WPC's Current MET Capability

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MET Tutorial

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MET at WPC

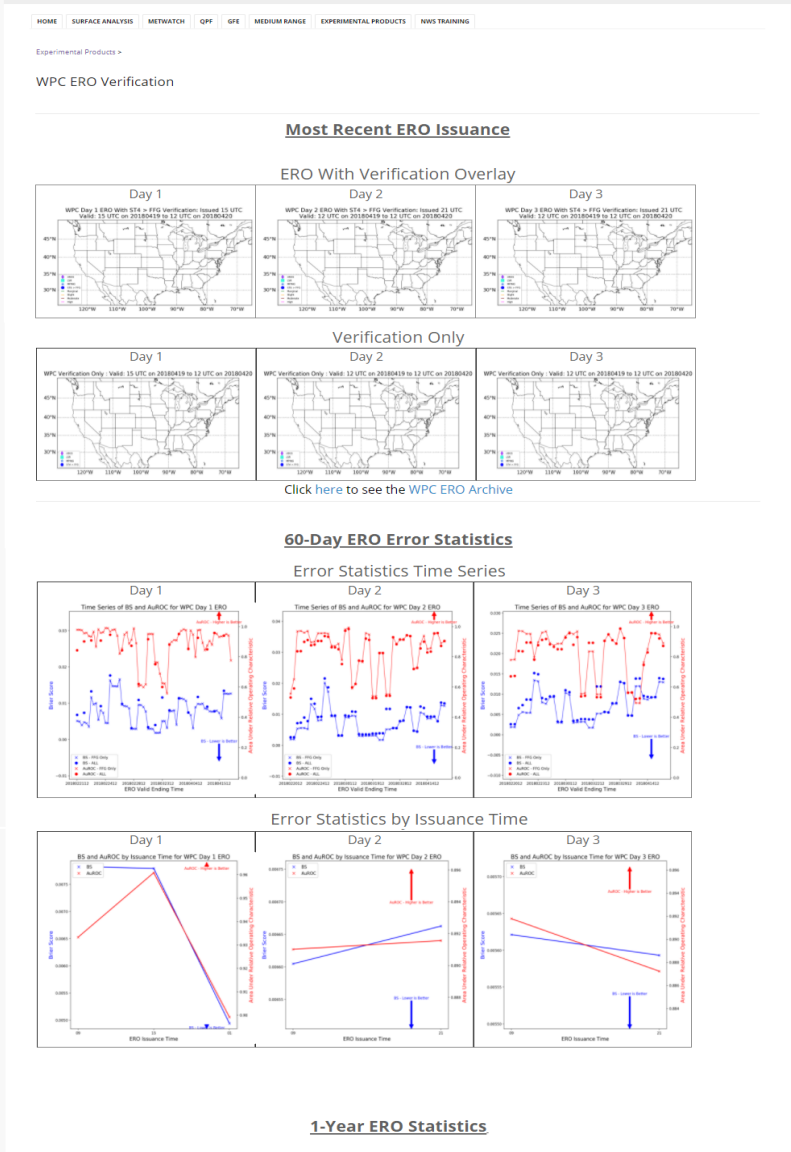
- Several python wrappers have been written to utilize the Model Evaluation Tools (MET) at WPC.
- The following projects are discussed:

1. Verification of the Excessive Rainfall Outlook (ERO) retrospectively, operationally, and for the Flash Flood and Intense Rainfall Experiment (FFaIR)
2. Creation of flash flood based Practically Perfect probabilities using all flooding observations and proxies
3. Evaluation of hydrologic model forecasts
4. Using MODE time-domain (MTD) for identifying/tracking heavy precipitation objects
5. Role of MET in verifying WPC's Extended Range Forecast Experiment (formally the 8-10 Day Experiment)

