

ENSEMBLE METHODS AND TOOLS

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NCAR

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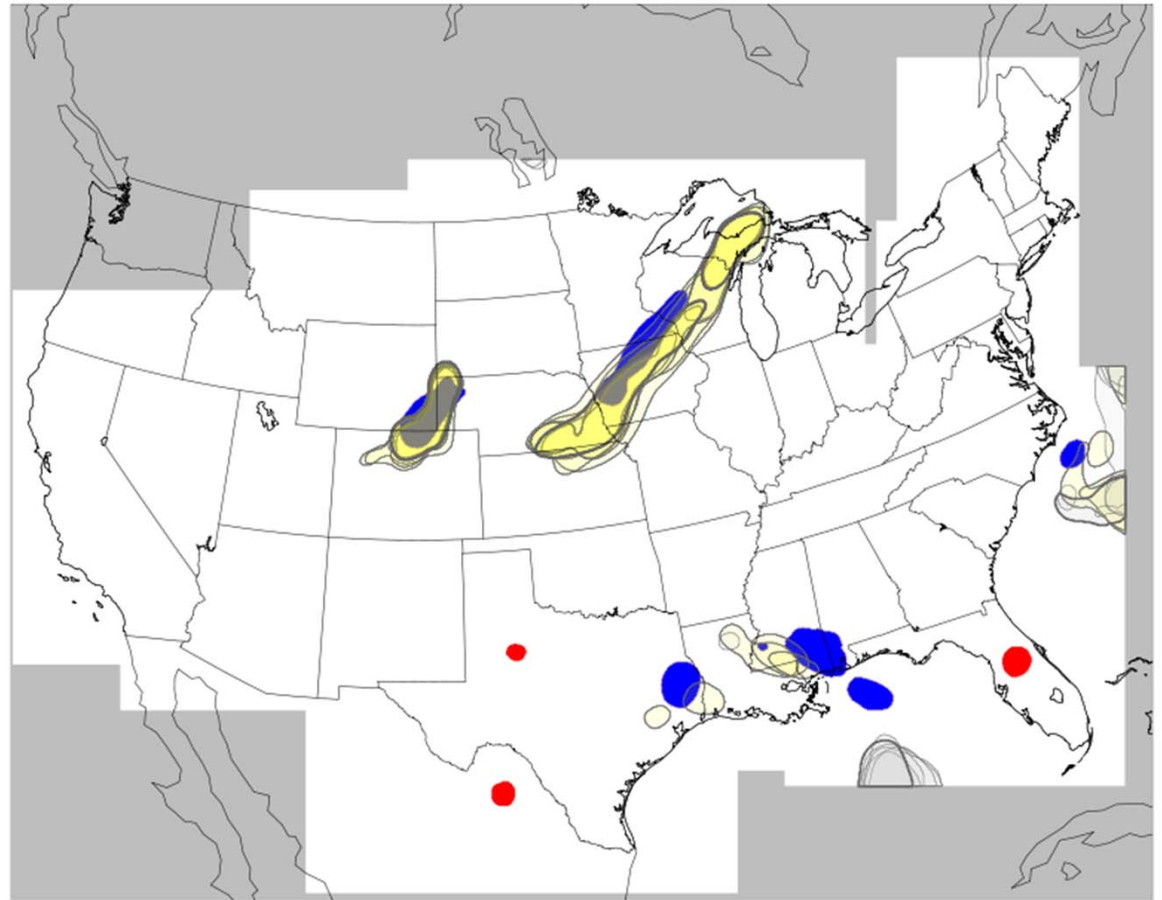
DTC
Developmental Testbed Center

OVERVIEW

- Tools
- Methods
- New Research

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TOOLS AND METHODS

R STATISTICS

- R ~ the dominant language in the statistical research community.
- R is Open Source and free.
- Runs on most operating systems
- Nearly 2,400 packages contributed.

