

# METplus Tutorial

Presenters: Tara Jensen, John Halley Gotway, Julie Prestopnik, Minna Win-Gildenmeister, Dan Adriaansen, Mallory Row and Perry Shafran  
*with contributions from Jim Frimel, George McCabe, Howard Soh, Tatiana Burek, Randy Bullock, Tina Kalb, Hank Fisher, and Jonathan Vigh*

*Oct 1-5, 2018*

*National Center for Weather and Climate Prediction  
College Park, MD*

# Welcome



Tutorial sponsored by Next Generation Global Prediction System (NGGPS) Program Office

**On the phone:** Mute your phones until you want to ask a question

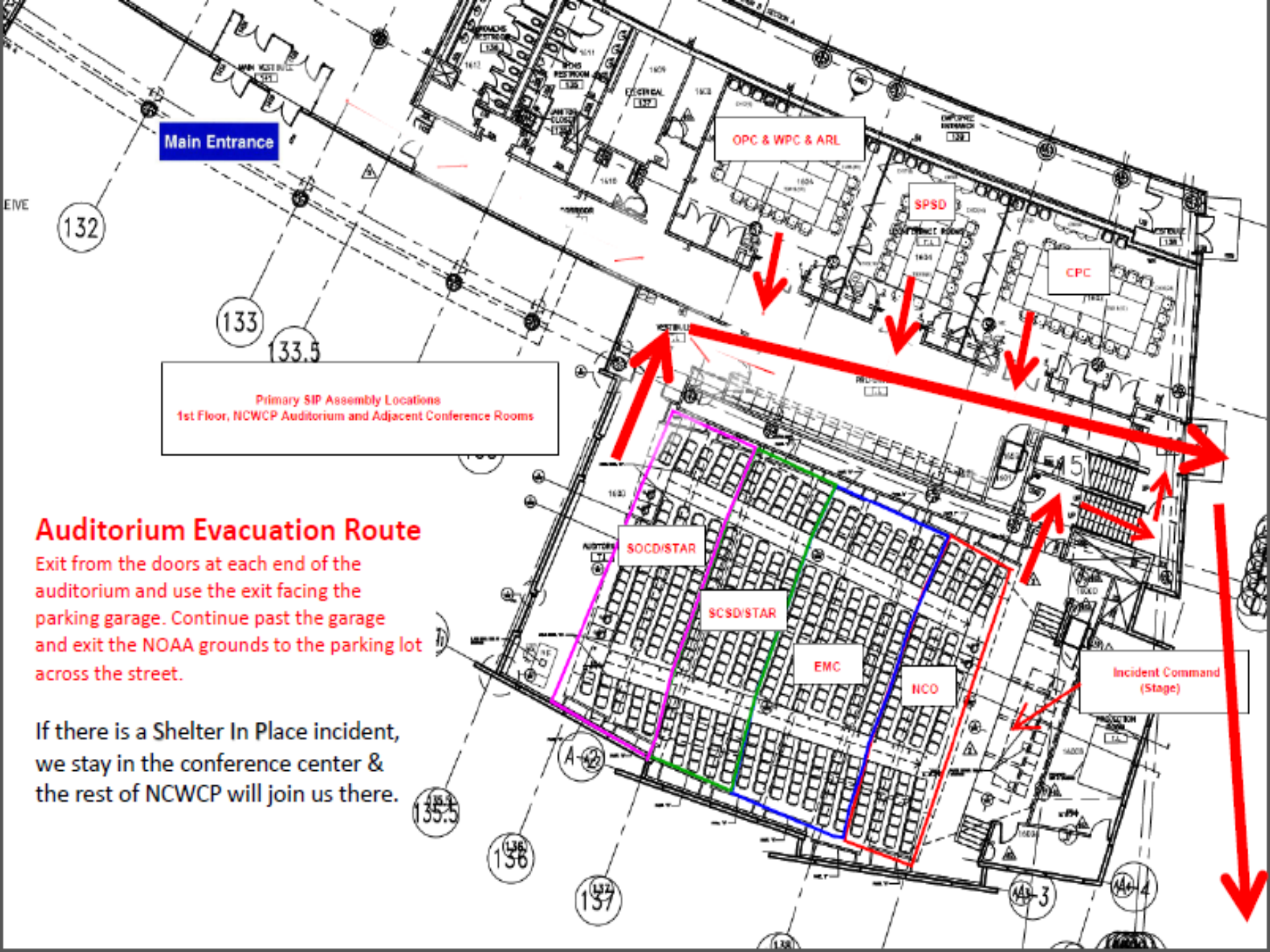
**In the audience:** Silence your phones; Use microphones for questions

**Meals and coffee breaks:**

Breaks and Lunches are on your own

**Wifi (NOAAGuest):** Type your email into browser

**Safety and evacuation:** See next slides



Main Entrance

OPC & WPC & ARL

SPSD

CPC

Primary SIP Assembly Locations  
1st Floor, NCWCP Auditorium and Adjacent Conference Rooms

### Auditorium Evacuation Route

Exit from the doors at each end of the auditorium and use the exit facing the parking garage. Continue past the garage and exit the NOAA grounds to the parking lot across the street.

If there is a Shelter In Place incident, we stay in the conference center & the rest of NCWCP will join us there.

SOCD/STAR

SCSD/STAR

EMC

NCO

Incident Command (Stage)

# Auditorium Evacuation Route

NCWCP



Earth System Science Interdisciplinary Center  
Joint Global Change Research Institute

Ronald Reagan Center Wash DC

Evacuation Assembly Area



Construction Zone

River Road

# Goals of Tutorial

- Train users on how to install METplus and the MET component
- Familiarize users with MET and METviewer components
- Train users on how to use METplus use-cases out of the box and then customize them
- Encourage users to contribute to development
- Update users on new and upcoming features
- Obtain input from users about how to enhance the system

# General Schedule

Detailed	Schedule			Color Key	
REMOTE ACCESS INFO - ReadyTalk		<i>Please share ReadyTalk resources when possible</i>		Fundamental/Overview	
Audio: 866-740-1260 meeting_id: 4978479				Advanced Topic	
Web: www.readytalk.com; join meeting_id: 4978479				Updates and User Input	
	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>
<b>8:30</b>	Tutorial starts at 10:30 AM ET	MET Tools Overview - pre-processing; masking; regridding	MODE and MODE-TD; Assistance with setting up METplus	MET-TC and METplus Track and Intensity use-case	Review of 1-3 METplus use-cases selected by group on Thursday
<b>10:00</b>	--	BREAK		BREAK	BREAK
<b>10:30</b>	Introductions, Basic METplus overview	MET Tools Overview - Grid-Stat; Point-Stat; Ensemble Stat	Whats New in MET and METviewer	METplus in use at NCEP; Assistance with METplus	Coming Enhancements and User Input
<b>12:00</b>	LUNCH	LUNCH	LUNCH	LUNCH	ADJOURN
<b>1:00</b>	Compiling MET - Fundamental instructions and nuances of Theia, WCOSS, Jet and Gaea; METviewer in a container	METviewer Overview - loading data and user interface	METplus repo and developers best practices; METplus use-cases; Global grid-to-grid	METplus use-cases; Feature Relative; Meso grid-to-point	
<b>2:30</b>	BREAK	BREAK	BREAK	BREAK	
<b>3:00</b>	Installing METplus - Fundamental Instructions, configuring for common install location; how to run and troubleshooting	METviewer Overview - running in batch; modify XML; scorecards	METplus use-cases; Global grid-to-point; Accumulated Precip	General METplus Q&A including MET and METviewer components	
<b>4:30</b>	ADJOURN	ADJOURN	ADJOURN	ADJOURN	

# Show of Hands... Who's here from

Who's here from:

- EMC
- WPC
- CPC
- JCSDA
- Other?

Who has used:

- MET
- METviewer
- METplus



# History

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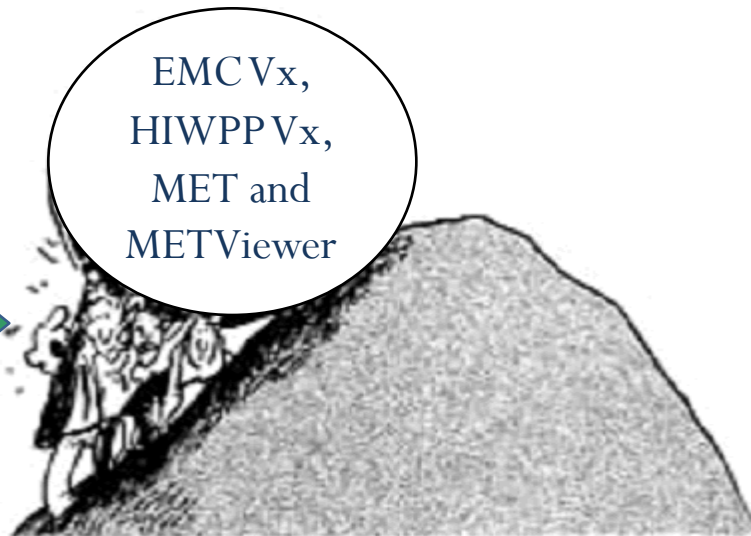


# Status in 2016

## Recommendations to unify on MET/METViewer (MET+):

- UMAC committee
- NGGPS Verification and Validation Team
- 2<sup>nd</sup> CAM Ensemble Design Workshop (*\*where possible*)
- NUOPC is tracking unification progress

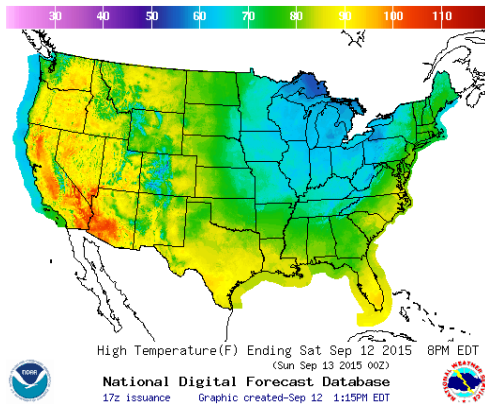
**Unification**  
Let's all work  
together to build a  
unified package



- *3400+ users in 130 countries*
- *Increased use at NOAA and Air Force*
- *MET is maintained publicly on NCAR and NOAA HPCs*

