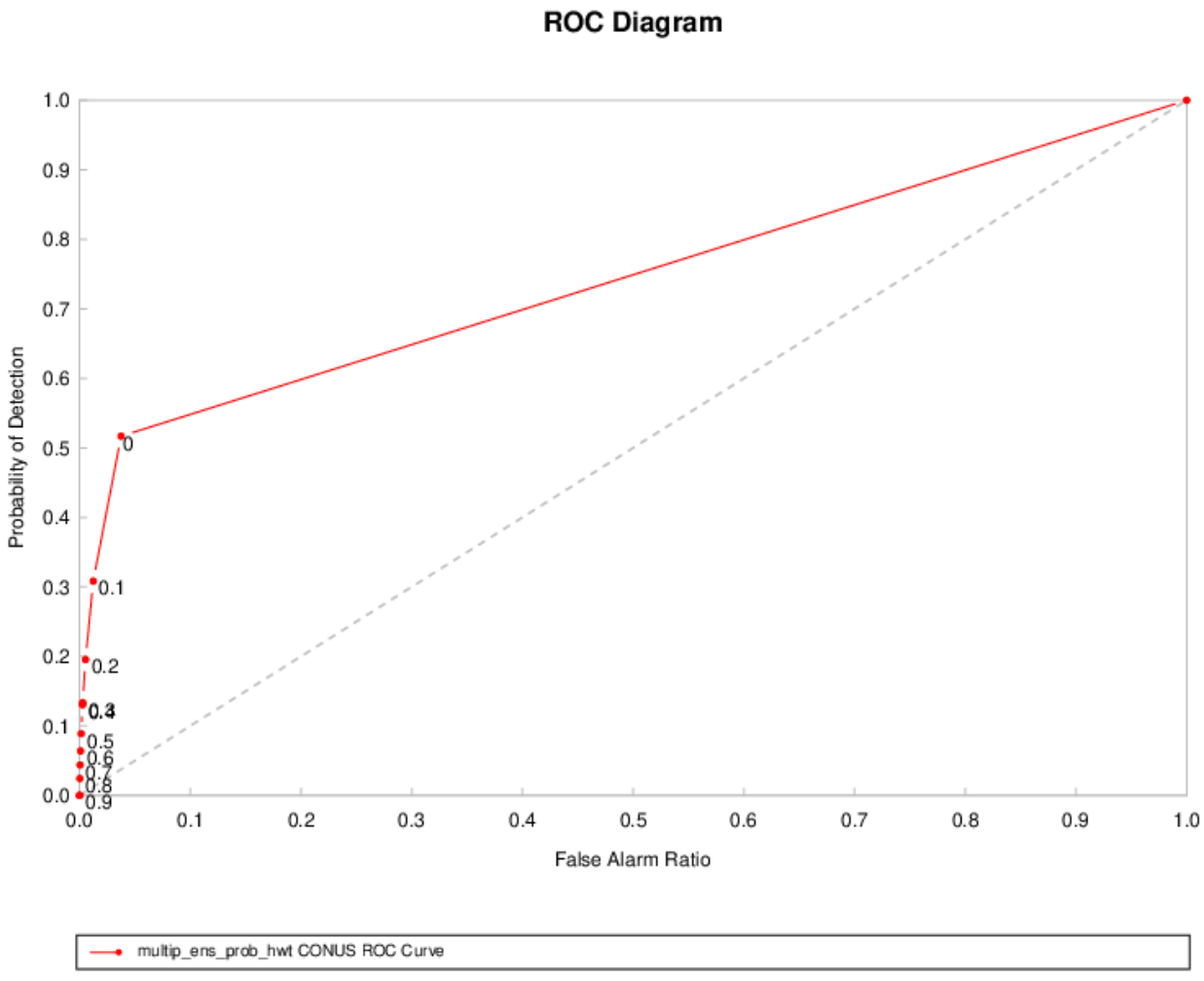
Select ROC Tab



Series: Select MODEL and add VX_MASK
Fixed Values: Select Threshold

Generate Plot





Explore a little

Does the ROC change with different ensemble compositions (multip, singlep, stocachastic)?

Add the other two modes_ens_prob_hwt to the MODEL list

Does the ROC change with different thresholds?