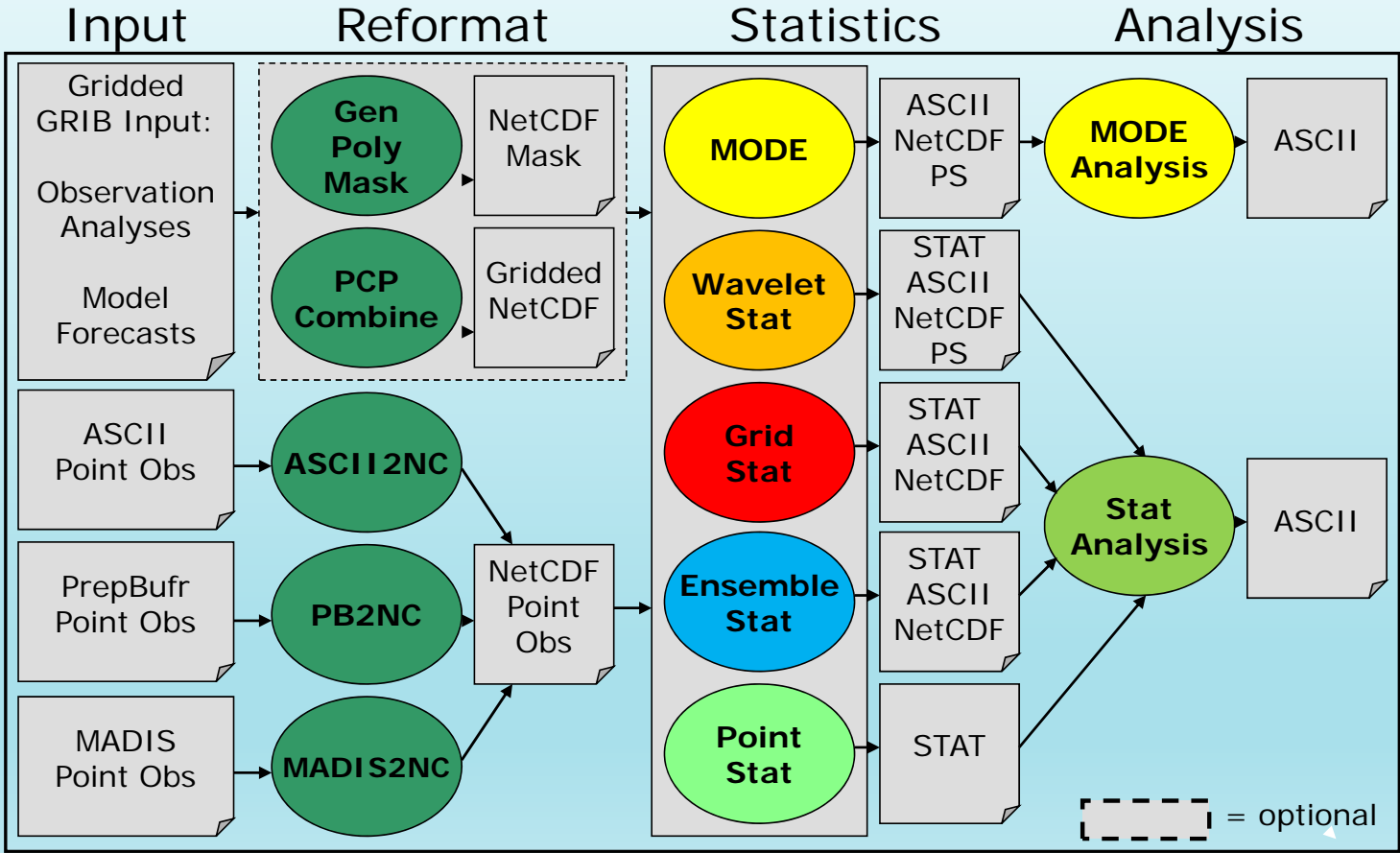
Some useful packages

- verification
- fields (spatial stats)
- radiosondes
- extRemes
- BMA(Bayesian Model Averaging)
- BMAensemble
- circular
- Rsqlite
- SpatialVx
- Rgis, spatstat (GIS)
- ncdf (support for netcdf files)
- rgdal (support for grib1 files)
- rNOMADS (support for grib2 files archived by NCEP)
- Rcolorbrewer
- randomForests

Good for point probability forecasts

Struggles with large gridded files

MODEL EVALUATION TOOLS (MET)

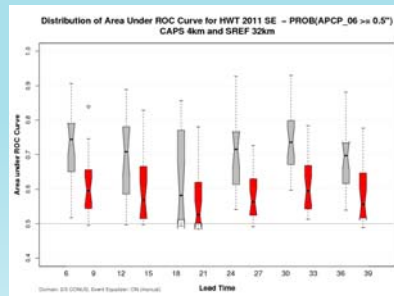
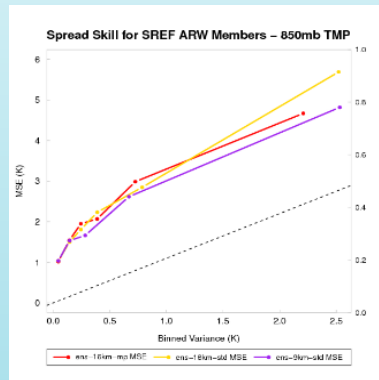
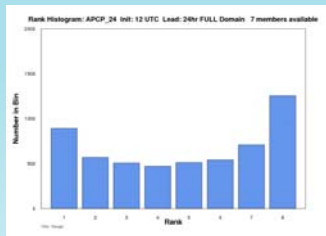




MET CAPABILITIES

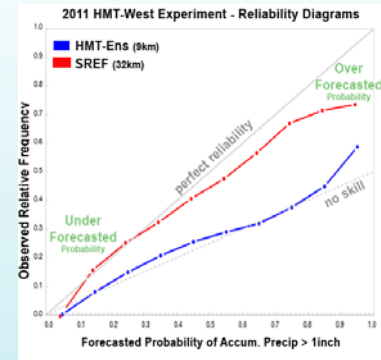
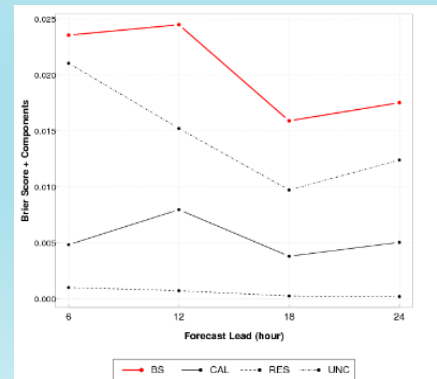
ENSEMBLE CHARACTERISTICS (ENSEMBLE STAT)

- Rank Histogram
- PIT
- CRPS
- Ignorance Score
- Spread-Skill

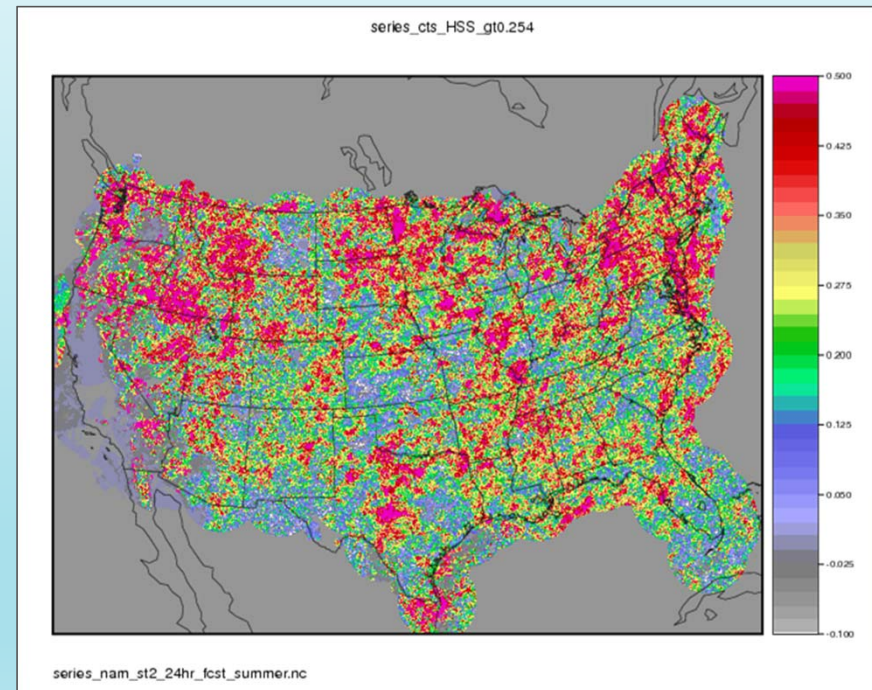
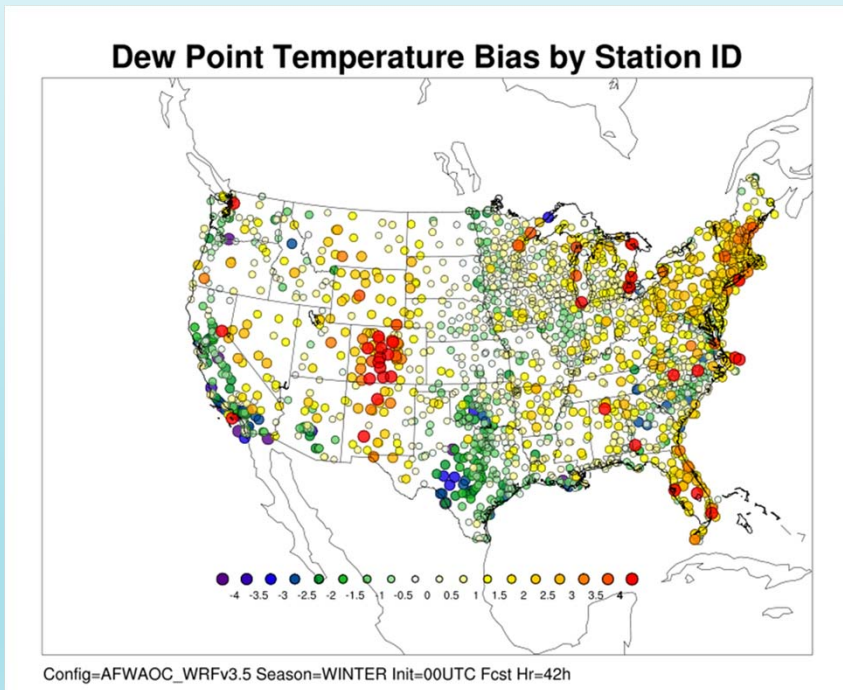