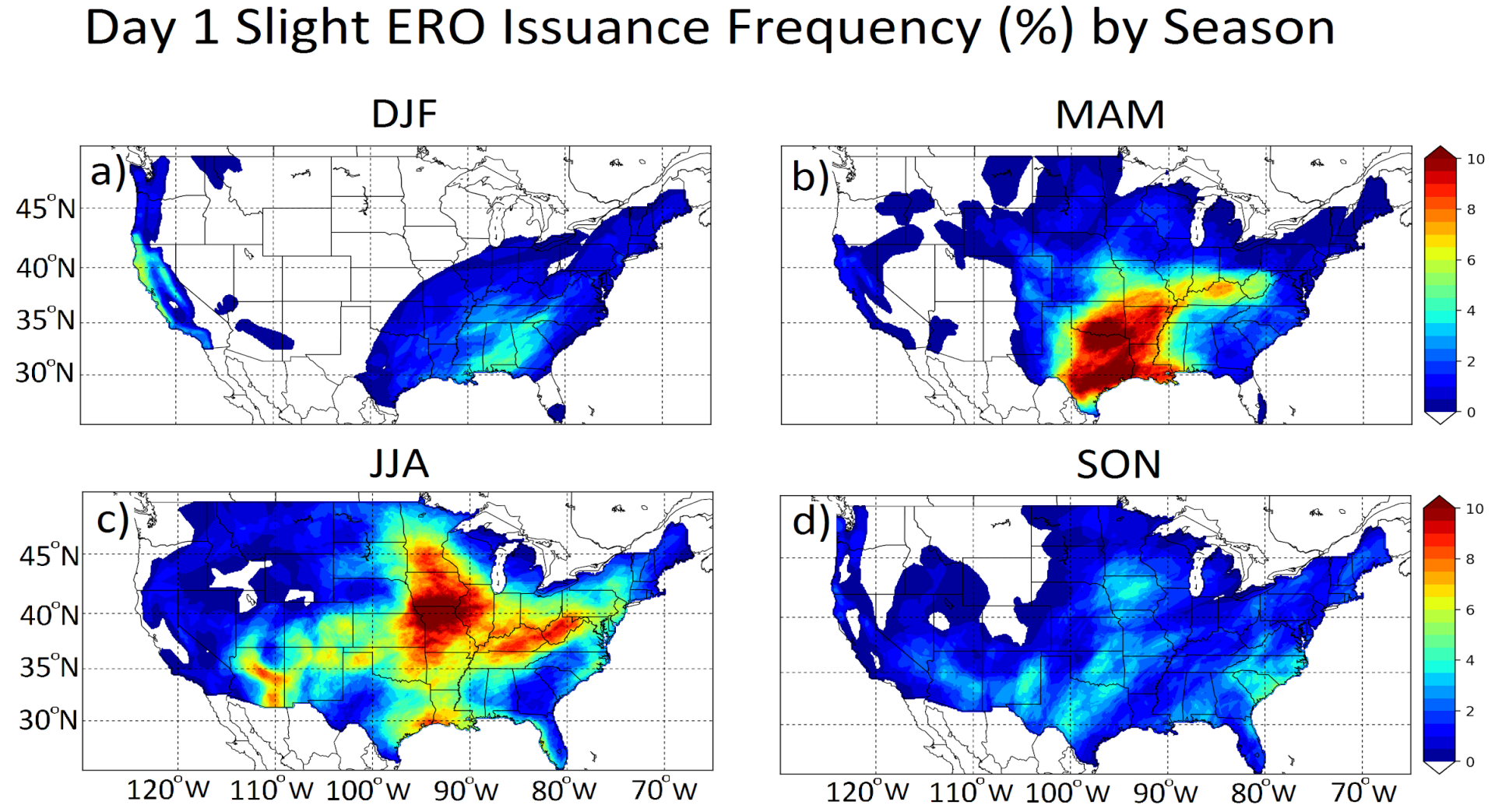
1) ERO Verification: MET's Role

- **Regrid_data_plane** is used to interpolate all gridded data to a common platform.
- **Gen_vx_mask** is used to interpolate the point observations (LSRs, USGS, and mPING) to a common grid.
- **Pcp_combine** is used to ensure all quantitative precipitation forecast (QPF) data is at 24 hour accumulation intervals and to combine all flooding observations.
- **Grid_stat** is used to compute daily statistics of ERO versus verification.
- **Stat_analysis** is used to aggregate the results from grid_stat.
- Python wrappers are used to call the MET functions and plot all data.