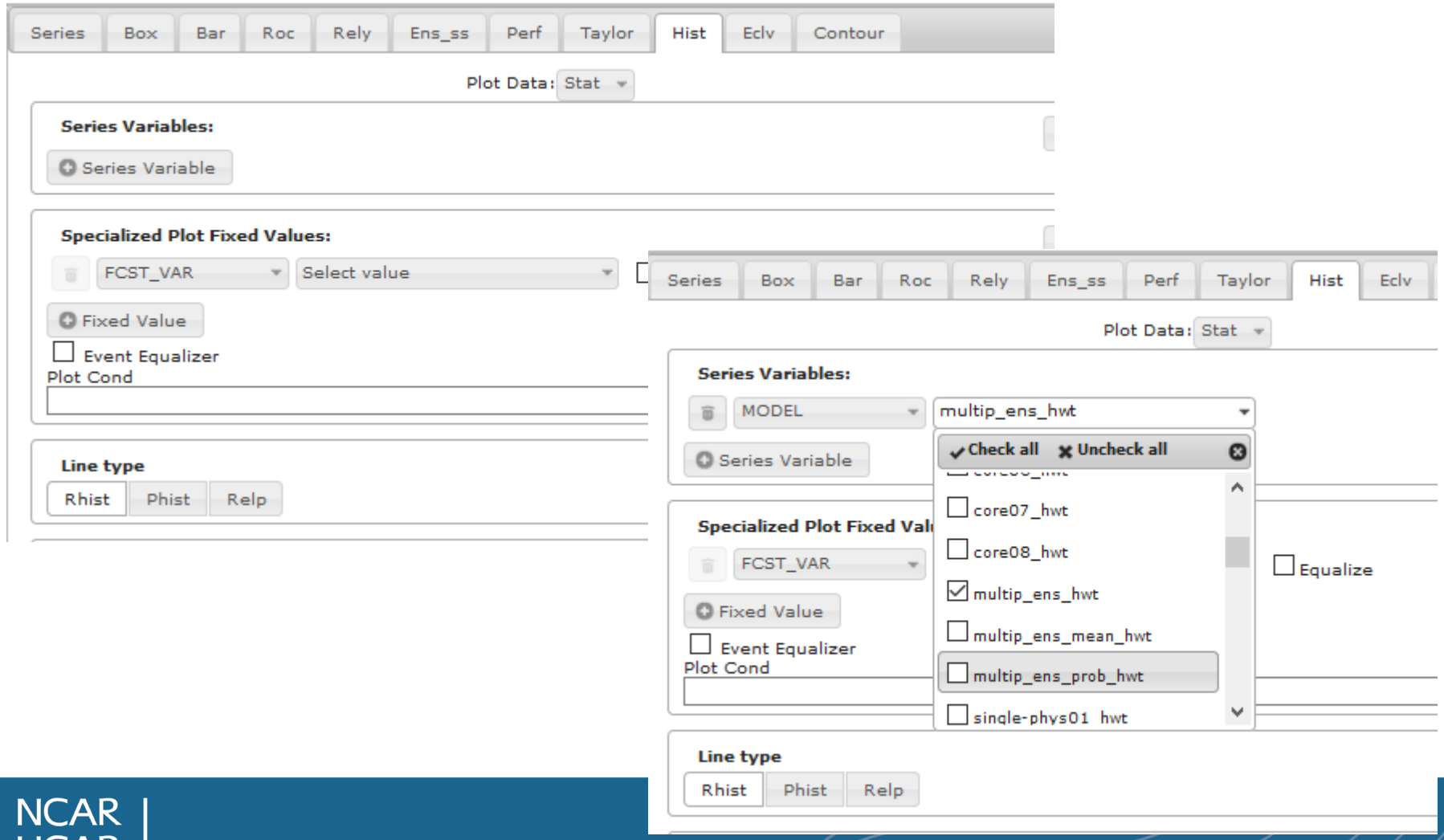
Change to a different thresholds to the FCST_VAR drop-down

Does ROC change with different regions?