PROBABILITY MEASURES (GRID AND POINT STAT)

- Brier Score + Decomposition
- Brier Skill Score
- ROC and Area Under ROC
- Reliability

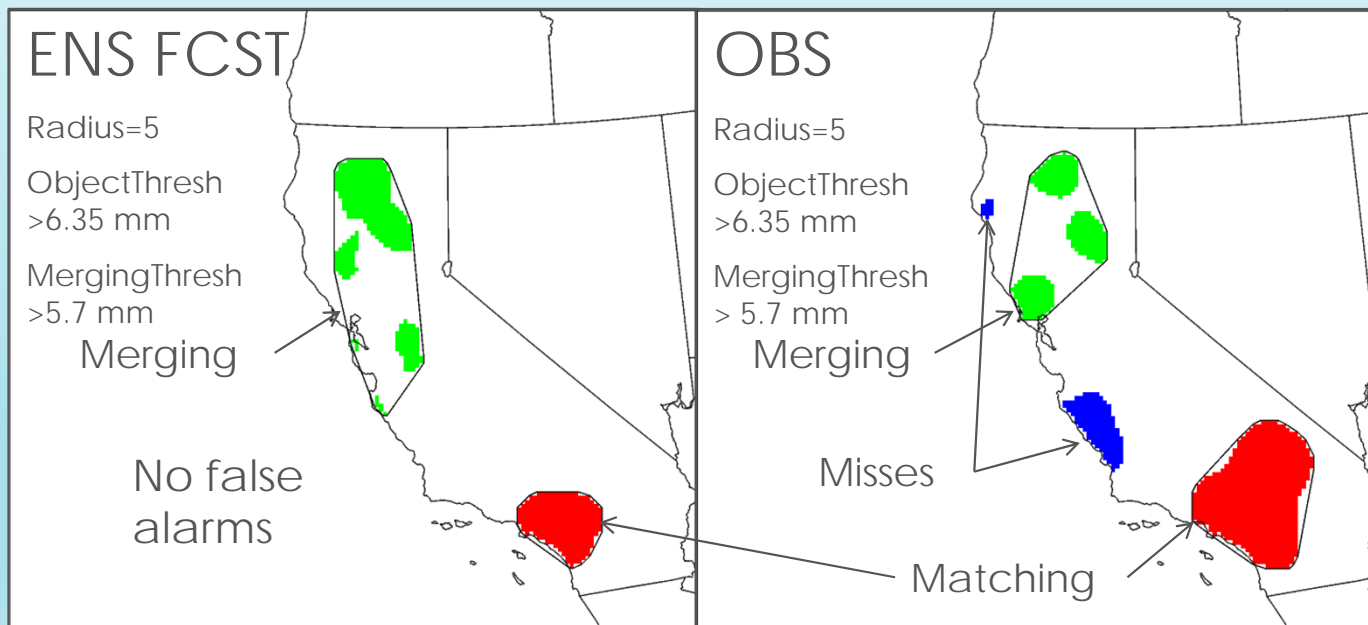
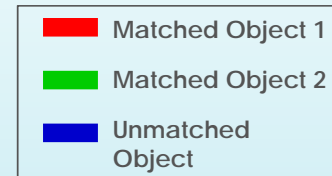


NEW IN MET: SERIES ANALYSIS TOOL GEOGRAPHIC REPRESENTATION OF SCORES



OBJECT ORIENTED METHOD: MODE

HOW IT WORKS

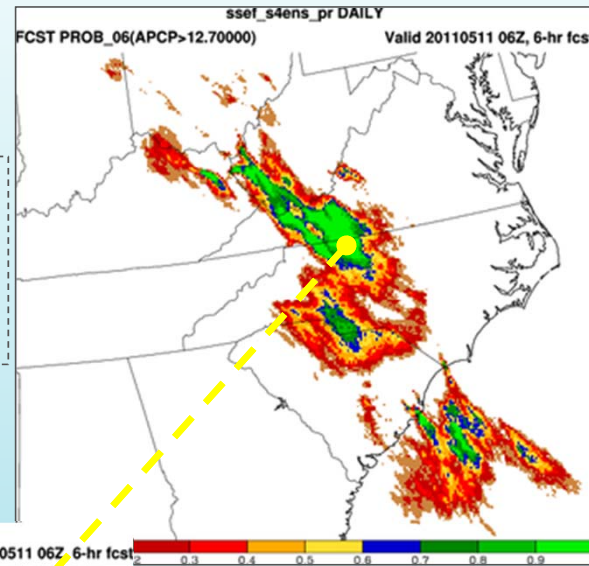
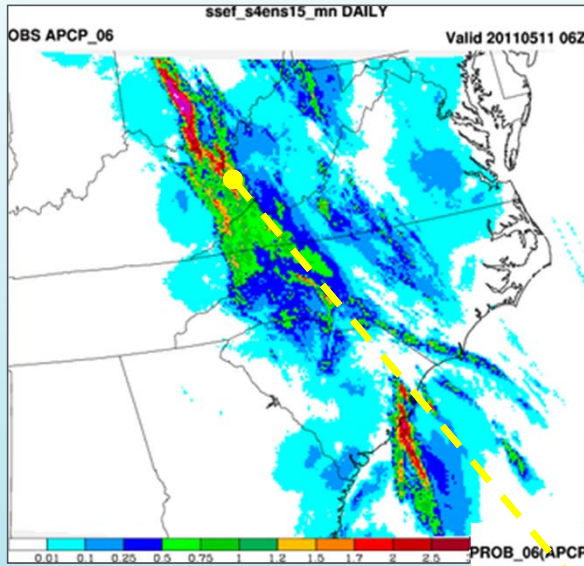