# Why Unification

Forecasters



Government Centers



University and National Lab Researchers



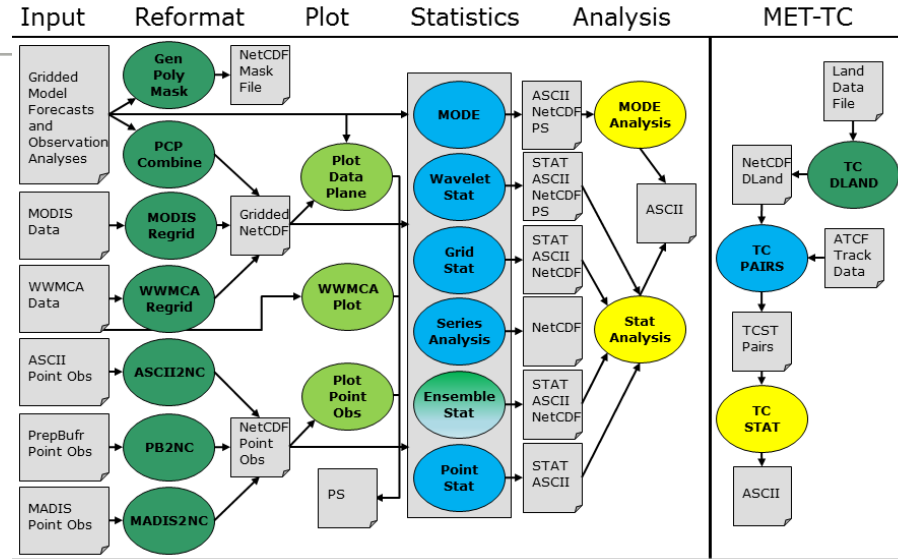
**Comprehensive and unified verification tool - Make R20 more efficient - Provide a consistent set of metrics**

Allows Researchers and Operational Scientists to speak a “common verification” language

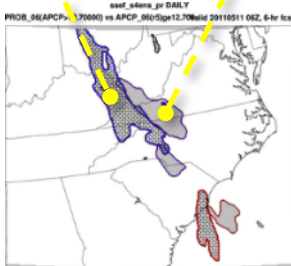
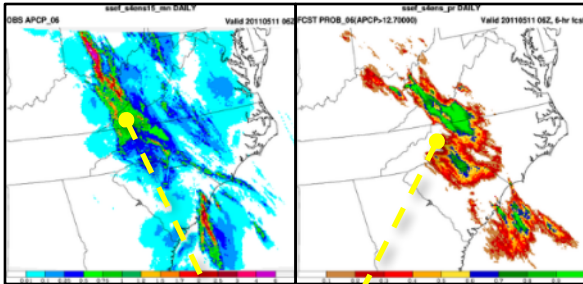


User Support of unified package provides greater opportunity to train all on verification best practices

- Originally developed to replicated the EMC mesoscale verification system
- Over 85 traditional statistics using both point and gridded datasets
- 15 interpolation methods
- Computation of confidence intervals
- Able to read in GRIB1, GRIB2 and CF-compliant NetCDF
- Applied to many spatial and temporal scales
- 3500+ users, both US & Int'l

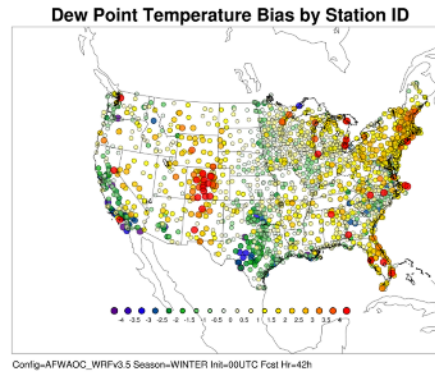


### Object Based and Spatial Methods

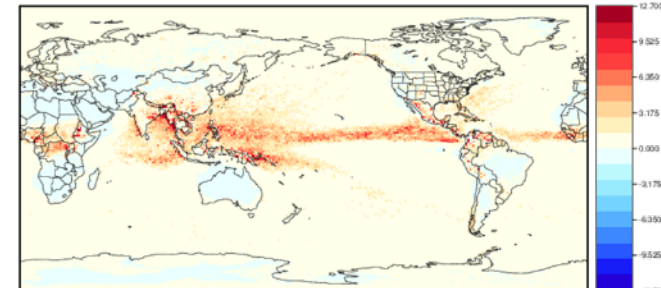


Bad forecast or Good forecast with displacement error?

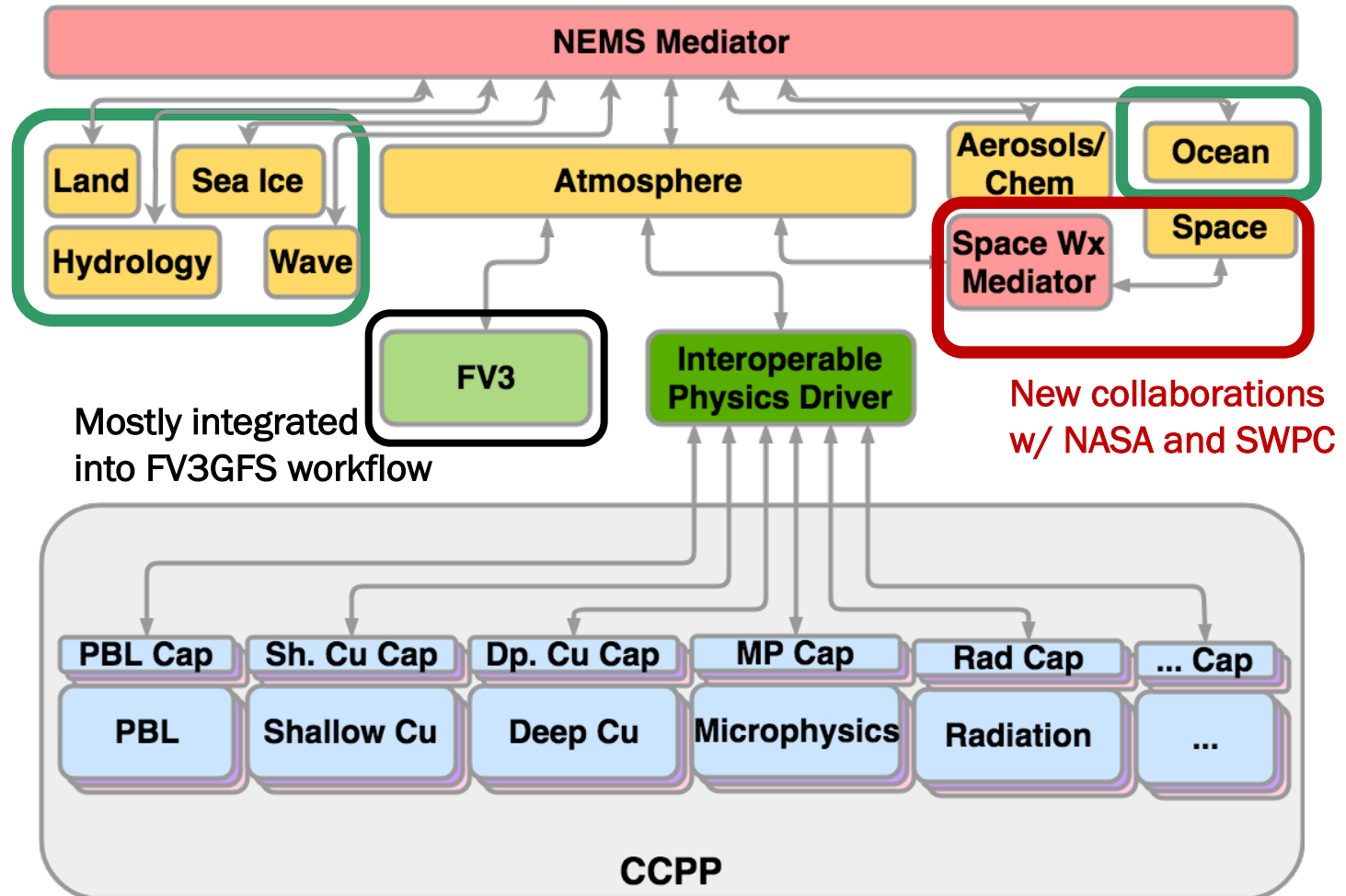
### Geographical Representation of Errors