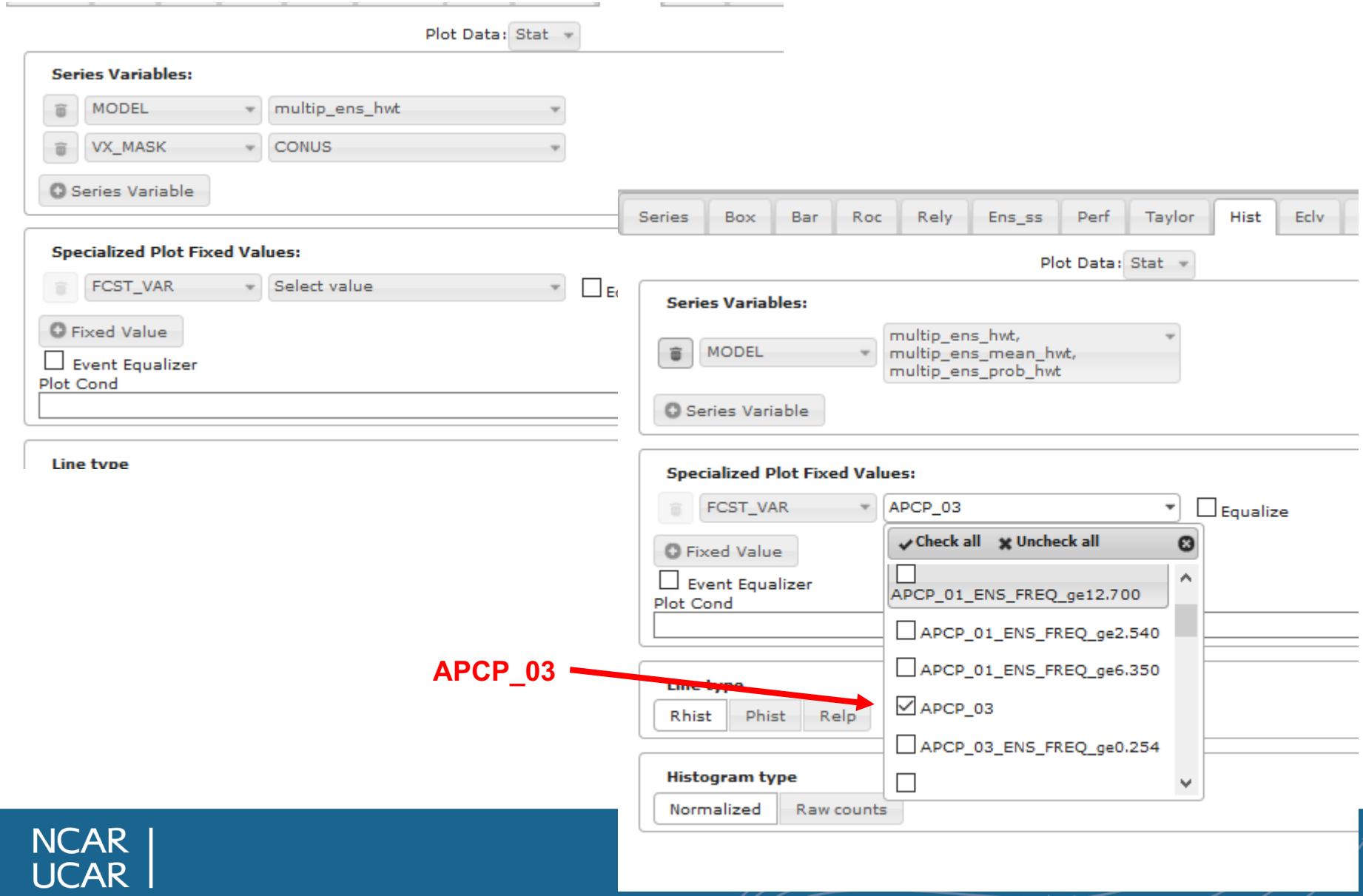
Move VX_MASTK to Series Variables and Add East, West

What else?