USING MODE ON PROBABILITY FIELDS

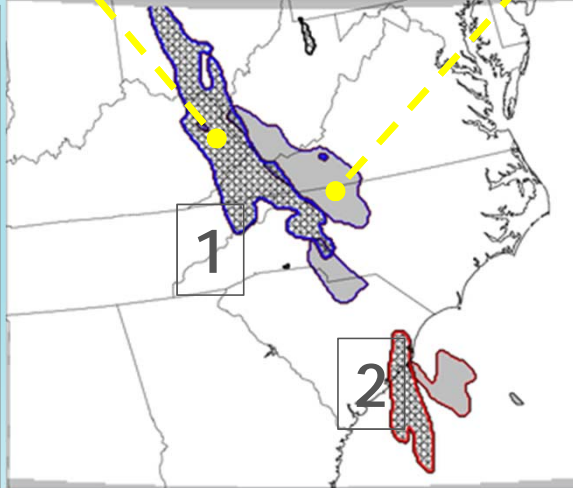
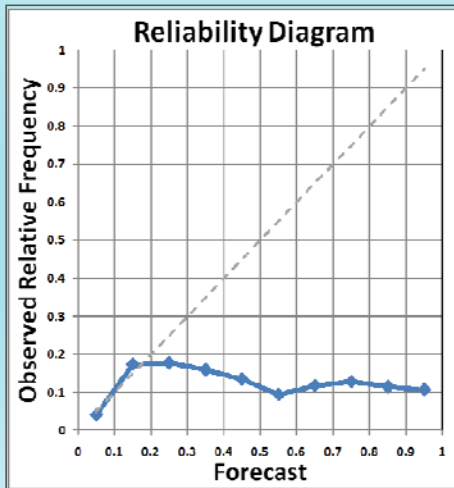
QPE_06 >12.7 MM

VS.

50% PROB(APCP_06>12.7 MM)



Good Forecast
with
Displacement
Error?



Spatial Metrics

Centroid Distance:

Obj1) 200 km

Obj2) 88km

Area Ratio:

Obj1) 0.69 Obj PODY: 0.72

Obj2) 0.65 Obj FAR: 0.32

Traditional Metrics

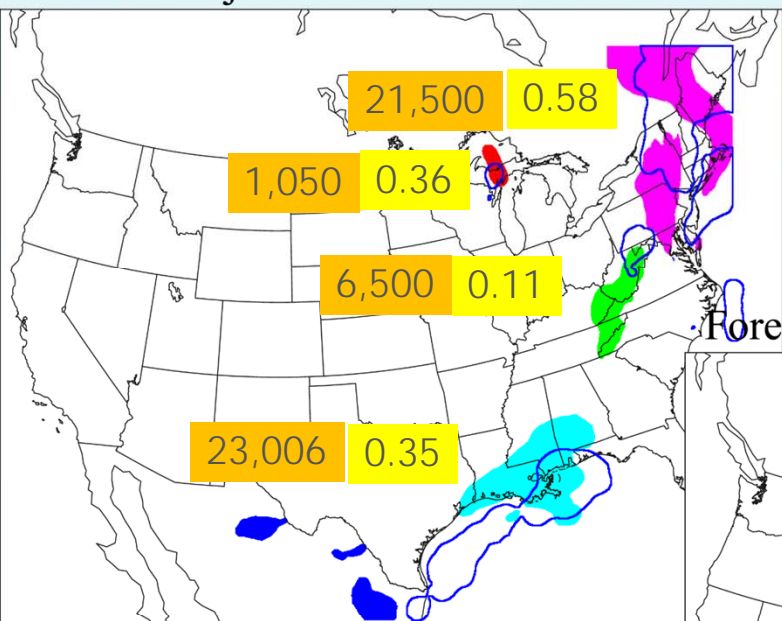
Brier: 0.07

Area Under ROC: 0.62

MODE FOR DIFFERENT PROBABILITIES – MAY 11, 2013

NWS PoP - Percent chance that rain will occur at any given point in the area.

Forecast Objects with Observation Outlines

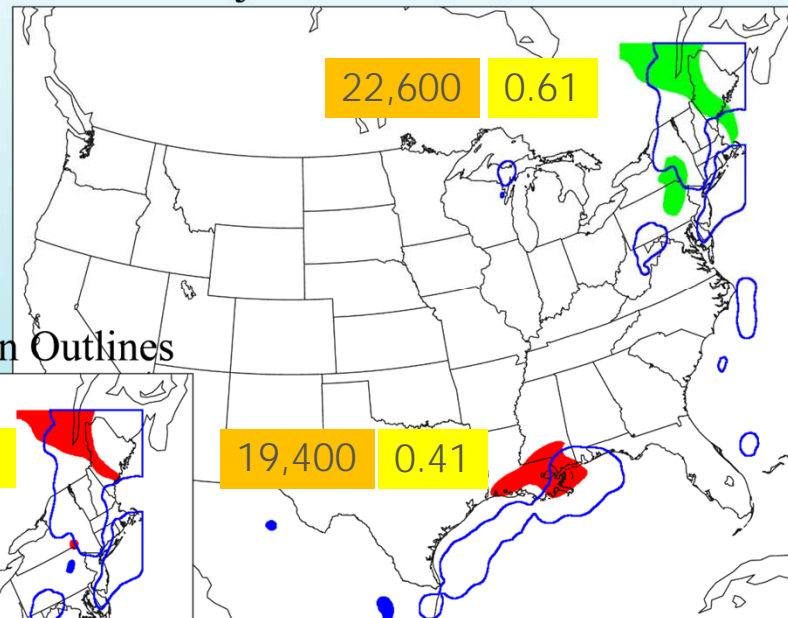


Prob > 2.54 mm > 25%

*NWS PoP = C x A where
 "C" = the confidence that precipitation will occur somewhere in the forecast area
 "A" = the percent of the area that will receive measurable precipitation.*