### 90<sup>th</sup> Percentile of difference between two models



# The Goal: Have Capability to Evaluate All Aspects of the Coupled UFS



Already have pre-existing packages which we will link in

Mostly integrated into FV3GFS workflow

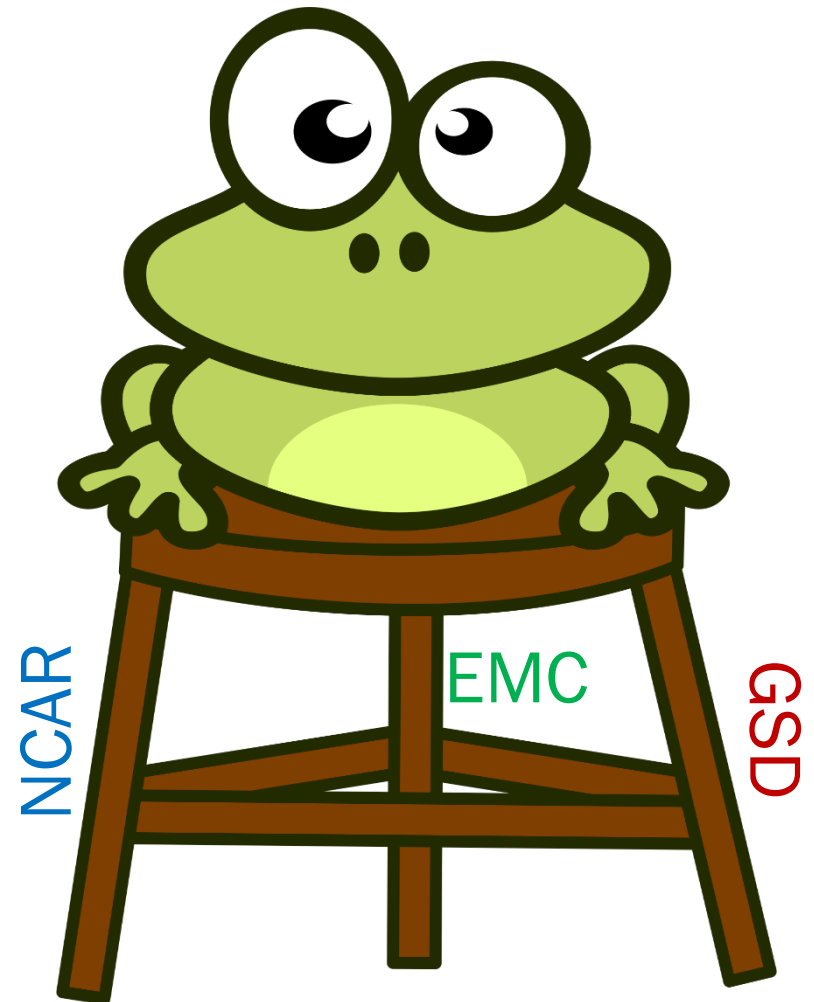
New collaborations w/ NASA and SWPC

Image courtesy of GMTB

# Unification Roadmap

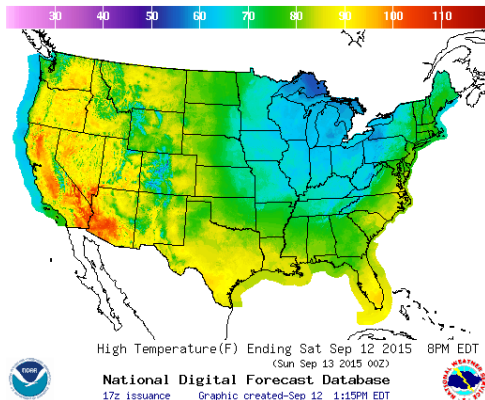
<https://github.com/NCAR/METplus/wiki/NGGPS-Verification-Unification-Requirements---Status-Reports>

- Met with 50+ NCEP staff (EMC, WPC, CPC, NCO)
- Included discussions with coupled system “components”
- 99 functional requirements and 19 non-functional broken down by priorities
  - Statistics
  - Plot types
  - Data types
  - Preprocessing
  - Database and display
  - Documentation and help desk



# Unifying Through Blending: Contributions from Multiple Projects

Forecasters



Operational Centers



Researchers



## DTC Community Support

### Long-term Projects

DTC  
T&E

NGGPS

HFIP

USWRP

JTTI

Hurricane  
Supplemental

### Projects of Opportunity

DTC  
Visitor

NOAA, NASA,  
DOE

Other NCAR  
Labs

International  
Capacity  
Building

Community  
Contribution

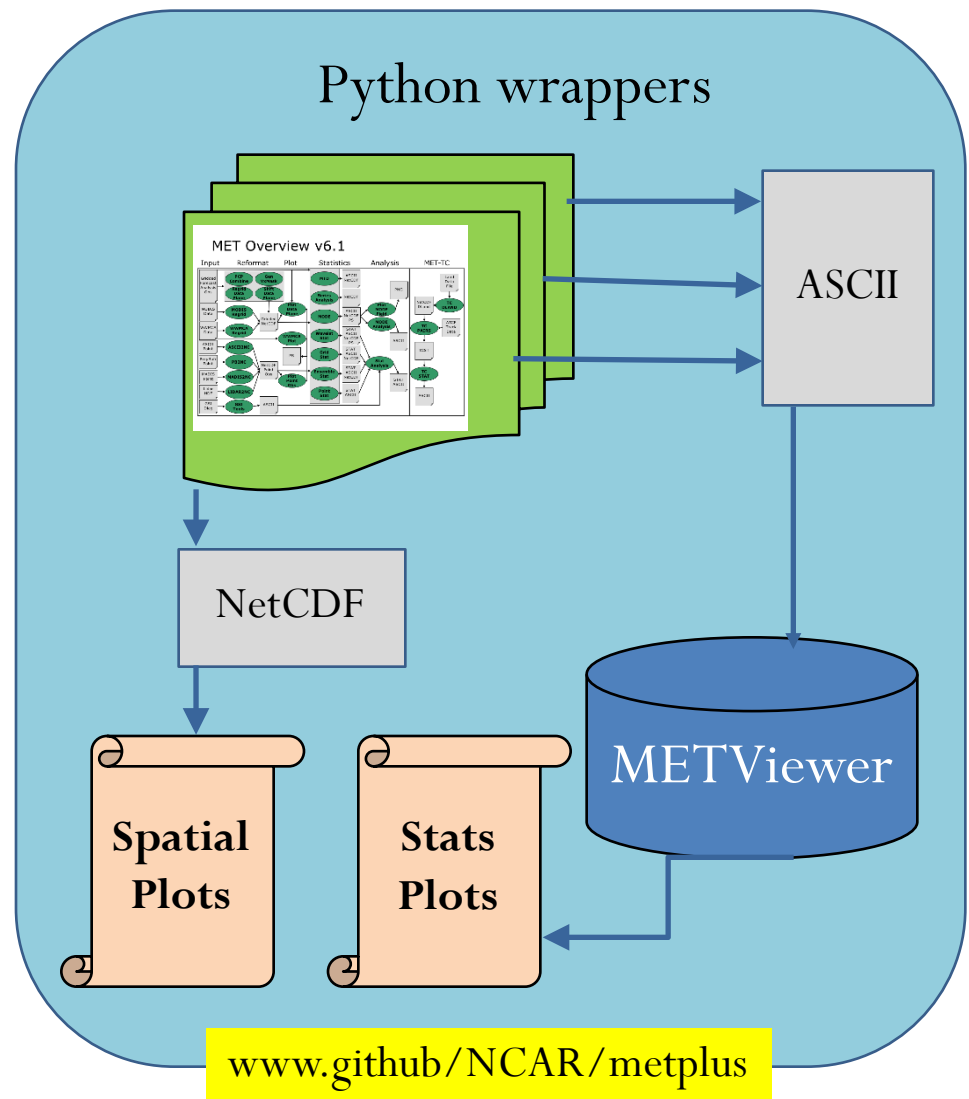
# METplus Overview

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# General Concept of METplus

Python wrappers around:

- MET (core)
- METViewer (core)
- Plotting
  - METViewer User Interface
  - METViewer Batch Engine
  - Python plotting scripts
- Communication between MET & python algorithms



***Near Term:** After Global - CAM, Ensembles and Aerosols / Air Qual*

***Longer Term:** Earth System "Components"*



# Components



NCAR / METplus

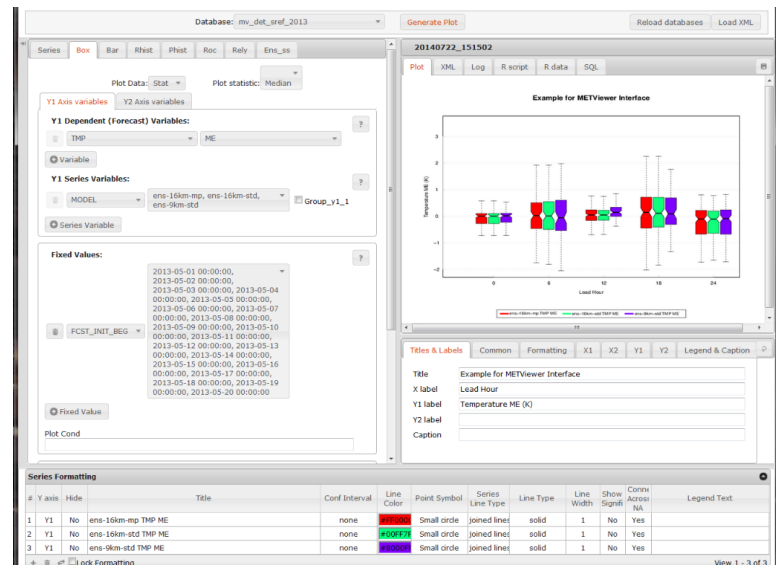
Code Issues 55 Pull requests 0 Projects 0 Wiki Insights

Python scripting infrastructure for MET tools.