WPC Internal Site

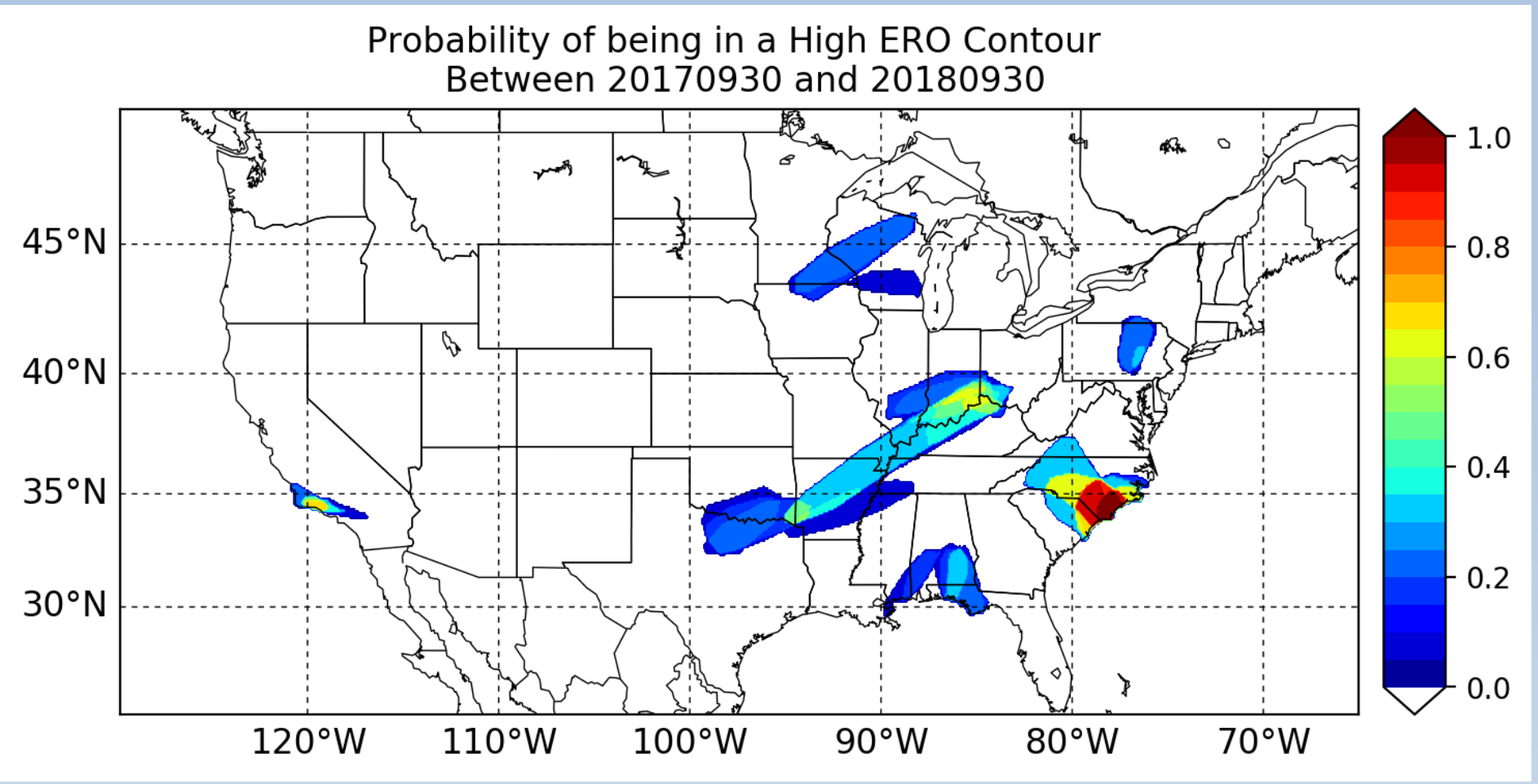


1) ERO Climatology: Slight Occurrence by Season - Day 1

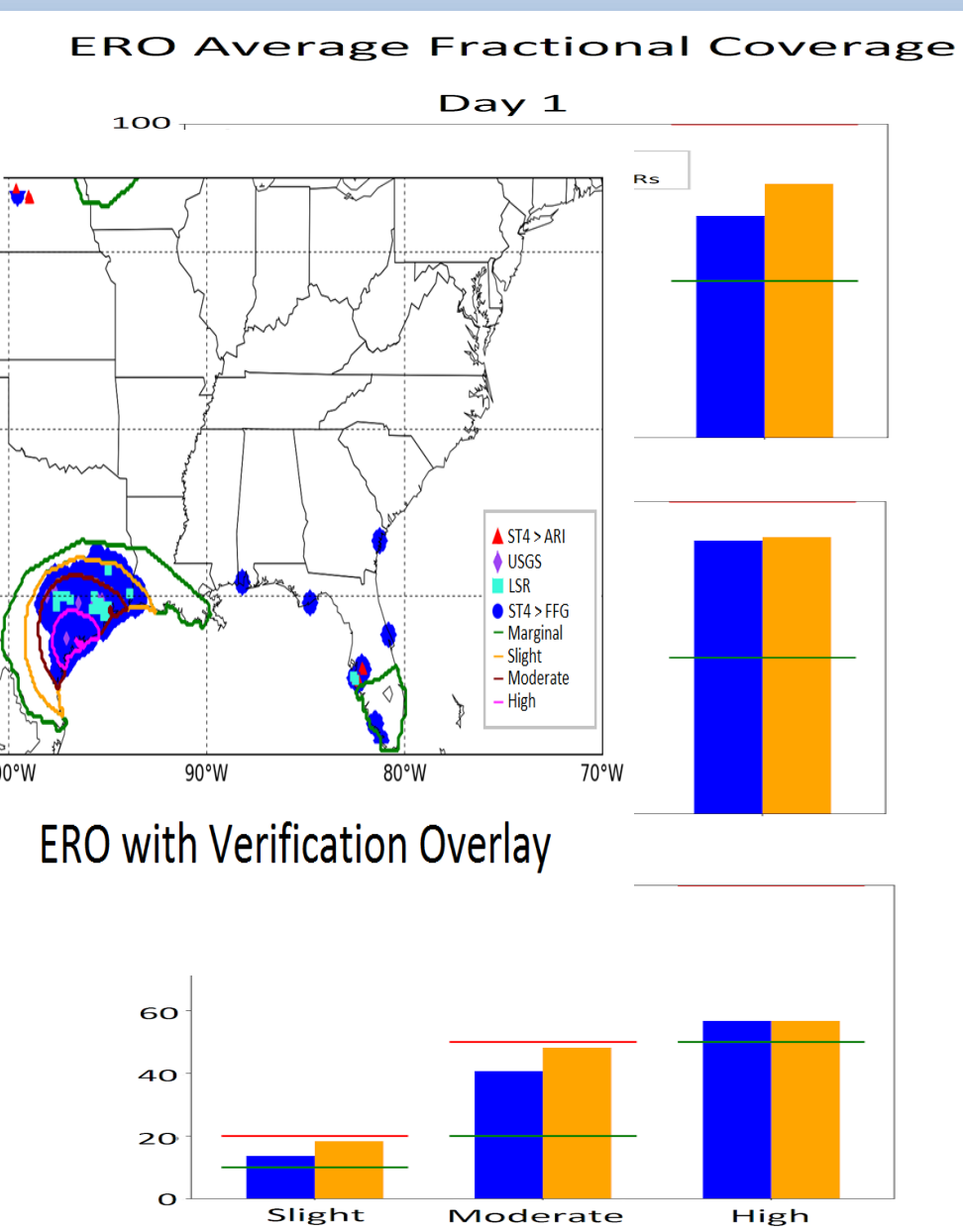


- Spring is dominated by MCS activity; summer is dominated by the tropics, MCS, small scale convection, and the monsoon.

1) ERO Climatology: Past Year



1) ERO Climatology: Bulk Fractional Coverage – 01 Jan 2015 – 31 Dec 2017

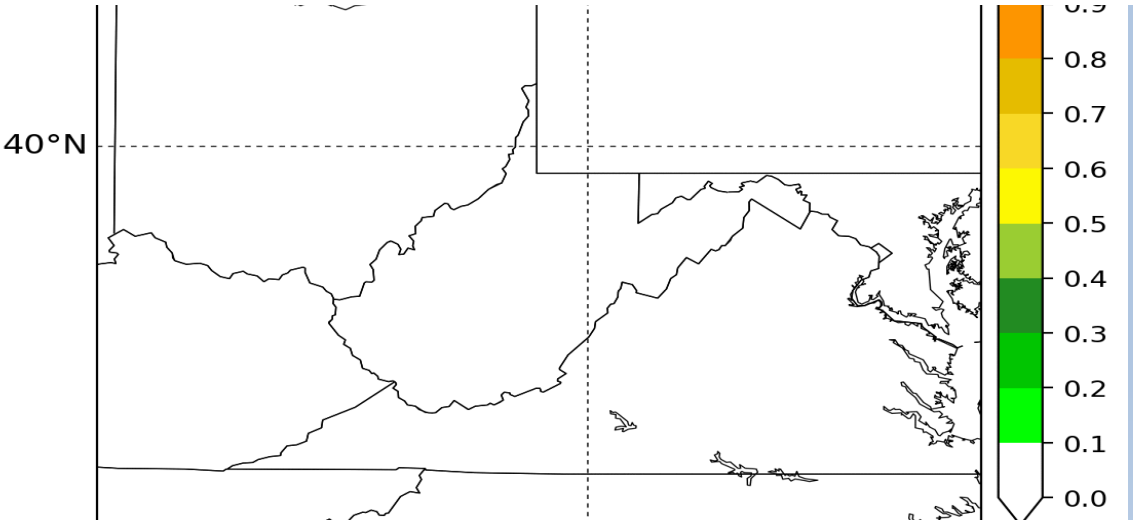


- Average fractional coverage of flooding/flooding proxy within 40 km of a point is computed for each threshold.
- Over the past 3 years, all ERO categories are calibrated for days 1 – 3.
- Including additional flooding observations increases fractional coverage over using Stage IV exceeding FFG.

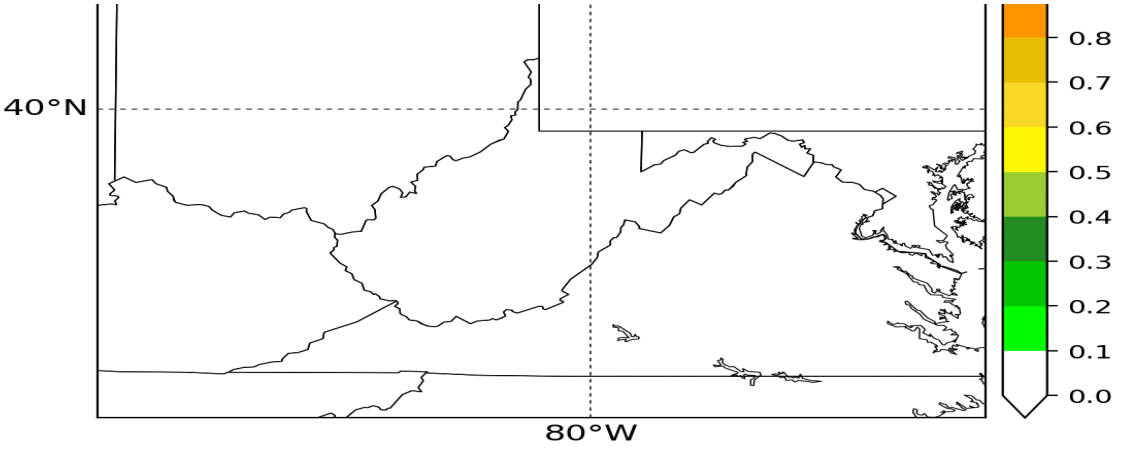
2) Verifying Hydrological Output – MET's Role

- **gen_vx_mask** is used to convert text files to a binomial grid of flooding occurrence with a 40 km square radius.
- **Pcp_combine** is used to sum all binomial occurrences.
- The FLASH system has been coupled with an ensemble of QPF for select high impact cases
- The utility of the FLASH output is being evaluated with MET

Ensemble Probability of > 2 UNITQ – Raw
20160623



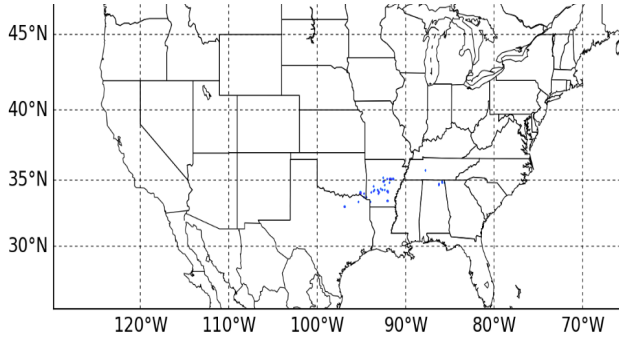
Ensemble Probability of > 2 UNITQ – 40 km
20160623