Prob > 2.54 mm > 75%

Forecast Objects with Observation Outlines



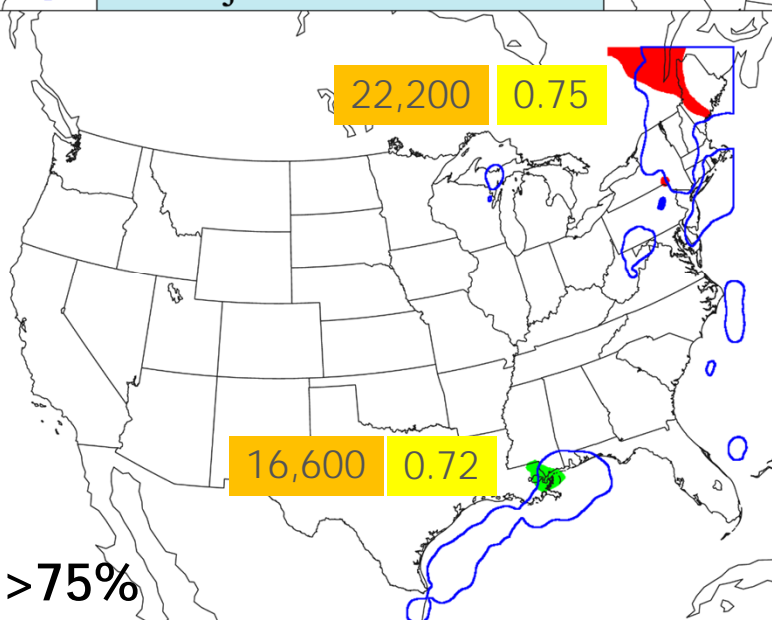
Prob > 2.54 mm > 50%

— Observation
 Forecast

Intersection Area
 Forecast Area

Symmetric_Difference
 (non-intersecting area)

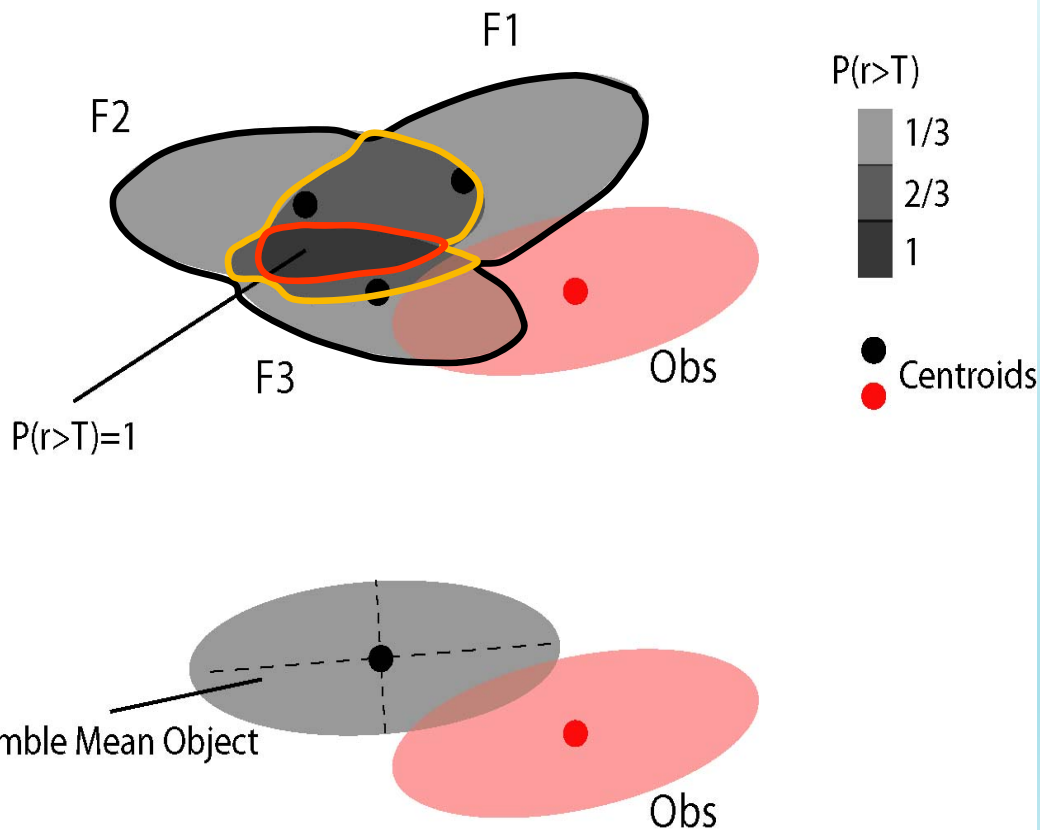
Forecast Objects with Observation Outlines