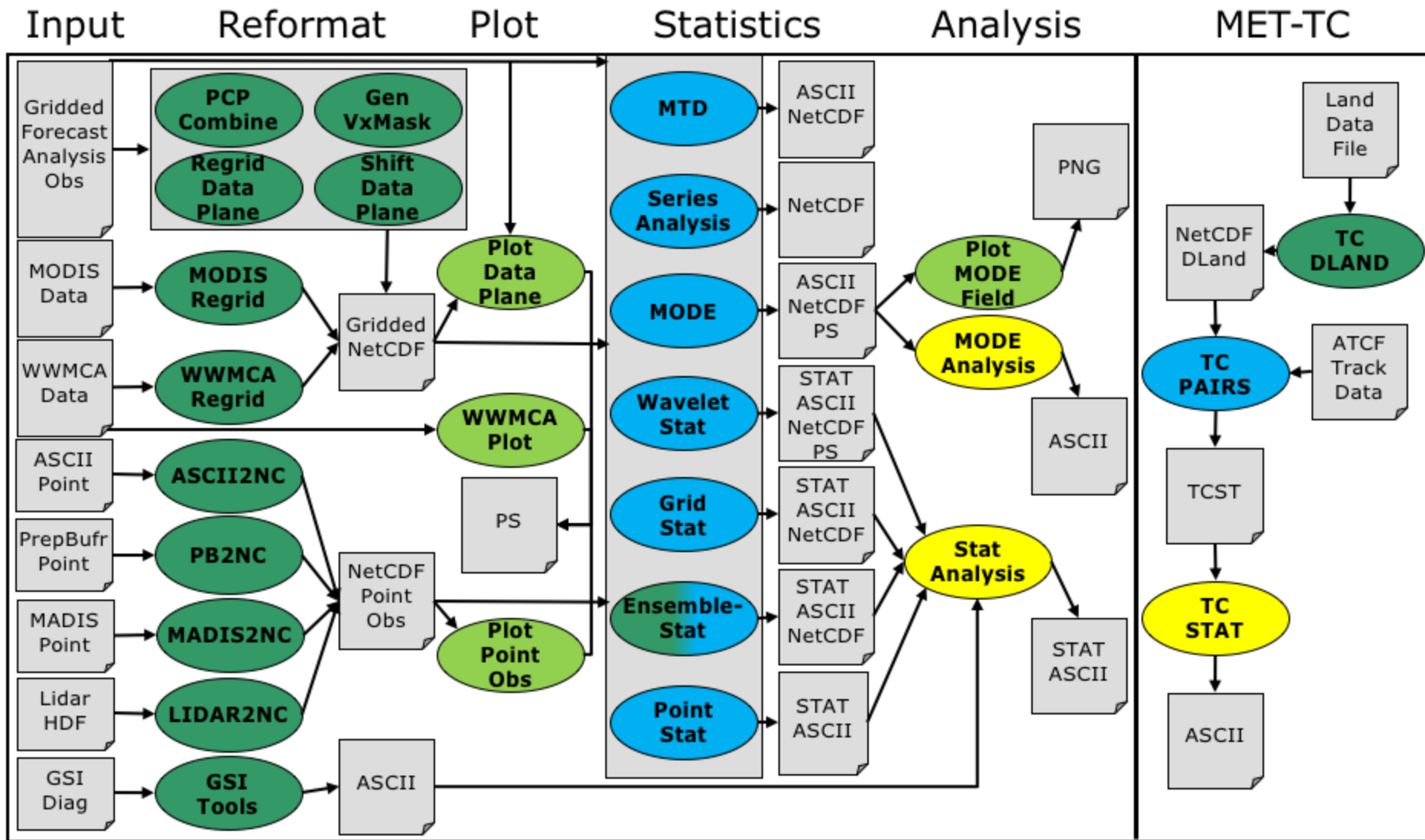
1,527 commits 14 branches 15 releases

Branch: master New pull request Create

- jimfrimel Updated notes in the logging conf file.
- doc One more minor change to affiliation list
- internal\_tests Replaced all instances of INIT\_INC with INIT\_INCREMENT
- parm Updated notes in the logging conf file.
- src Change name from Alpha-produtil to Beta-METplus.
- ush Aligned the feature relative use case INIT\_END time with the sample d...



# MET Overview v8.0



# Laundry List of Statistics

Type	Statistics
Continuous	Forecast and Observation mean, Standard deviation of the forecast and observations, Mean error (F-O), Standard deviation of the error, Anomaly Correlation, Pearson correlation coefficient, Spearman's rank correlation coefficient, Kendall's tau statistic, Multiplicative bias, Mean absolute error, Mean squared error, Bias-corrected mean squared error, Root mean squared error, 10th, 25th, 50th, 75th, and 90th percentiles of the error, Interquartile Range, Median Absolute Deviation, Square of the mean error, Mean squared error skill score, Root mean squared forecast anomaly, Root mean squared observation anomaly, Mean of absolute value of forecast and observed gradients, Mean of maximum of absolute values of forecast and observed gradients, Mean of absolute value of forecast minus observed gradients, S1 score, S1 score with respect to observed gradient, Ratio of forecast and observed gradients, Scalar Partial Sums, Vector Partial Sums, Anomaly Partial Sums
Categorical	Base rate, Forecast mean, Accuracy, Frequency Bias, Probability of detecting yes, Probability of detecting no, Probability of false detection, False alarm ratio, Critical Success Index, Gilbert Skill Score, Hanssen-Kuipers Discriminant, Heidke Skill Score, Odds Ratio, Logarithm of the Odds Ratio, Odds Ratio Skill Score, Extreme Dependency Score, Symmetric Extreme Dependency Score, Extreme Dependency Index, Symmetric Extremal Dependency Index, Bias Adjusted Gilbert Skill Score, Gerrity Score for multi-categorical statistics

# Laundry List of Statistics

Type	Statistics
<b>Probability</b>	Base Rate, Reliability, Brier Score, Resolution, Uncertainty, Climatological Brier Score, Brier Skill Score, Receiver Operating Characteristic (ROC) Curve, Area under the ROC curve, Reliability Diagram points, Economic Cost/Loss Relative Value Diagram points), Calibration, Refinement, Likelihood
<b>Ensemble</b>	Continuous Ranked Probability Skill Score, Ignorance Score, Rank Histogram, Probability Integral Transform, Relative Position
<b>Skill by Spatial Scale</b>	Fourier Decomposition of fields prior to computation of scores or use Wavelet_Stat tool which computes for each scale: Mean squared error, Intensity scale skill score, Forecast energy squared, Observed energy squared, Frequency Bias. Not scale dependent: Base rate
<b>Neighborhood</b>	Same as categorical statistics plus Fractions Brier Score, Fractions Skill Score, Asymptotic Fractions Skill Score, Uniform Fractions Skill ScoreTCe
<b>Tropical Cyclones</b>	Mean, Standard deviation, Minimum Value, Percentiles, Maximum Value, Interquartile Range, Range, Sum, Independence time, Frequency of superior performance, contingency tables counts for Rapid Intensification and Rapid Weakening, contingency tables counts for Probability of Rapid Intensification and Rapid Weakening

Type	Statistics
2D Objects	<p>For each object: Location of the centroid in grid units, Location of the centroid in lat/lon degrees, Axis angle, Length of the enclosing rectangle, Width of the enclosing rectangle, Object area, Radius of curvature of the object defined in terms of third order moments, Center of curvature, Ratio of the difference between the area of an object and the area of its convex hull divided by the area of the complex hull, percentiles of intensity of the raw field within the object, Percentile of intensity chosen for use in the percentile intensity ratio, Sum of the intensities of the raw field within the object,</p> <p>For paired objects: Distance between two objects centroids, Minimum distance between the boundaries of two objects, Minimum distance between the convex hulls of two objects, Difference between the axis angles of two objects, Ratio of the areas of two objects, Intersection area of two objects, Union area of two objects, Symmetric difference of two objects, Ratio of intersection areas, Ratio of complexities, Ratio of the nth percentile of intensity, Total interest value computed for a pair of simple objects, NetCDF files with the objects and raw data for further processing</p>
Objects through time	<p>For 3D objects: x,y and t coordinates of centroid, Latitude and Longitude of centroid, x, y component of object velocity, Angle that the axis plane of an object makes with the grid x direction, Integer count of the number of 3D “cells” in an object, Object start time, Object end time, Total great circle distance travelled by the 2D spatial centroid over the lifetime of the 3D object, percentiles of intensity of the raw field within the object</p> <p>For 3D object pairs: Spatial distance between coordinates of object space-time centroid, Difference in index of object spacetime centroid, Difference in spatial axis plane angles, Difference in object speeds, Difference in object direction of movement, Ratio of object volumes, Difference in object start times, Difference in object end times, “Volume” of object intersection, Difference in the lifetimes of the two objects, Total interest for this object pair, NetCDF files with the objects and raw data for further processing</p>

# METViewer Database and Display

Database: mv\_det\_sref\_2013 Generate Plot Reload databases Load XML

Series: **Box** Bar Rhist Phist Roc Rely Ens\_ss 20140722\_151502

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:  
 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

Temperature (K)

Lead Hour

ens-16km-mp TMP ME ens-16km-std TMP ME ens-9km-std TMP ME

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	Connec 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	

View 1 - 3 of 3

METViewer

- Allows users to thoroughly interrogate the data

# METViewer Plot Templates

The screenshot shows the METViewer 2.2 interface with the following components:

- Database: mv\_aerocivil
- Generate Plot button
- Reload databases and Load XML buttons
- Series menu: Box, Bar, Roc, Rely, Ens\_ss, Perf, Taylor, Hist, Edlv
- Plot Data: Stat
- Y1 Axis variables and Y2 Axis variables sections
- Y1 Dependent (Forecast) Variables: APCR\_03, CSI
- Y1 Series Variables: MODEL, GFS\_27km\_WRFv3.6.1, GFS\_3km\_WRFv3.6.1, GFS\_9km\_WRFv3.6.1, Group\_y1\_1
- Fixed Values: Fixed Value, Event Equalizer
- Plot Cond
- Independent Variable: FCST\_LEAD, Select value, Equalize
- Statistics
- Series Formatting table

#	Y axis	Hide	Title	Conf Interval
1	Y1	No	GFS_27km_WRFv3.6.1 APCR_03 CSI	none
2	Y1	No	GFS_3km_WRFv3.6.1 APCR_03 CSI	none
3	Y1	No	GFS_9km_WRFv3.6.1 APCR_03 CSI	none

Series Formatting table (partial view):

Color	Marker	Line Style	Line Width	Fill	Stroke	Stroke Width	Stroke Color
#8000FF	Small circle	joined lines	solid	1	No	Yes	
#00FF7F	Small circle	joined lines	solid	1	No	Yes	