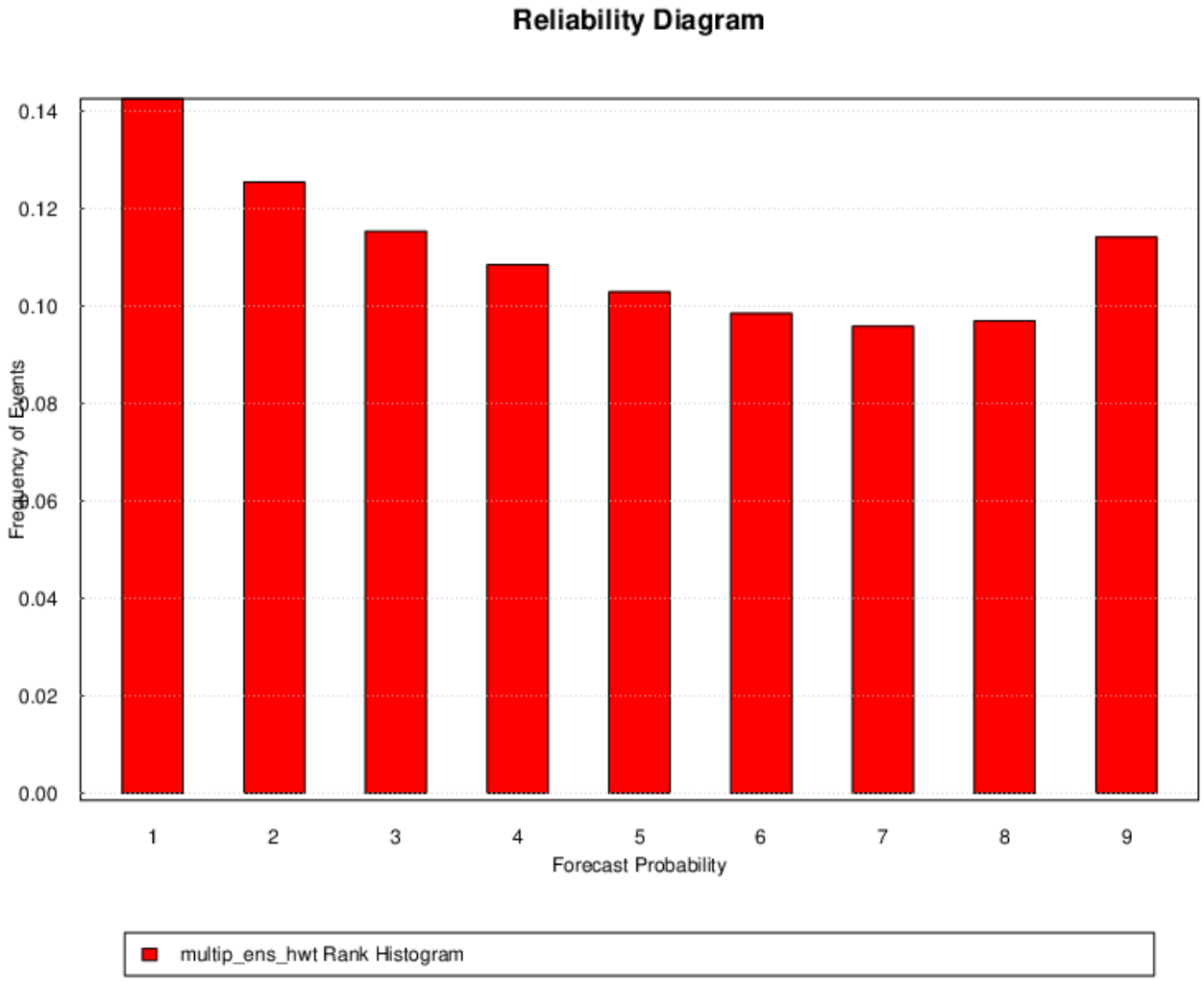
Rank Histograms



Add VX_MASK to Series; Select FCST_VAR



Plot Rank Histogram



Explore a little

Does the rank histogram change with different ensemble compositions (multip, singlep, stocachastic)?

Add the other two modes_ens_prob_hwt to the MODEL list

Does the rank histogram change with different thresholds?

Change to a different thresholds to the FCST_VAR drop-down

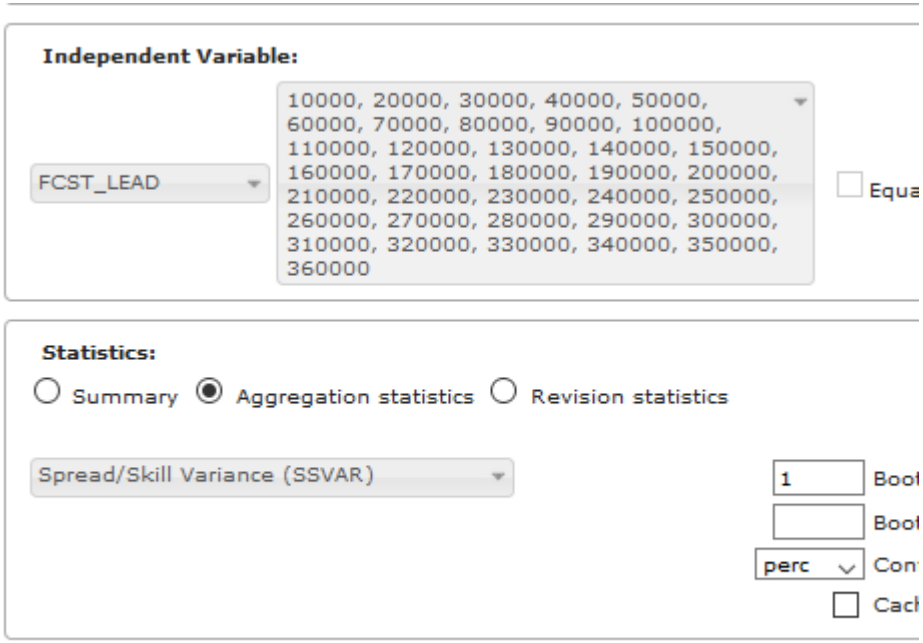
Does rank histogram change with different regions?

Move VX_MASK to Series Variables and Add East, West

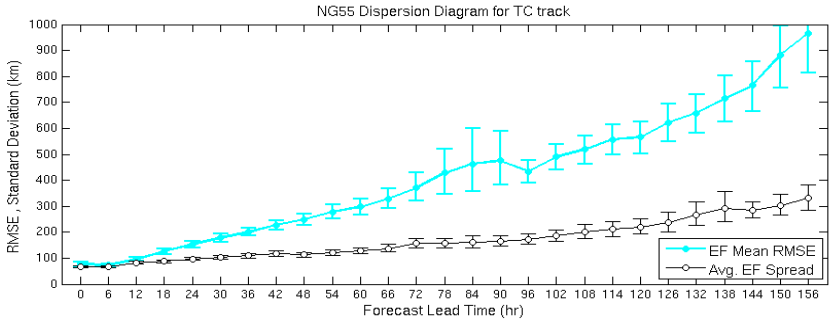
What else?