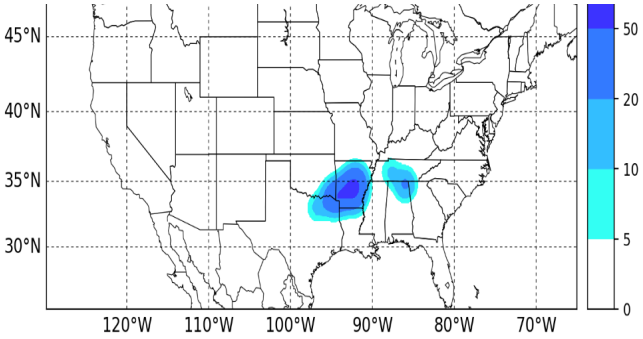
3) Generating Practically Perfect – MET's Role

- **gen_vx_mask** is used to convert text files to a binomial grid of flooding occurrence with a 40 km square radius.
- **Pcp_combine** is used to sum all binomial occurrences.
- A python definition using MET software has been created to calculate Practically Perfect.

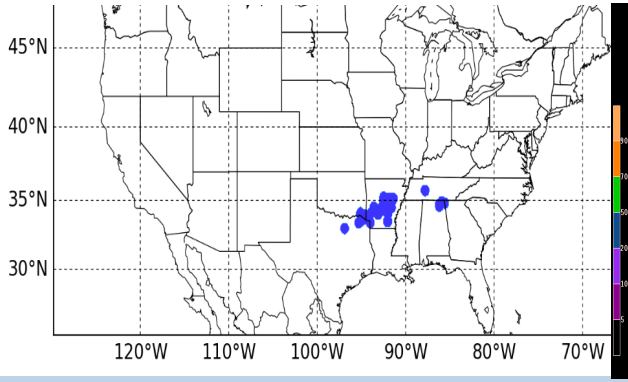
Flash Flood LSR Observations



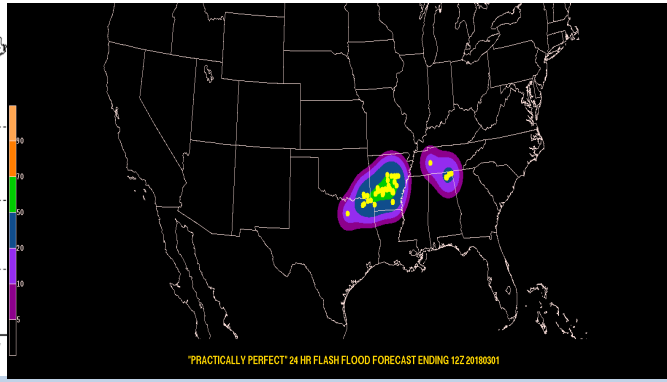
Flash Flood LSR Practically Perfect



Flash Flood LSR 40 km Neighborhood



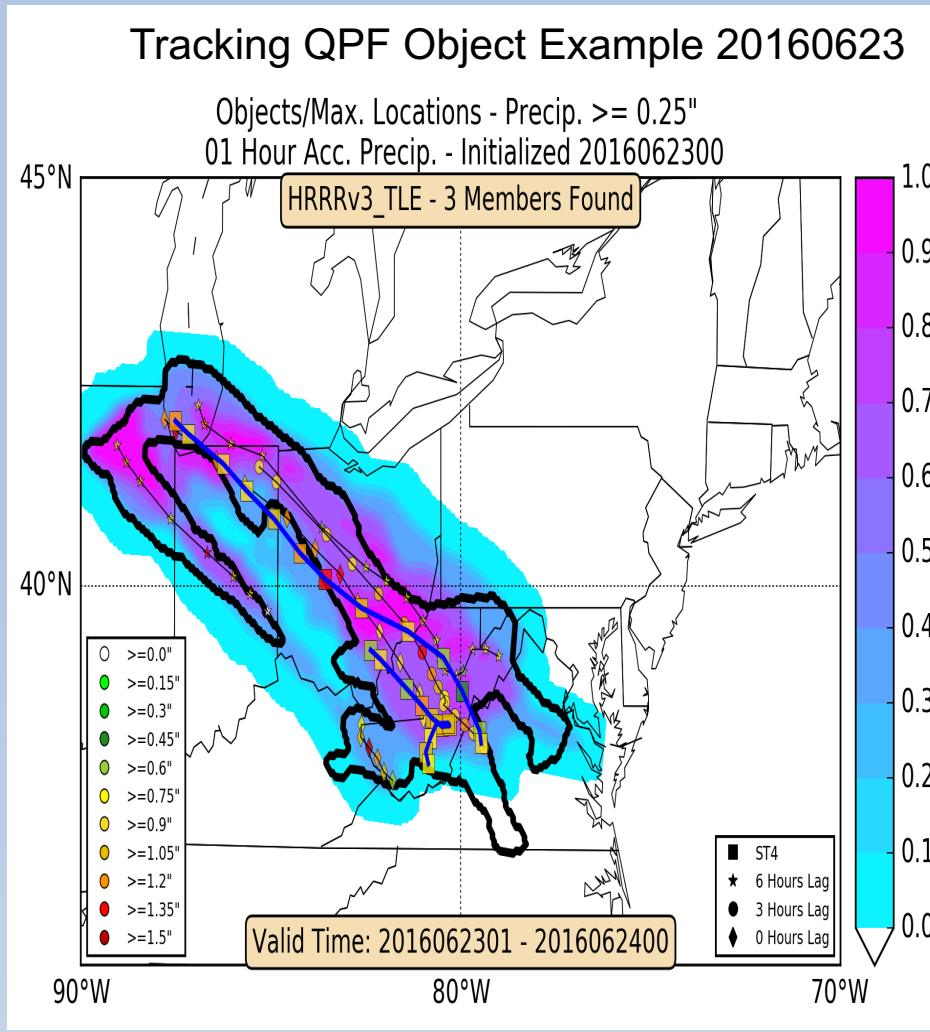
WPC's Current Practically Perfect



- When considering flooding proxies/observations, P-P values are too high.
- WPC is experimenting with the practically perfect method to create calibrated probabilities