ENSEMBLE MODE

APPLYING SPATIAL METHODS TO ENSEMBLES

Areas of rainfall r greater than threshold T



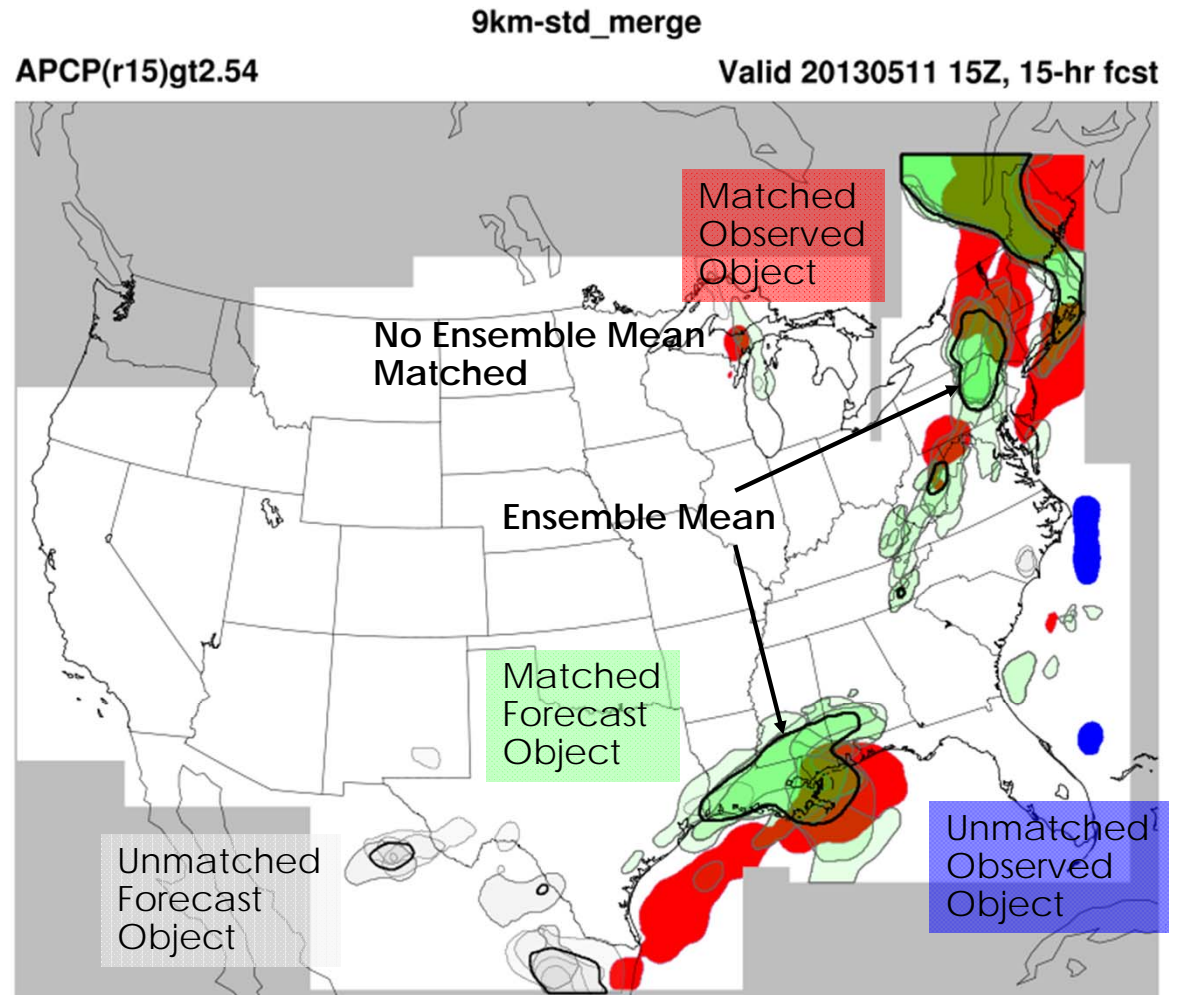
As probabilities: Areas do not have "shape" of precipitation areas; may "spread" the area

As mean:

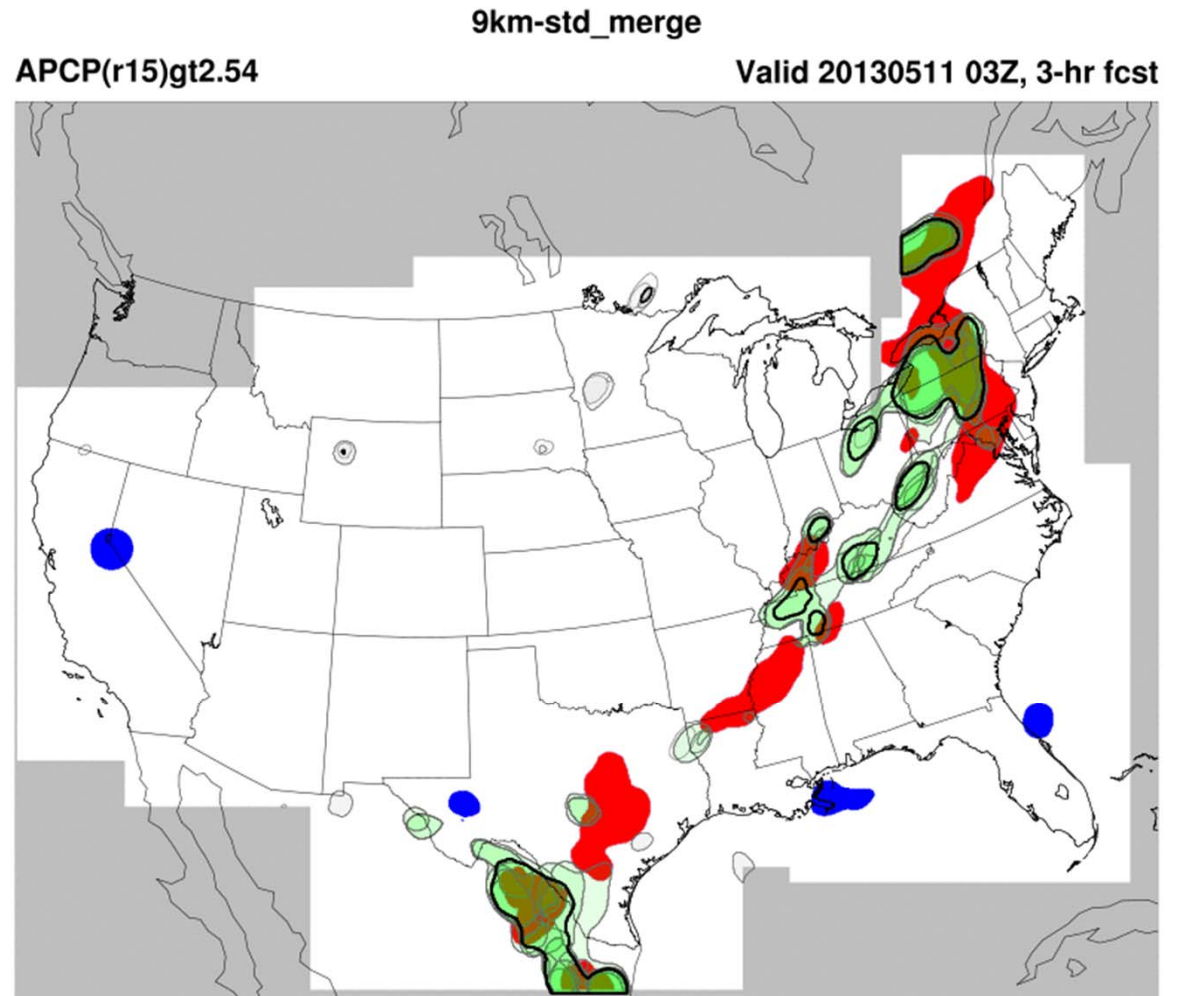
Area is not equivalent to any of the underlying ensemble members