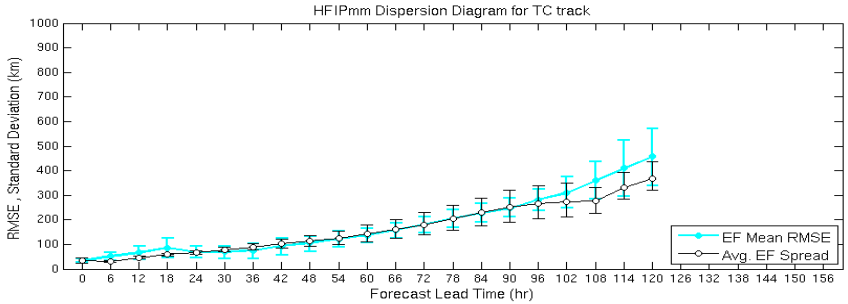
Evaluating ensembles

- Select Series Tab
- Y1 Dependent is APCP_03 -> SSVAR_RMSE, SSVAR_Spread
- Add Y1 Dependent VX_MASK -> CONUS
- Y1 Series Var MODEL -> multip_ens_hwt
- FCST_LEAD -> Select all leads
- Statistics
- Aggregation (see below)

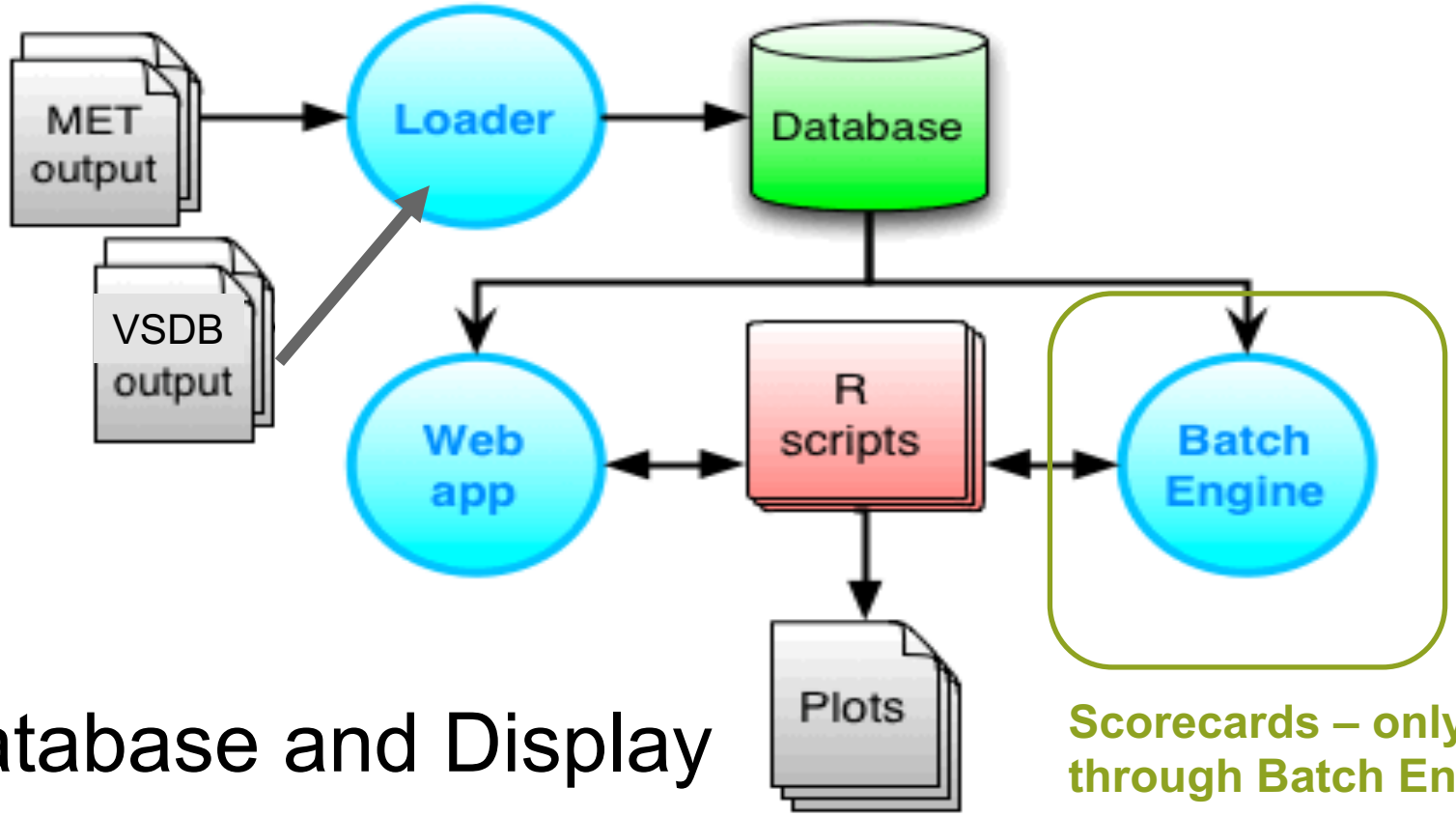


Spread-skill





Scorecards



Database and Display

Scorecards – only run through Batch Engines

MET+ Scorecard

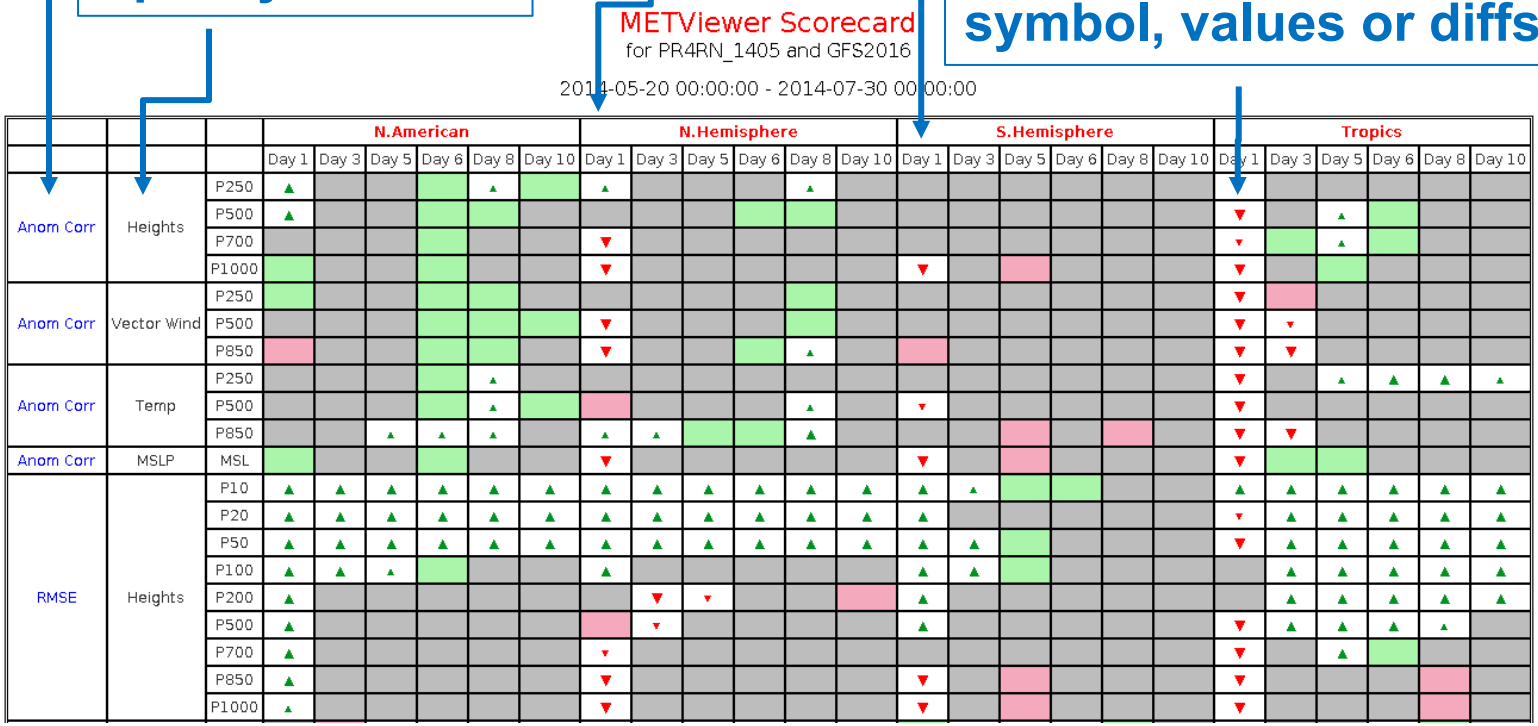
Specify the Statistic

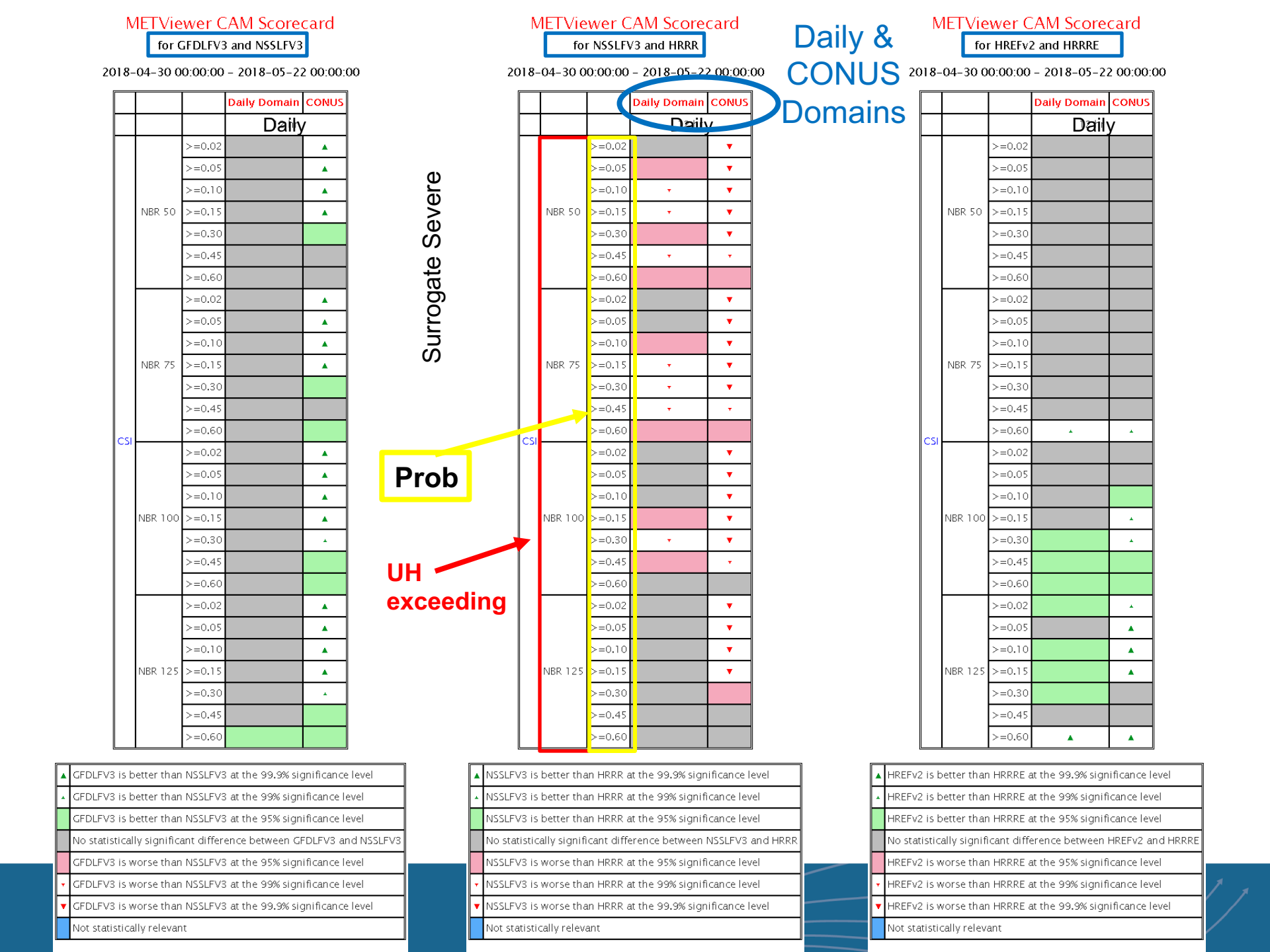
Specify the aggregations

Specify the regions

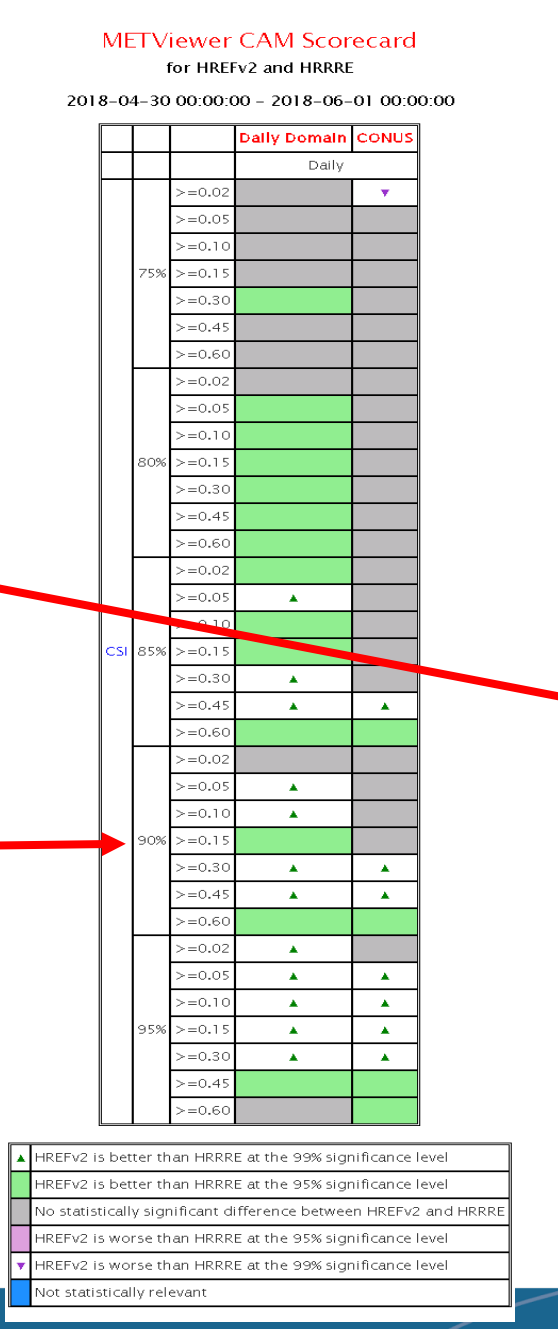
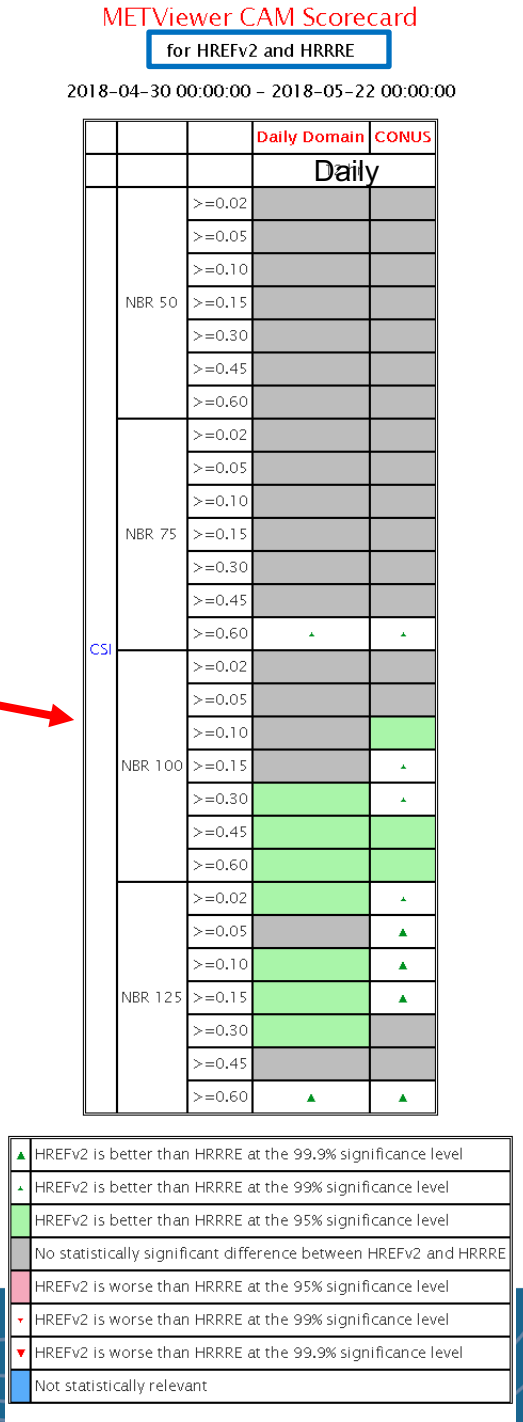