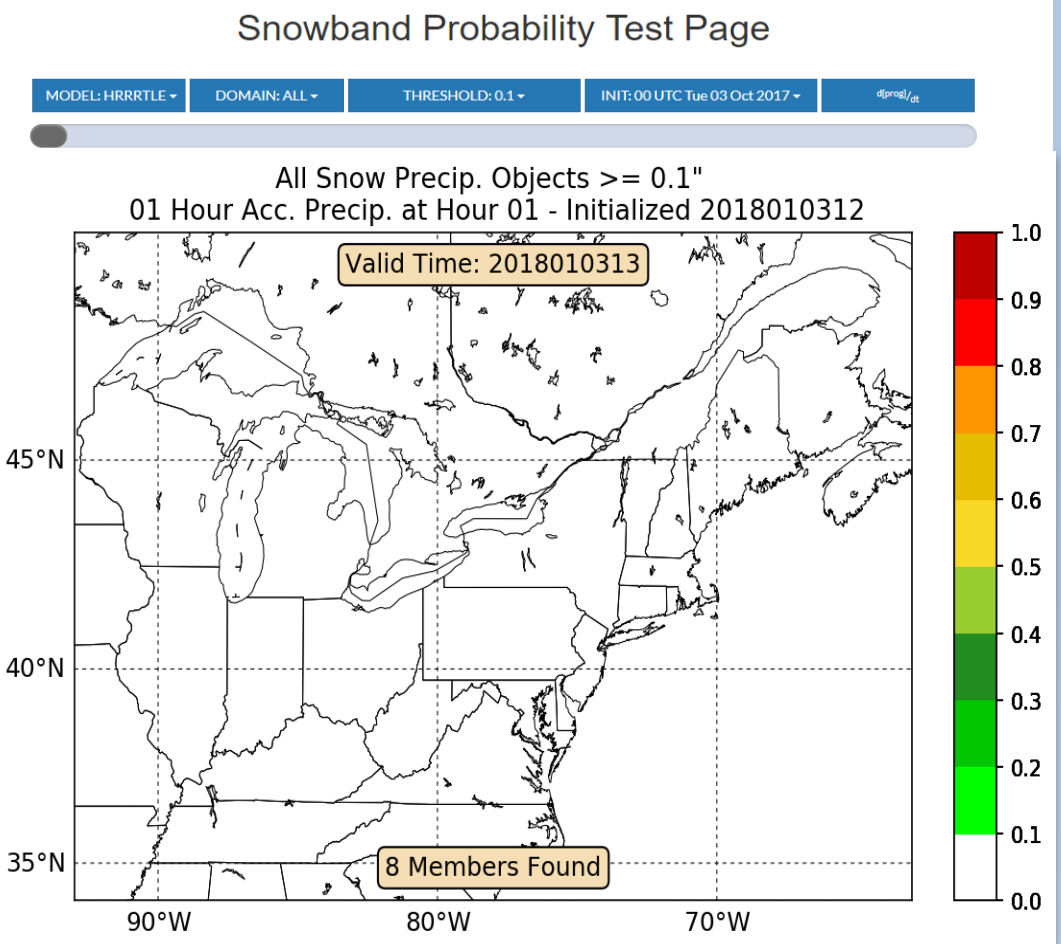
4) Tracking Heavy Precipitation Objects – MET's Role

- **Regrid_data_plane** is used to interpolate all gridded data to a common platform.
- **Pcp_combine** is used to ensure all quantitative precipitation forecast (QPF) data is at 1 hour accumulation intervals.
- **MODE** is used to identify objects with matching and merging.
- **MTD** is used to identify objects, track them through time, and perform any matching/merging.
- Python wrappers are used to call the MET functions and plot all data.



4) Experimental Graphics - Snowband Website

Example from Website
HREF on 12 UTC 03 Jan 2018



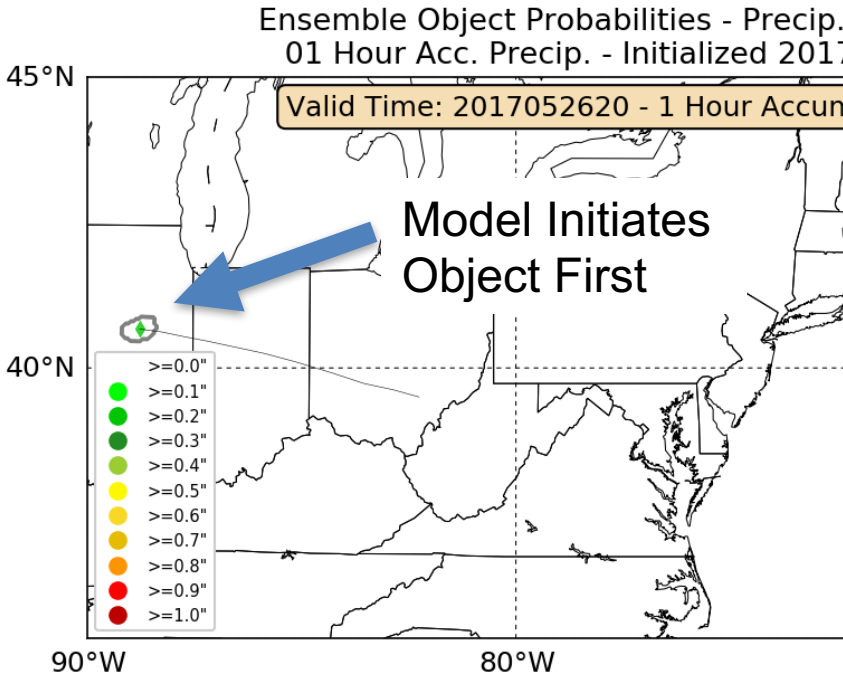
Website Work Performed by Sara Ganetis
WPC/IMSG

- QPF is masked with the categorical snow field and tracked to generate snow band images.
- Snow band objects from the 03 - 04 Jan 2018 Blizzard are shown for the HREFv2.
- The shape of the snow band object is displayed, with the border color representing 90th percentile of object intensity.
- Website interface allows for the user to specify ensemble, domain, model initialization, and model trends.

4) Retrospective Tracking – Methodology

- The HRRRv2 and HRRRv3 QPF objects exceeding 0.1” 0.25” and 0.5" **per hour** are tracked and compared to the Stage IV analysis between 01 May – 31 Aug 2017.
- Using **paired** model and observation object attributes, differences are computed in *object centroid latitude, centroid longitude, intensity, orientation, and size*.
- Using start/end time of **paired** objects, differences in *object initiation and dissipation* are calculated between model and observation.

Tracking Example - 26 May 2017



- All difference statistics are aggregated on a 2^{o} latitude/longitude grid.
- Only results that are statistically significant at 99% using a Student’s T-test are retained.