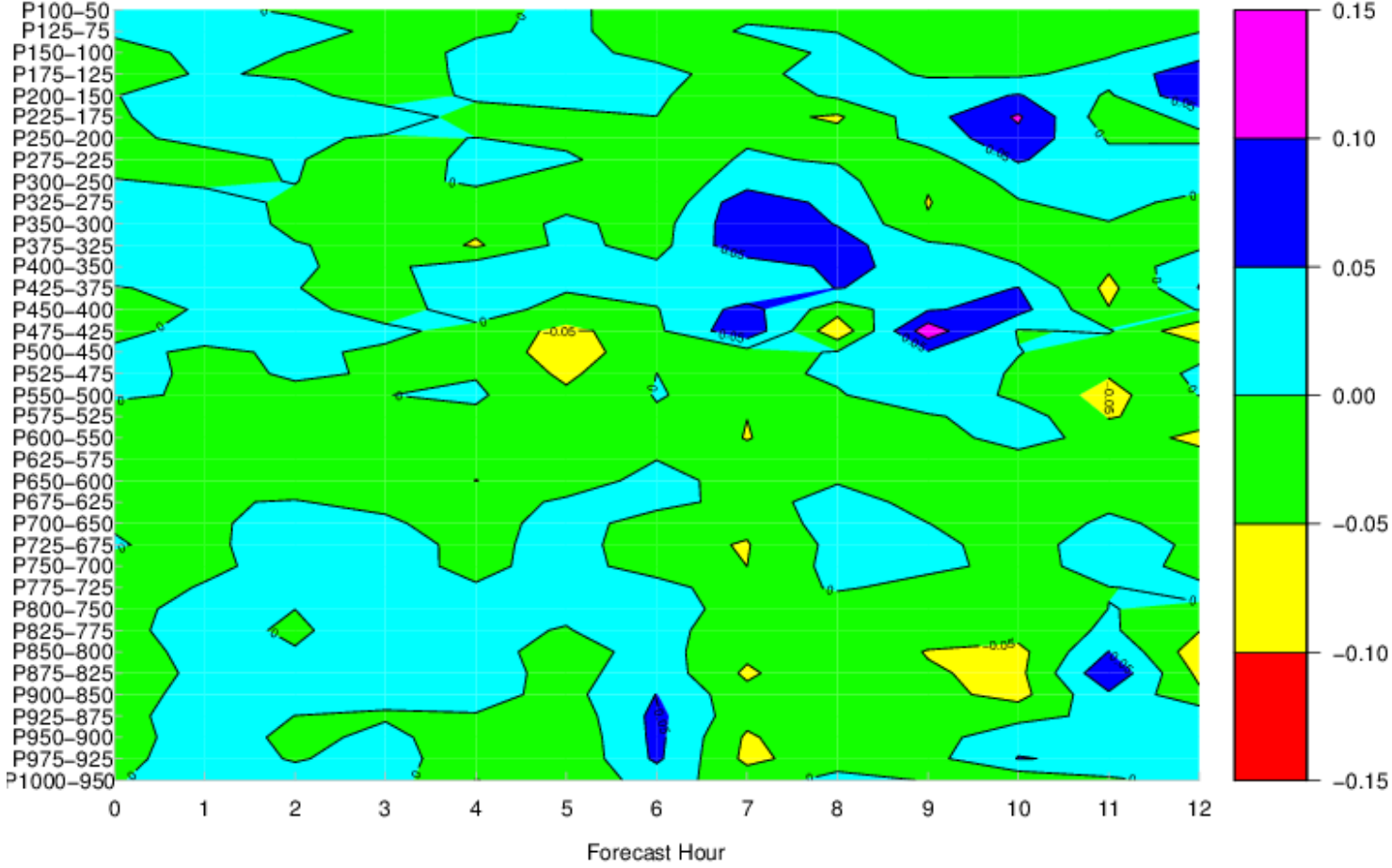
Buttons: + Add Derived Curve, - Remove Derived Curve, Apply defaults, Lock Formatting

View 1 - 3 of 3

- Series
- Box
- Bar
- ROC
- Reliability
- Ensemble Spread-Skill
- Performance Diagram
- Taylor Diagram
- Hist (Rhist, Phist, RELP)
- ECLV
- Contour \*NEW
- Scorecard \*Batch Engine

# METViewer Contour Plots

Wind Speed RMSE (NoVAD-CTRL)



WIND RMSE DIFF



This Year:

# Scorecarding using METViewer

Specify statistic

Specify aggregations

Specify regions

Specify field and level

Specify whether you have symbol, values or both

METViewer Scorecard  
for PR4RN\_1405 and GFS2016  
2014-05-20 00:00:00 - 2014-07-30 00:00:00

		N.American					N.Hemisphere					S.Hemisphere					Tropics								
		Day 1	Day 3	Day 5	Day 6	Day 8	Day 10	Day 1	Day 3	Day 5	Day 6	Day 8	Day 10	Day 1	Day 3	Day 5	Day 6	Day 8	Day 10	Day 1	Day 3	Day 5	Day 6	Day 8	Day 10
Anom Corr	Heights	P250	▲			▲	▲	▲				▲									▼	▲	▲		
		P500	▲			▲	▲	▲				▲									▼	▲	▲	▲	
		P700																			▼	▲	▲	▲	
		P1000	▲			▲	▲	▲													▼	▲	▲	▲	
Anom Corr	Vector Wind	P250			▲	▲	▲					▲								▼	▲	▲			
		P500				▲	▲	▲												▼	▲	▲			
		P850	▲			▲	▲	▲												▼	▲	▲			
Anom Corr	Temp	P250			▲	▲	▲													▼	▲	▲	▲	▲	
		P500				▲	▲	▲												▼	▲	▲			
		P850		▲	▲	▲	▲	▲												▼	▲	▲			
Anom Corr	MSLP	MSL	▲			▲	▲												▼	▲	▲				
RMSE	Heights	P10	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	
		P20	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▼	▲	▲	▲	▲
		P50	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▼	▲	▲	▲	▲
		P100	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▼	▲	▲	▲	▲
		P200	▲																		▼	▲	▲	▲	▲
		P500	▲																		▼	▲	▲	▲	▲
		P700	▲																		▼	▲	▲	▲	▲
		P850	▲																		▼	▲	▲	▲	▲
P1000	▲																		▼	▲	▲	▲	▲		





# Working Towards Easy Usability: METplus Use Case Example

Observed 1-min  
AOD Data



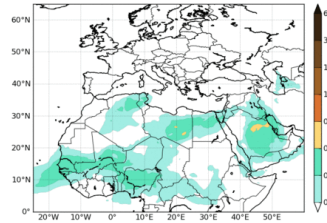
ASCII  
2NC

Observed AOD  
6-hr mean, max, stdev, range

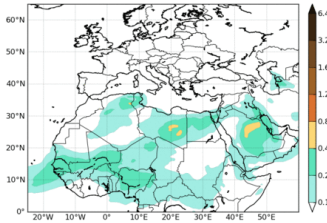


Forecasted  
Aerosol Optical  
Depth (AOD):  
6-hr mean, max  
stdev, range

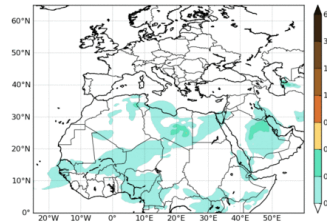
WMO SDS-WAS N.Africa-Middle East-Europe RC  
MEDIAN Dust AOD  
Run: 12h 15 MAR 2018 Valid: 12h 15 MAR 2018 (H+00)



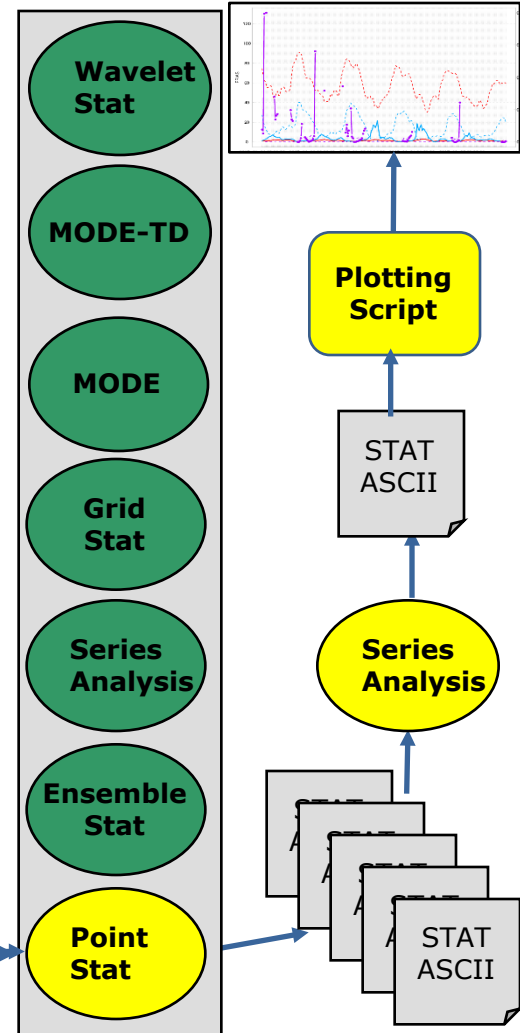
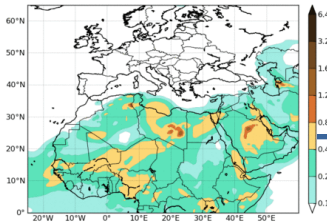
WMO SDS-WAS N.Africa-Middle East-Europe RC  
MEAN Dust AOD  
Run: 12h 15 MAR 2018 Valid: 12h 15 MAR 2018 (H+00)



WMO SDS-WAS N.Africa-Middle East-Europe RC  
STDEV Dust AOD  
Run: 12h 15 MAR 2018 Valid: 12h 15 MAR 2018 (H+00)



WMO SDS-WAS N.Africa-Middle East-Europe RC  
RANGE Dust AOD  
Run: 12h 15 MAR 2018 Valid: 12h 15 MAR 2018 (H+00)



# Working Towards Easy Usability: METplus Use Case Example

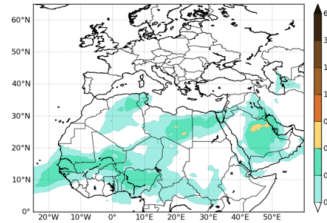
Observed 1-min  
AOD Data



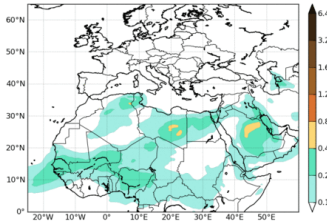
Observed AOD  
6-hr mean, max, stdev, range



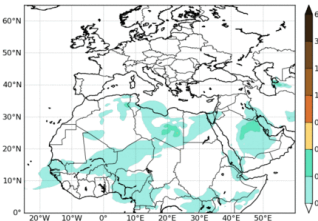
WMO SDS-WAS N.Africa-Middle East-Europe RC  
MEDIAN Dust AOD  
Run: 12h 15 MAR 2018 Valid: 12h 15 MAR 2018 (H+00)



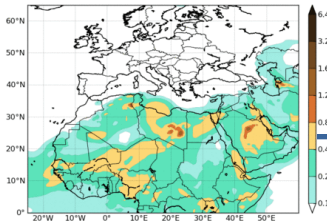
WMO SDS-WAS N.Africa-Middle East-Europe RC  
MEAN Dust AOD  
Run: 12h 15 MAR 2018 Valid: 12h 15 MAR 2018 (H+00)



WMO SDS-WAS N.Africa-Middle East-Europe RC  
STDEV Dust AOD  
Run: 12h 15 MAR 2018 Valid: 12h 15 MAR 2018 (H+00)