Specify the Field

Specify whether you have symbol, values or diffs




METViewer CAM Scorecard
for GFDLFV3 and NSSLFV3
2018-04-30 00:00:00 - 2018-05-22 00:00:00
Daily Domain
CONUS
Daily
CSI
NBR 50
NBR 75
NBR 100
NBR 125
>=0.02
>=0.05
>=0.10
>=0.15
>=0.30
>=0.45
>=0.60
METViewer CAM Scorecard
for NSSLFV3 and HRRR
2018-04-30 00:00:00 - 2018-05-22 00:00:00
Daily Domain
CONUS
Daily
Daily & CONUS Domains
Surrogate Severe
Prob
UH exceeding
METViewer CAM Scorecard
for HREFv2 and HRRRE
2018-04-30 00:00:00 - 2018-05-22 00:00:00
Daily Domain
CONUS
Daily
GFDLFV3 is better than NSSLFV3 at the 99.9% significance level
GFDLFV3 is better than NSSLFV3 at the 99% significance level
GFDLFV3 is better than NSSLFV3 at the 95% significance level
No statistically significant difference between GFDLFV3 and NSSLFV3
GFDLFV3 is worse than NSSLFV3 at the 95% significance level
GFDLFV3 is worse than NSSLFV3 at the 99% significance level
GFDLFV3 is worse than NSSLFV3 at the 99.9% significance level
Not statistically relevant
NSSLFV3 is better than HRRR at the 99.9% significance level
NSSLFV3 is better than HRRR at the 99% significance level
NSSLFV3 is better than HRRR at the 95% significance level
No statistically significant difference between NSSLFV3 and HRRR
NSSLFV3 is worse than HRRR at the 95% significance level
NSSLFV3 is worse than HRRR at the 99% significance level
NSSLFV3 is worse than HRRR at the 99.9% significance level
Not statistically relevant
HREFv2 is better than HRRRE at the 99.9% significance level
HREFv2 is better than HRRRE at the 99% significance level
HREFv2 is better than HRRRE at the 95% significance level
No statistically significant difference between HREFv2 and HRRRE
HREFv2 is worse than HRRRE at the 95% significance level
HREFv2 is worse than HRRRE at the 99% significance level
HREFv2 is worse than HRRRE at the 99.9% significance level
Not statistically relevant

To eliminate biases Percentile Thresholding applied

Specific Threshold

Threshold used is associated with Percentiles (75, 80, 85, 90, 95) computed from climatology