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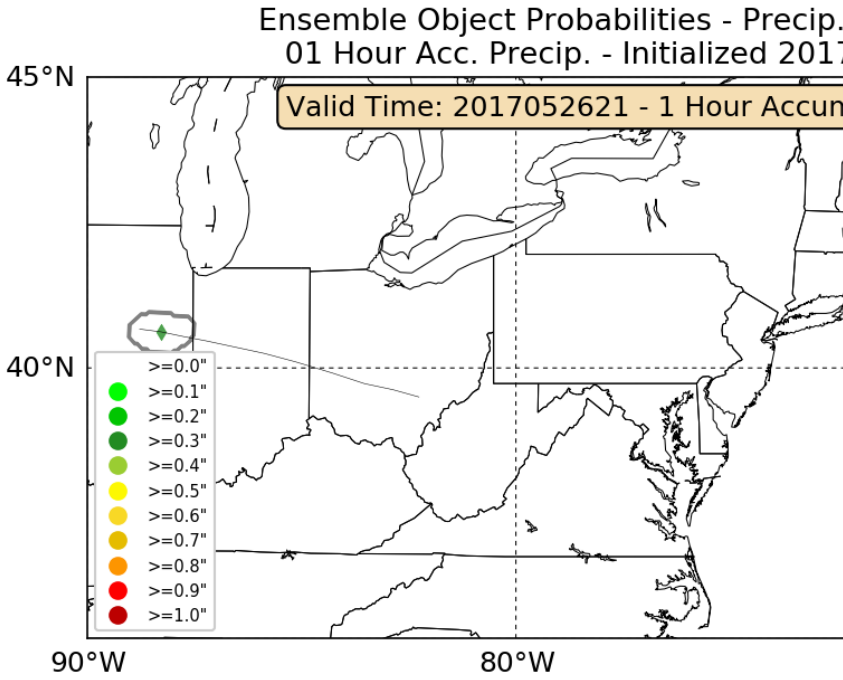

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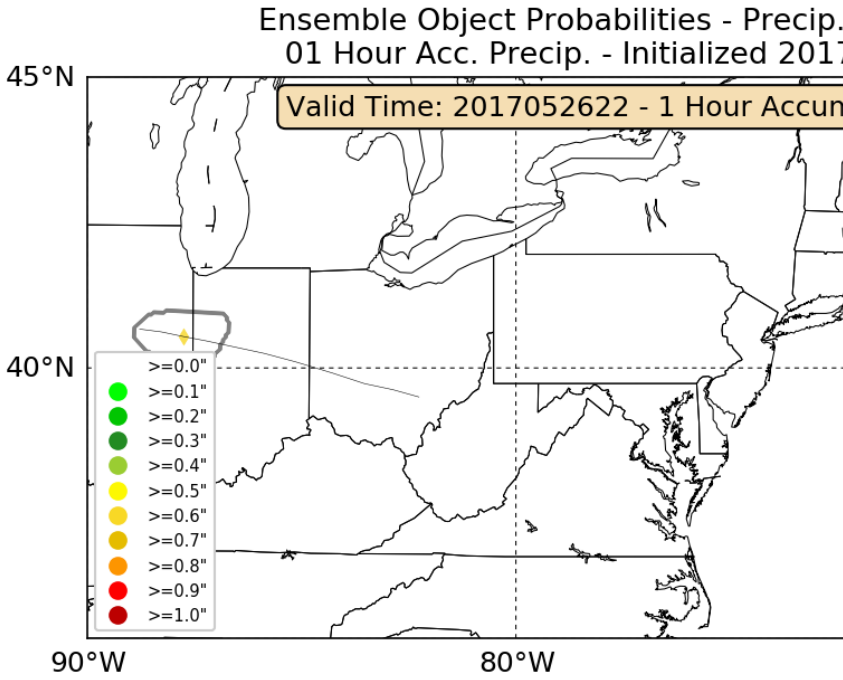

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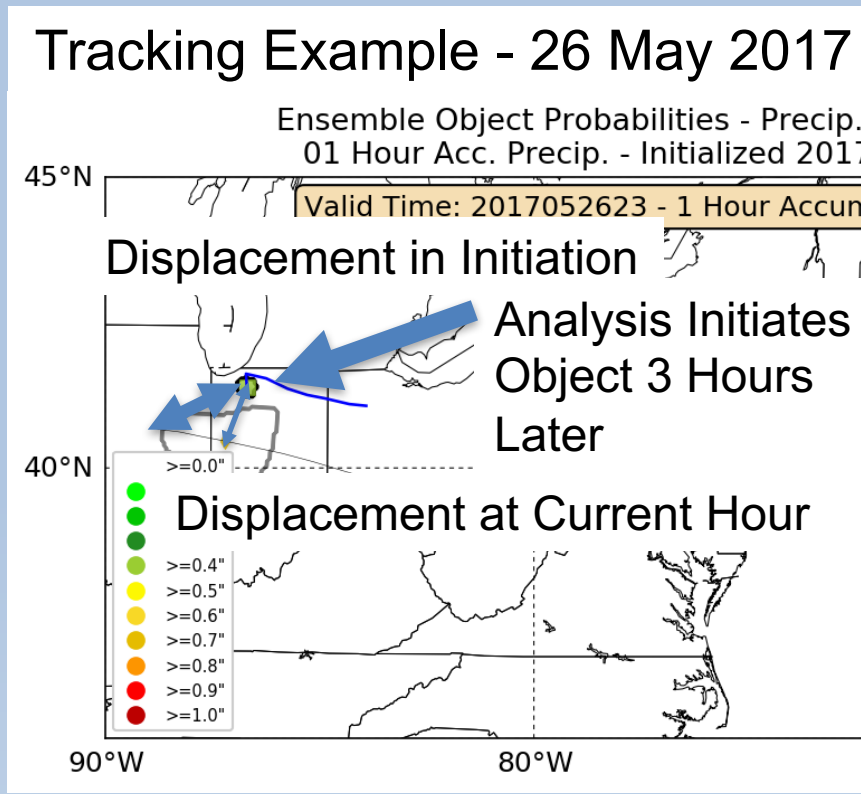