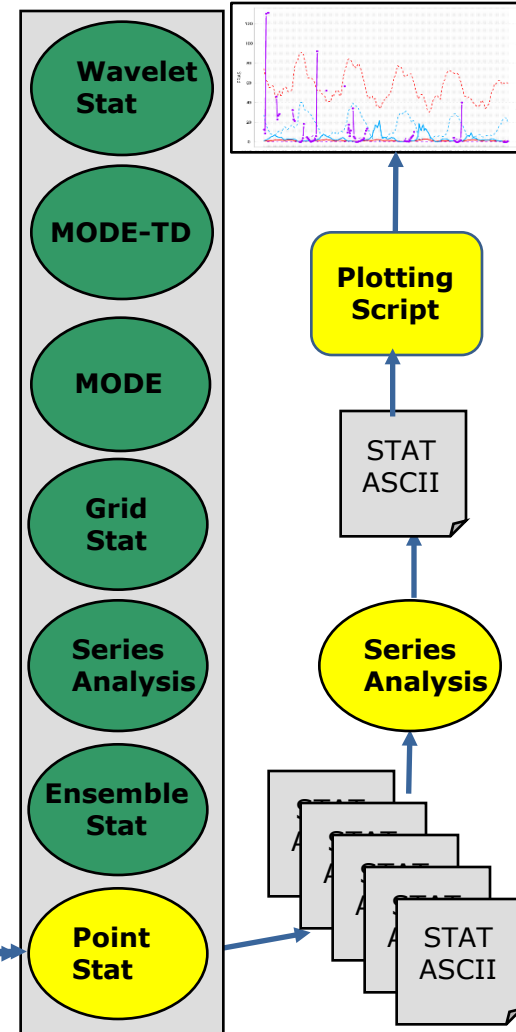


WMO SDS-WAS N.Africa-Middle East-Europe RC  
RANGE Dust AOD  
Run: 12h 15 MAR 2018 Valid: 12h 15 MAR 2018 (H+00)



## Use-case includes

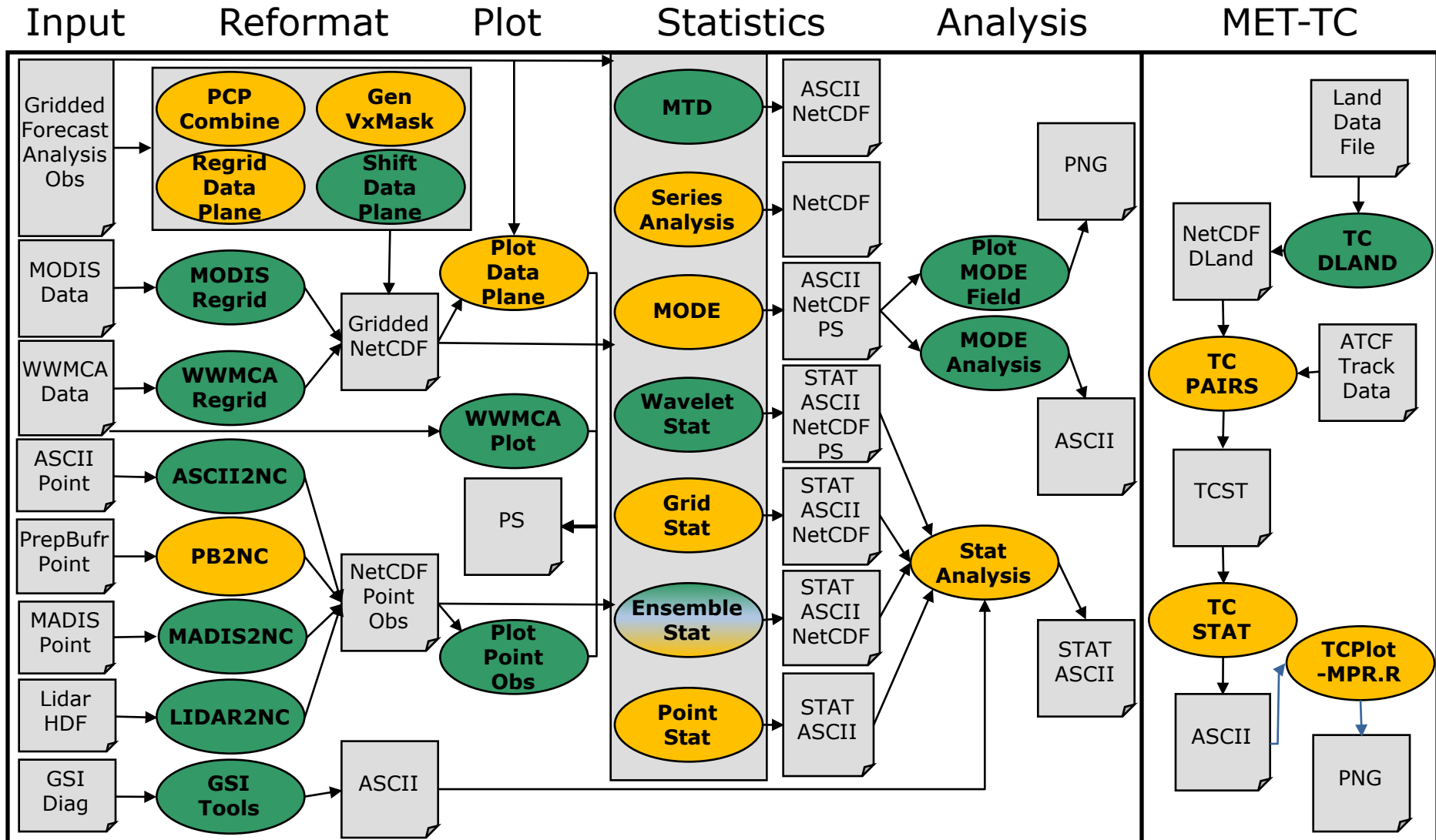
- METplus .conf file
- MET config files
- Python scripts to:
  - Call Ascii2NC
  - Call Point-Stat
  - Call Stat-Analysis
  - Make statistics plot
  - Make plot of fields



# What Does Wrapped by Python Mean?

---

# What is Wrapped by Python Right Now



# What does wrapped by Python mean?

At <https://github.com/NCAR/METplus/>

In MET  
Configs:  
Environment  
variables  
passed in  
from  
METplus  
.conf (config)  
file

```
30
31  ////////////////////////////////////////////////////////////////////
32
33  cat_thresh = [ NA ];
34  cnt_thresh = [ NA ];
35  cnt_logic  = UNION;
36
37  //
38  // Forecast and observation fields to be verified
39  //
40  fcst = {
41
42  {
43      {
44          name = "${NAME}";
45          level = [ "${LEVEL}" ];
46      }
47  };
48
49  }
50  obs = fcst;
51
52  ////////////////////////////////////////////////////////////////////
53
54  //
55  // Climatology mean data
```

Series\_Analysis\_Config



master\_metplus.py

METplus  
config  
scripts

metplus\_final.conf

```
63 MET_BUILD_BASE = /path/to
64 MET_BASE = {MET_BUILD_BASE}/share/met
65
66 ## Output directories
67 LOG_DIR = {OUTPUT_BASE}/logs
68
69 TMP_DIR = #
70 # DIRECTORIES
71 # [dir]
72 # EXE # Input data
73 [exe] # This is the
74 # NON # PROJ_DIR = /
75 WGRIB # MODEL_DATA_D
76 CUT_EX #
77 TR_EX # FILENAME
78 RM_EX #
79 NCAP2 # [filename_t
80 CONVE # NOTE: The
81 NCDUM #
82 EGREP # #GFS_FCST_FI
83 #GFS_FCST_NC
#GFS_ANLY_FI
#GFS_ANLY_NC
```

```
66 [config]
67 EXPT=METplus ;; Experiment name, used for finding installation locati
68 # Options are processes, times
69 LOOP_METHOD = processes
70 # Processes to run in master script (master_met_plus.py)
71 PROCESS_LIST = Usage
72 # NOTE: "TOTAL" is a REQUIRED cnt statistic used by the series analysi
73 STAT_LIST = TOTAL, FBAR, OBAR, ME, MAE, RMSE, BCMSE, E50, ETQR, MAD
74 # Init time
75 INIT_TIME_FMT = %Y%m%d
76 INIT_BEG = 20141214
77 INIT_END = 20141216
78 INIT_THC = 21600
79 #21600 sec (hours) The increment in seconds in integer format
80 # LOGGING
81 LOG_LEVEL = DEBUG ;; Levels: DEBUG, INFO, WARNING, ERROR, CRITICAL
82 LOG_FILENAME = {LOG_DIR}/master_met_plus.log ;; NOTE: current YYYYMMDD
```

METplus  
Wrapper 1

Input

MET  
Tool  
1

Output  
1

METplus  
Wrapper 2

Output  
2

METplus  
Wrapper 3

MET  
Tool  
2

Output  
3

From .conf  
to running MET



# What does wrapped by Python mean?

At <https://github.com/NCAR/METplus/>

NCAR / METplus Private

Unwatch 10 Star 2 Fork 4

Code Issues 32 Pull requests 0 Projects 0 Wiki Insights

Python scripting infrastructure for MET tools.