EXAMPLE

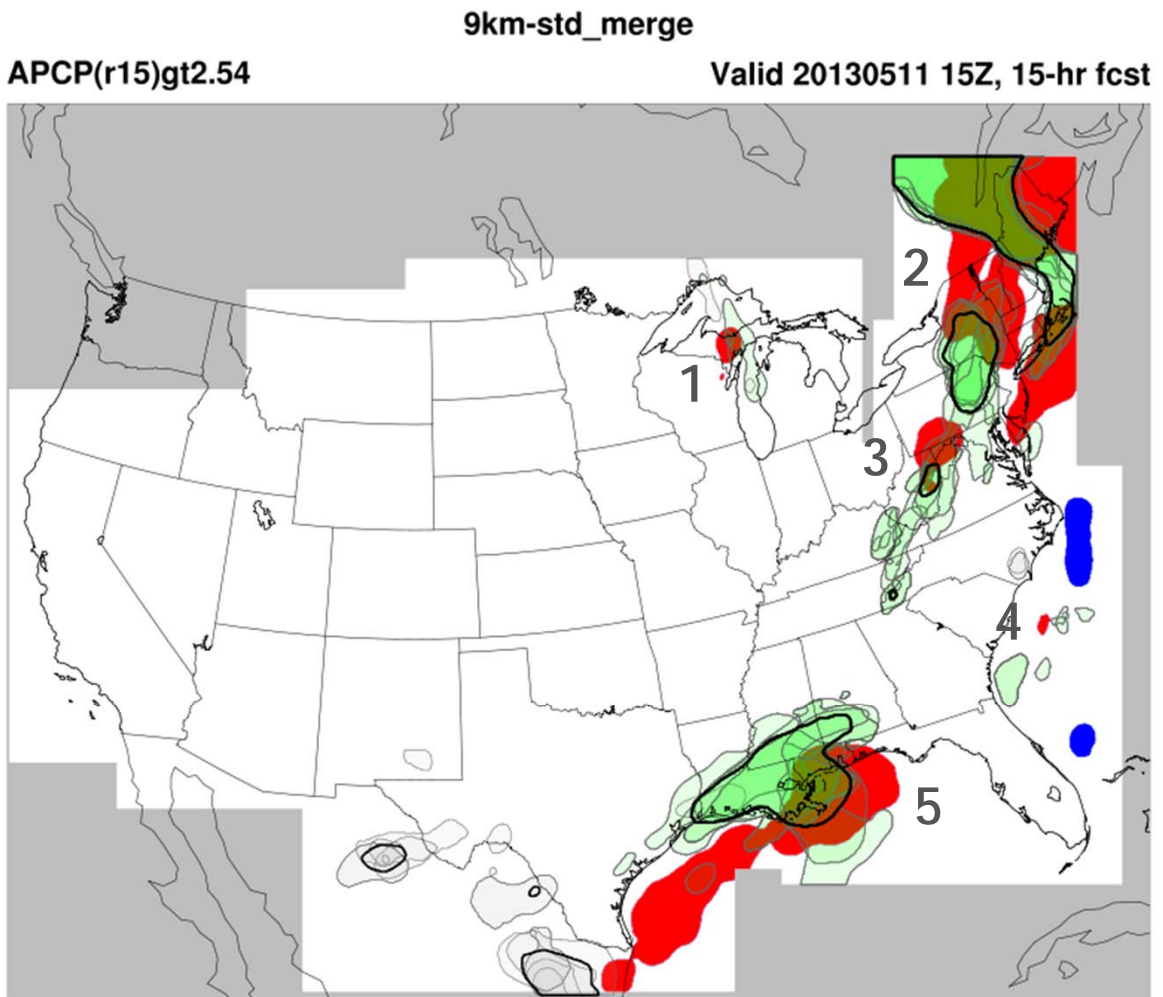
MAY 11, 2013

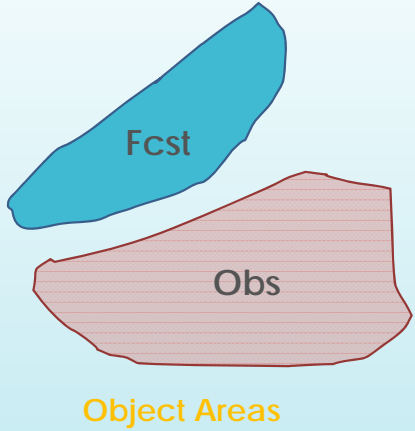


SPREAD INCREASES WITH TIME



INDIVIDUAL MATCHED OBSERVED OBJECTS



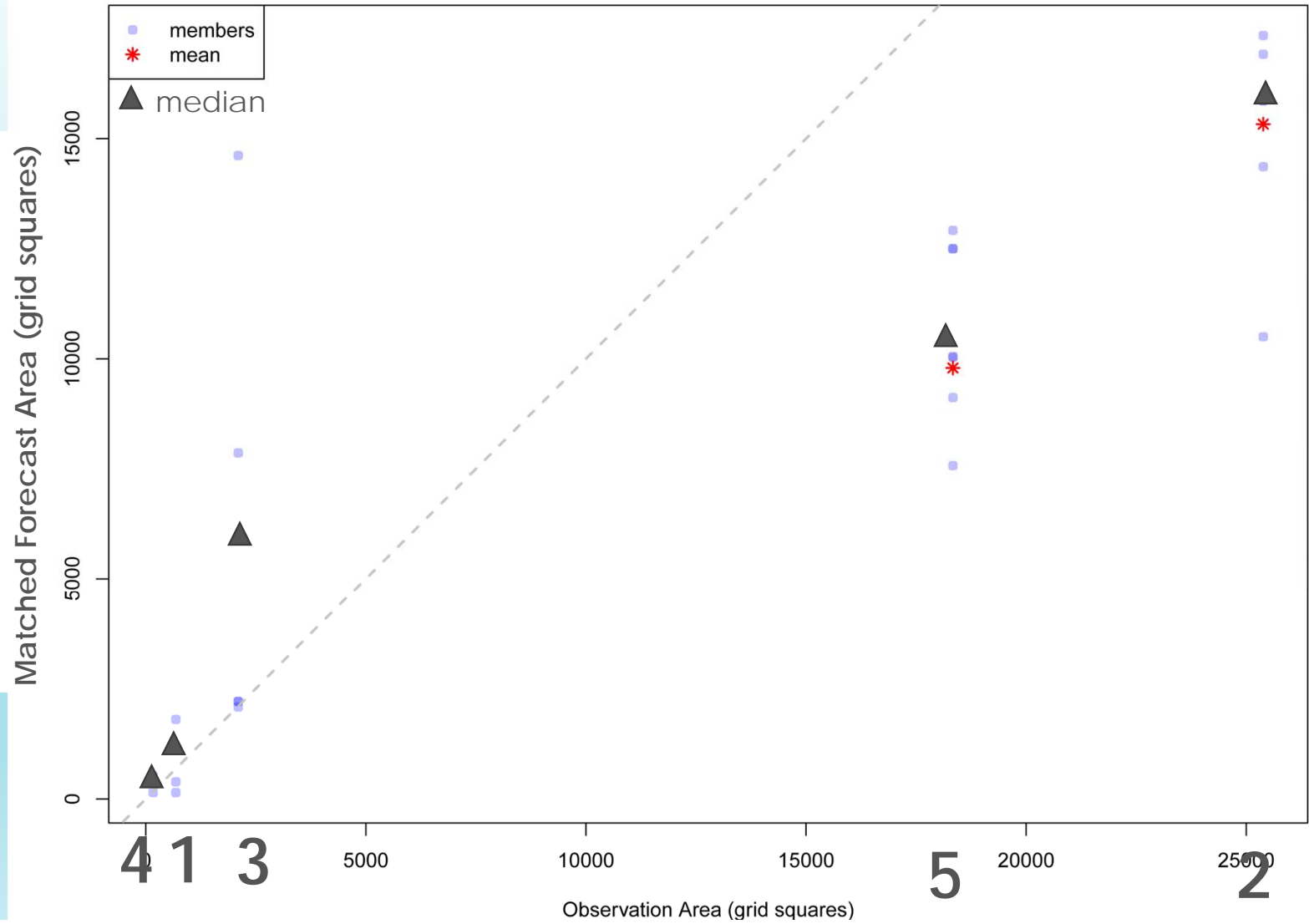


Some observed objects do not have ensemble means matched - this may be good information to have



9km-std_merge Ensemble Cluster Objects

Valid Range: 2013-05-11 15:00:00 to 2013-05-11 15:00:00, Lead Times: 15 hr

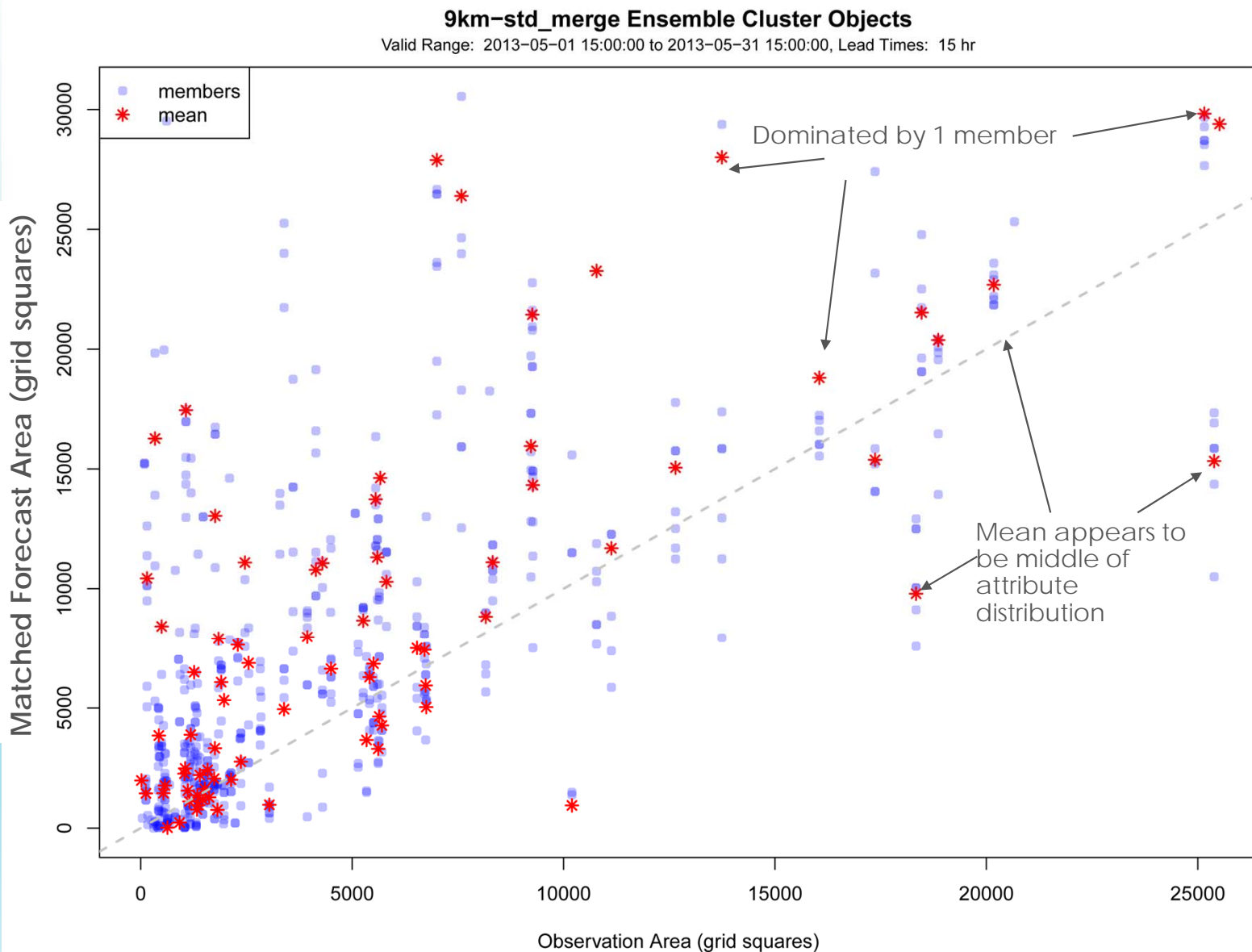


May 2013:
27 Days of
Matched
Observed/Forecast
Pairs

FORECAST
AREA

High bias on forecast
area.

Sometimes ensemble
mean is in middle of
attribute distribution
and sometimes is it
dominated by 1
member



WHAT NEXT?

- Now that we have ability to keep track of all member objects paired with observed objects
 - **Rank Histograms** of individual attributes (i.e. area, centroid latitude, longitude, complexity)
 - **Distribution of Attributes**
 - Individual attributes may be used prognostically
 - Paired Forecast-Observed attributes used diagnostically
 - Summary with Inner Quartile Range
 - Spread-Skill diagrams
 - **Diagnostic Analysis**
 - How many ensemble means are not matched even though members are indicating the event may occur
 - **Evaluation of probability fields** using MODE objects in new ways

THANK YOU

DTC: <http://www.dtcenter.org>

MET: <http://www.dtcenter.org/met/users>

MET HELP: met_help@ucar.edu

Email: jensen@ucar.edu