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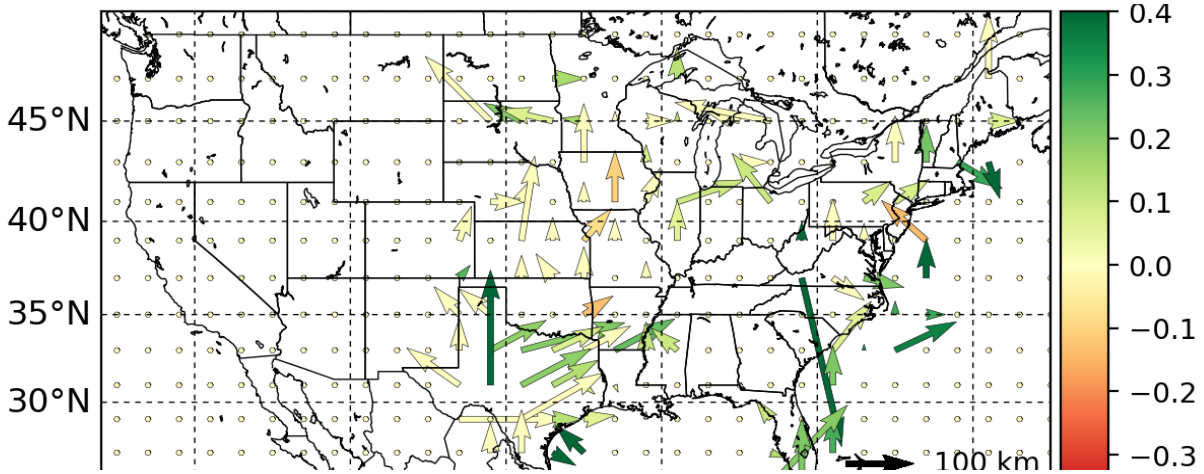
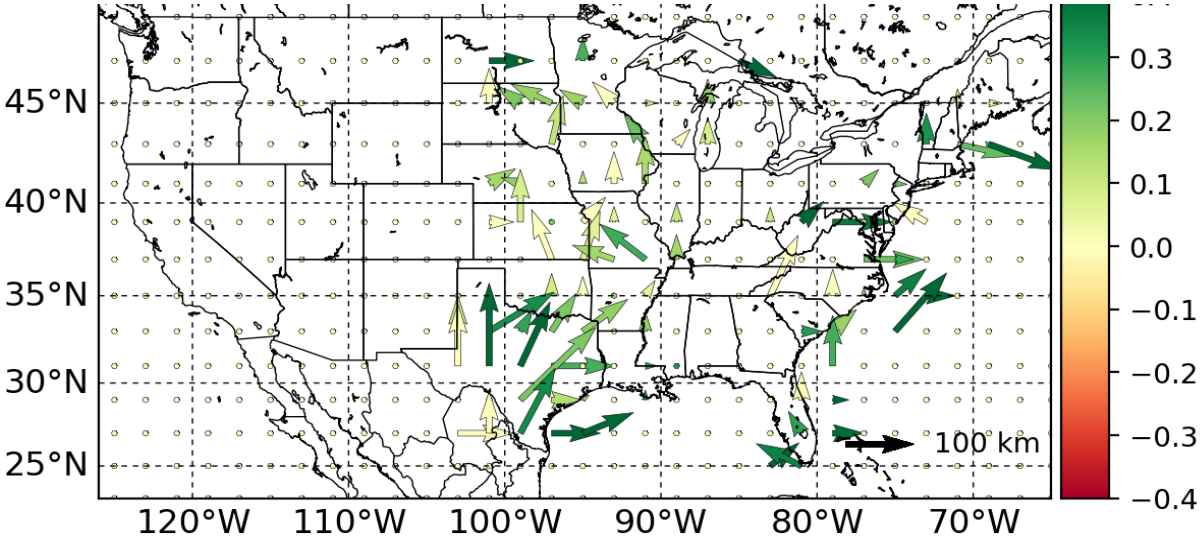
4) Paired Displacement and Intensity HRRRv2 and HRRRv3 at > 0.25”

- Analyzing a higher threshold (> 0.25” per hour) reveal similar biases, with a north/northeastward displacement bias over the Central and Southern Plains.
- The dry bias over the Central Plains becomes more apparent with a wet bias over Texas and most of the East Coast.

HRRRv2 - Intensity/Displacement



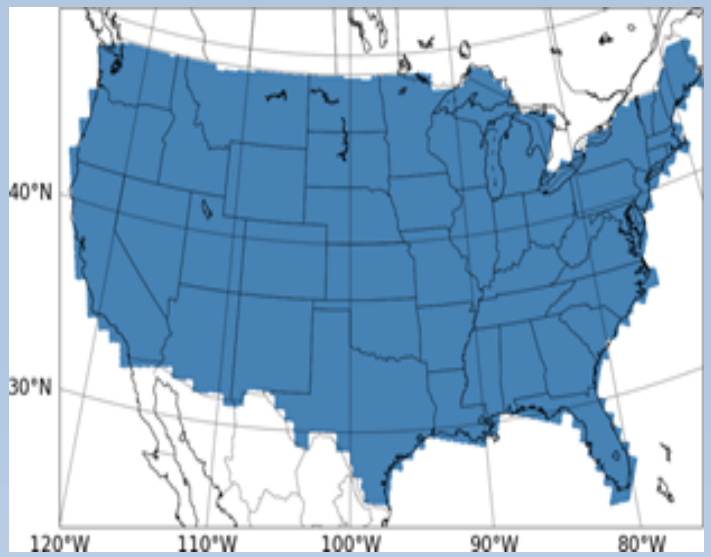
HRRRv3 - Intensity/Displacement



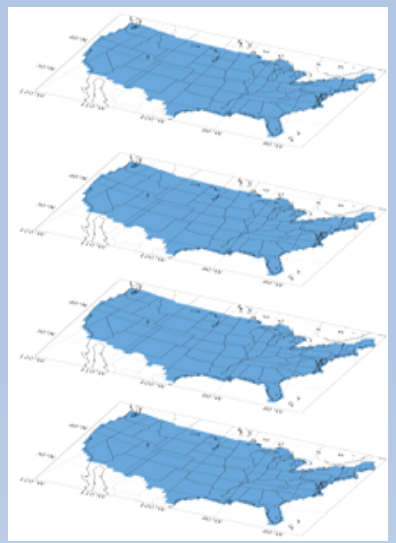
5) WPC-HMT Extended Range Forecast Experiment – MET's Role

General Verification Workflow

regrid_data_plane:
regrids files onto common grid



grid_stat:
calculates continuous statistics



stat_analysis:
bulk statistics over a specified time period

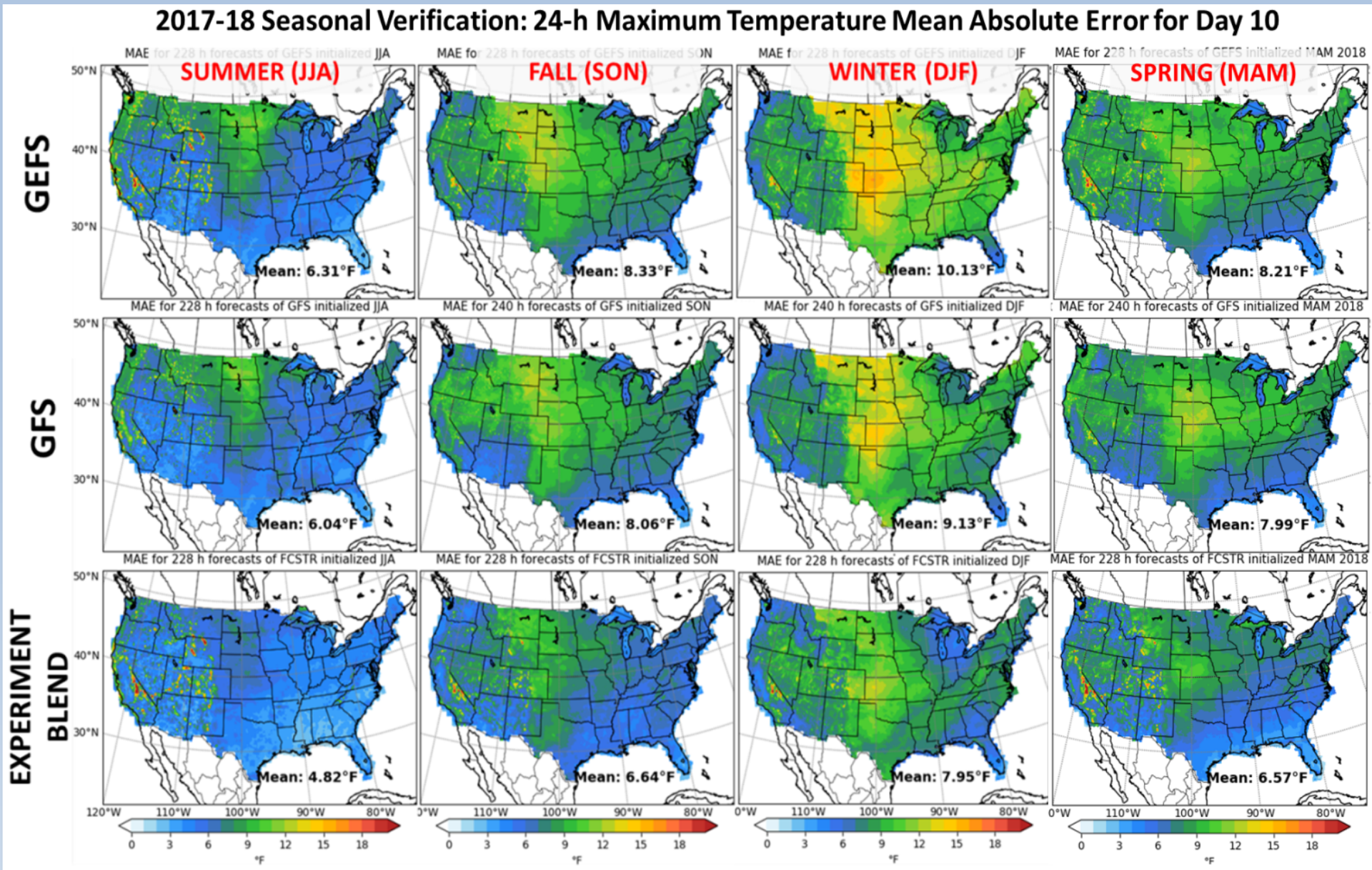
series_analysis:
calculates continuous statistics at each grid point