590 commits 4 branches 7 releases 6 contributors

Branch: master New pull request Create new file Upload files Find file Clone or download

bikegeek Include TcStat in process list Latest commit c8be465 17 minutes ago

doc	Replaced GFS_DIR with MODEL_DATA_DIR, now consistent with metplus_dat...	2 days ago
internal_tests	Merge branch 'master' into merge-qpf-sbu	7 days ago
parm	Include TcStat in process list	17 minutes ago
sorc	Initial Commit of Doxygen documentation suite.	4 months ago
ush	Fixed incorrect syntax for retrieving the MET_BUILD_BASE from the met...	25 minutes ago
.gitignore	Initial commit	a year ago
README.md	Updated top-level README .	3 months ago

README.md

Control  
File and  
Config



Python  
Scripts



# What does wrapped by Python mean?

## METplus/parm/use\_cases/feature\_relative









### feature\_relative.conf

```
120 #
121 #   LISTS AND SETTINGS
122 #
123
124 #   Processes to run in master script (master_met_plus.py)
125
126 PROCESS_LIST = ["run_tc_pairs.py", "extract_tiles.py", "series_by_lead.py"]
127
128 #
129 #   NOTE: "TOTAL" is a REQUIRED cnt statistic used by the series analysis scripts
130 #
131
132 STAT_LIST = ["TOTAL", "FBAR", "OBAR", "ME", "MAE", "RMSE", "BCMSE", "E50", "EIQR", "MAD"]
133
134 #   Dates must be in YYYYMMDD format
135 #   INIT_HOUR_INC is the increment in integer format
136 #   INIT_HOUR_END should be a string in HH or HHH format
137
138 INIT_DATE_BEG = "20141201"
139 INIT_DATE_END = "20150331"
140 INIT_HOUR_INC = 6
141 INIT_HOUR_END = "18"
142
143 #   Used by extract_tiles.py to define the records of interest from the grib2 file
144
145 VAR_LIST = ["HGT/P500", "PRMSL/Z0", "TMP/Z2", "PWAT/L0", "HGT/P250", "TMP/P850", "TMP/P500", "UGRD/P250", "VGRD/P250" ]
146 EXTRACT_TILES_VAR_LIST = []
147
148 #   Used for performing series analysis based on lead time
149
```

# METplus Use-Cases

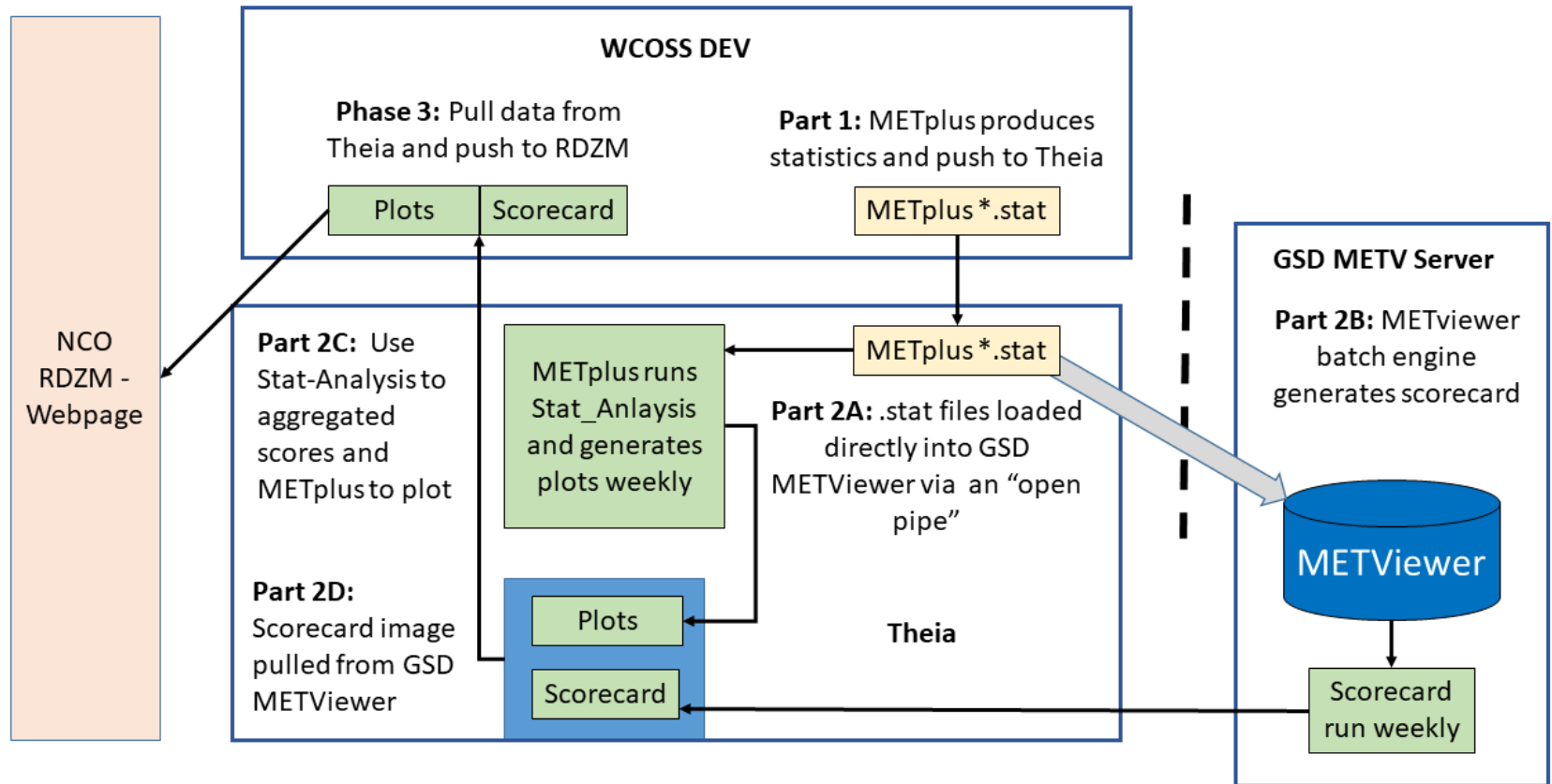
- MET+ integrated into FV3GFS parallel workflow
- Grid-to-Grid, Grid-to-Point, QPF/Precip, and TC Track and Intensity verification included
- Feature Relative and Extra-Tropical Cyclone examples also available

Branch: **master** ▾ [METplus](#) / [parm](#) / [use\\_cases](#) /

 <b>bikegeek</b> Removed hard-coded path to MET v6.0	
..	
 <a href="#">cyclone_plotter</a>	Config updates to cyclone_plotter, featu
 <a href="#">feature_relative</a>	Aligned the feature relative use case INI
 <a href="#">grid_to_grid</a>	Deleted README_grid_to_grid.pdf
 <a href="#">grid_to_obs</a>	Removed hard-coded path to MET v6.0
 <a href="#">hwt</a> <b>In progress</b>	Aligned the feature relative use case INI
 <a href="#">qpf</a>	Changed time range and updated old va
 <a href="#">track_and_intensity</a>	Aligned the feature relative use case INI

# METplus at EMC

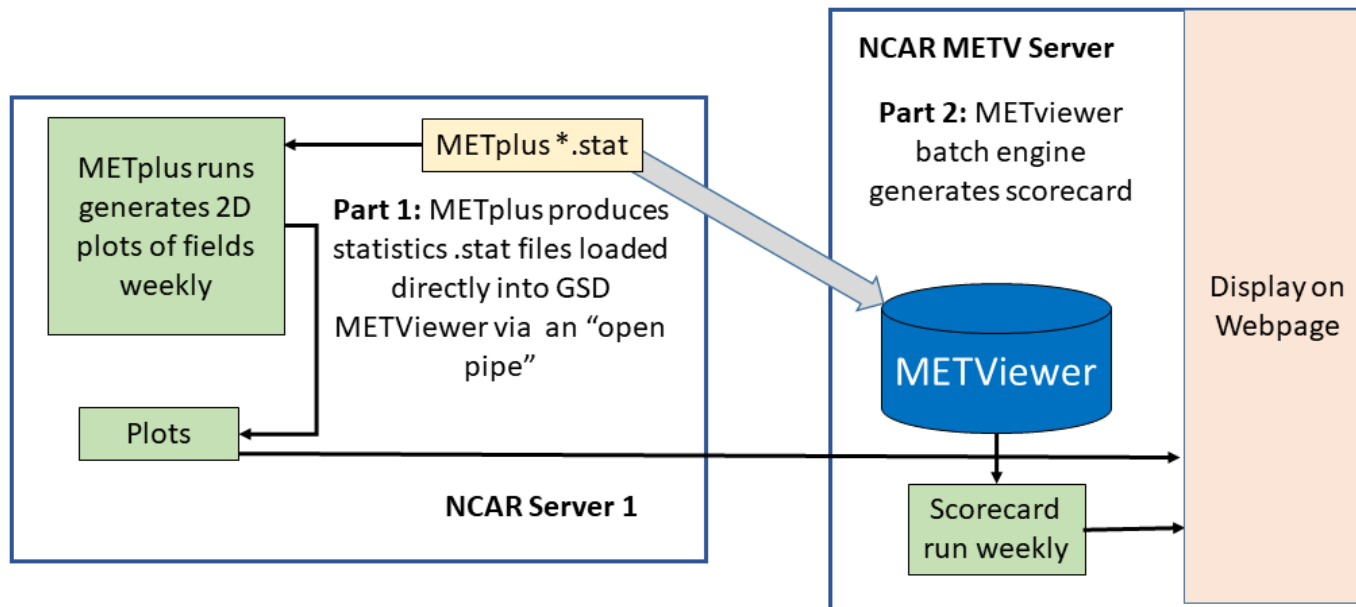
Data Flow for Diagram for METplus as Part of Parallel/Retrospective Forecast Runs



Mallory Row, NOAA/EMC, has become a METplus developer and set up this workflow

# METplus at NCAR

Data Flow for Diagram for METplus as Part of Parallel/Retrospective Forecast Runs

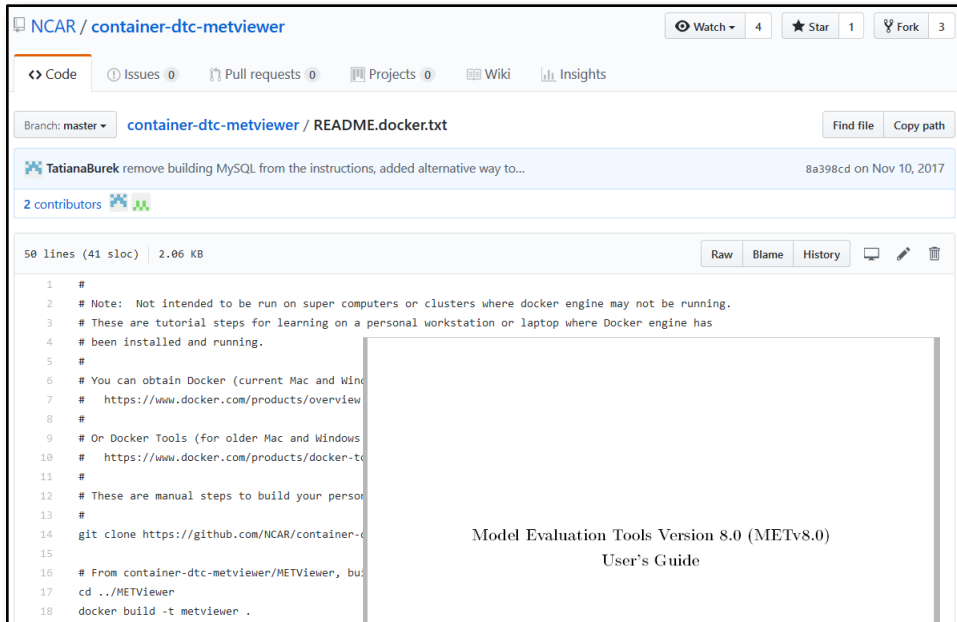


With direct access to METviewer Server, the system is significantly less complicated

# Support

---

# Repositories and Support



The screenshot shows a GitHub repository page for 'NCAR / container-dtc-metviewer'. The main content is the 'README.docker.txt' file, which contains instructions for building and running the application. The code is as follows:

```
1 #
2 # Note: Not intended to be run on super computers or clusters where docker engine may not be running.
3 # These are tutorial steps for learning on a personal workstation or laptop where Docker engine has
4 # been installed and running.
5 #
6 # You can obtain Docker (current Mac and Windows)
7 # https://www.docker.com/products/overview
8 #
9 # Or Docker Tools (for older Mac and Windows)
10 # https://www.docker.com/products/docker-toolbox
11 #
12 # These are manual steps to build your personal workstation
13 #
14 git clone https://github.com/NCAR/container-dtc-metviewer
15
16 # From container-dtc-metviewer/METViewer, build the application
17 cd ../METViewer
18 docker build -t metviewer .
```

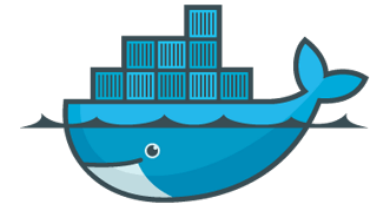
## Model Evaluation Tools Version 8.0 (METv8.0) User's Guide

Developmental Testbed Center  
Boulder, Colorado

*John Halley Gotway, Kathryn Neuman, Tara Jensen,  
Barbara Brown, Randy Bullock, and Tressa Fowler  
with contributions from Julie Prestopnik, Eric Gilleland, Howard Sob,  
Mima Win-Gildenmeister, George McCabe and James Frimel*

September 2018

# GitHub



# docker

## MET ONLINE TUTORIAL

### MET ONLINE TUTORIAL FOR METv6.1

#### Welcome to the MET Online Tutorial

- This tutorial is designed for use with METv6.1 released in December 2017.
- The exercises have been expanded to include examples for all of the MET tools.
- It describes step-by-step how to compile, configure MET, and run MET, or how to use pre-compiled versions of MET either on an HPS platform or using a docker container.
- We recommend that you work through this tutorial before you try to run MET on your own.
- A description of what's new since the previous tutorial can be found in the release notes for [METv6.0](#) and [METv6.1](#).
- For comments, suggestions, errors, or help concerning this online tutorial (or other MET issues) please send email to [met\\_help@ucar.edu](mailto:met_help@ucar.edu).

#### Thanks for the support!

Many thanks are owed to our sponsors for their support of MET and the development of this tutorial, including the National Oceanic and Atmospheric Administration and the United States Air Force. Thanks also go to the registered MET users and the MET workshop participants for your feedback and ideas. Thanks also go to the staff at the Developmental Testbed Center for their help, advice, and many types of support.

#### Using the MET Online Tutorial

Throughout this tutorial, the following conventions are used:

- **Bold font** is used for directory and filenames and occasionally to simply indicate emphasis.
- **Bold and italic font** is used for things to be typed on the command line, configurable items, and executable names.



# Supporting the Community: Current Releases and Resources

## METv8.0

- Downloadable Tarballs on DTC website
- Support for NCAR and NOAA HPC platforms
- In Container
  - *User's Guide available*
  - *Online Tutorial*
  - *Will move to GitHub by end of year*

## METviewer 2.8

- On GitHub
  - *User Guide out soon*
- In Container
  - *Limited Online Tutorial*
- Support for NOAA network

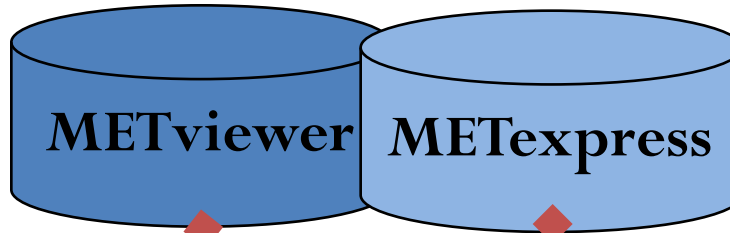
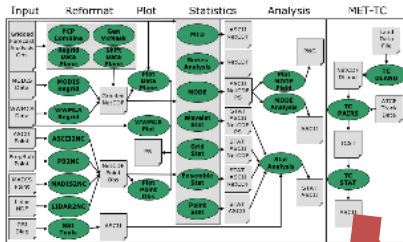
## METplus 2.0

- *User Guide now available*
- On GitHub
  - *Limited Online Tutorial*
- Support for NCAR and NOAA HPC platforms

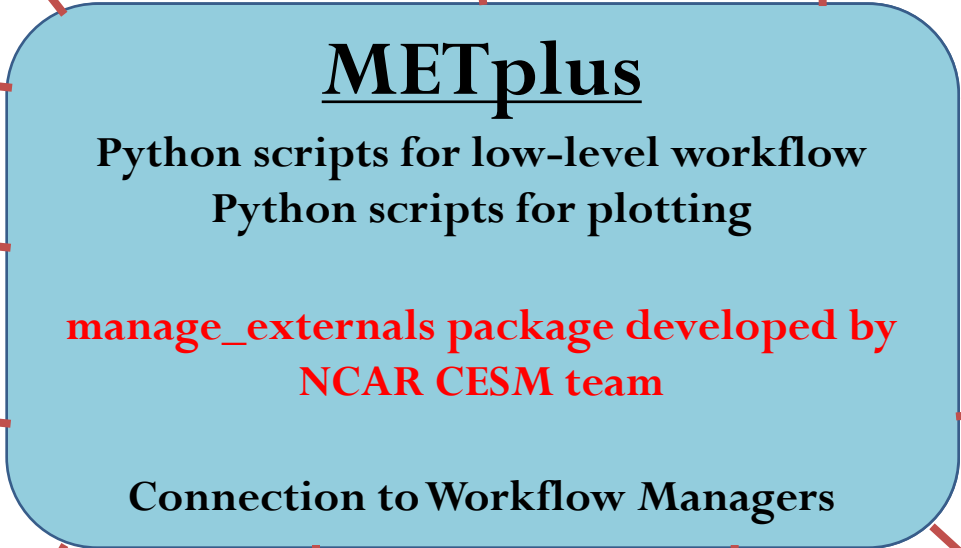
The screenshot shows the 'MET USERS PAGE' website. The header includes the DTC logo and navigation links: ABOUT, TESTING & EVALUATION, COMMUNITY CODES, VISITOR PROGRAM, NEWS, and EVENTS. The main content area is titled 'MODEL EVALUATION TOOLS' and features a 'Welcome' section with a description of the MET verification package. A 'Description' section explains that MET is a highly-configurable, state-of-the-art suite of verification tools. A list of verification techniques is provided, including standard verification scores, spatial verification methods, ensemble and probabilistic verification methods, and aggregating output. The right sidebar contains sections for 'EVENTS' (No Upcoming Events), 'ANNOUNCEMENTS' (MET version 8.0 Release 09.27.2018, 2017 GSI Annual Release Version 3.6/ENKF Version 1.2 10.04.2017), 'MET NEWS' (Run MET in a Docker container), and 'MET SPONSORS' (National Center for Atmospheric Research (NCAR), National Oceanic and Atmospheric Administration (NOAA), and United States Air Force (USAF)).

# Developing a Strategy: METplus Authoritative Repository

MET



*In Development  
through NGGPS*



# Building a Unified Community: Tutorials, Workshops and Telecons



## Tutorials and Workshops

Tutorial: Oct 1-5, 2018 (NGGPS) @NCWCP

Tutorial: Feb 4-6, 2019 (DTC) @NCAR

## Bi-Weekly User Telecons

- Co-hosted by EMC and DTC
- Google Doc gathers questions
- Every other Monday METplus team answers questions on a call



# Continuing to Enhance: Upcoming METplus Additions

- **Code clean-up to pass cyber-security software scans (Fortify) and improve memory handling and speed (DTC for AF)**
- **Ensemble and Atmospheric Composition/Air Quality Use-Cases (DTC for NOAA)**
- **Process Oriented Diagnostics (NGGPS)**
  - Moisture-Convection Coupling
  - MJO, NAO, and Teleconnection
  - TC Genesis
  - Extreme Weather related to Blocking
  - Cloud Property and Structure
- **Feature Relative Diagnostics (NGGPS)**
  - Extending the METplus Feature Relative use-case to include multi-variate fields and fluxes
- **CAM Specific Evaluation (USWRP and JTTI)**
- **Space Weather Evaluation (NOAA and NASA)**



**Contacts:** Tara Jensen – [jensen@ucar.edu](mailto:jensen@ucar.edu) and John Halley Gotway – [johnhg@ucar.edu](mailto:johnhg@ucar.edu)

**METplus GitHub:** [github.com/NCAR/METplus](https://github.com/NCAR/METplus)

**MET Users Page:** [www.dtcenter.org/met/users/](http://www.dtcenter.org/met/users/)

**Container MET GitHub:** [github.com/NCAR/container-dtc-met](https://github.com/NCAR/container-dtc-met)

**METviewer GitHub:** [github.com/NCAR/METviewer](https://github.com/NCAR/METviewer)

**Container METviewer Github:** [github.com/NCAR/container-dtc-metviewer](https://github.com/NCAR/container-dtc-metviewer)

**All help requests go through MET Helpdesk:** [met\\_help@ucar.edu](mailto:met_help@ucar.edu)

*METplus work is funded by the DTC partners (NOAA, Air Force, NCAR and NSF), NGGPS program office, and USWRP R2O grants*