MODE:
identify forecast objects exceeding a given value at a specific probability threshold

All MET programs are run using Python scripts. All graphics are created using Python (Basemap, Matplotlib, etc.)

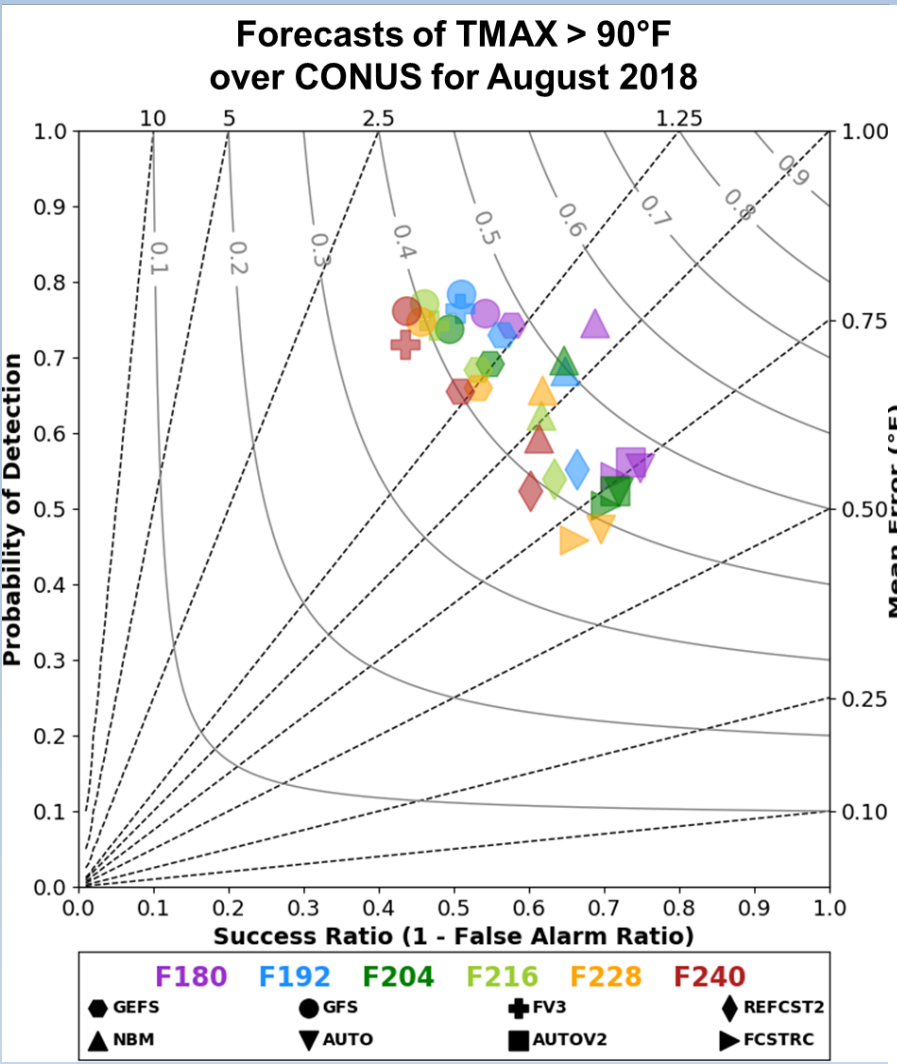
5) WPC-HMT Extended Range Forecast Experiment

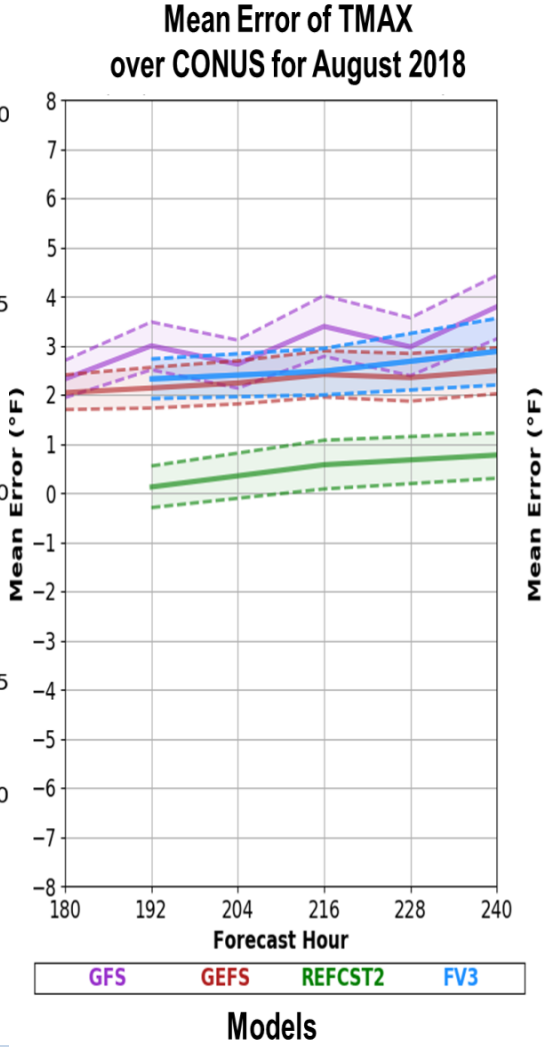
Series Analysis Example

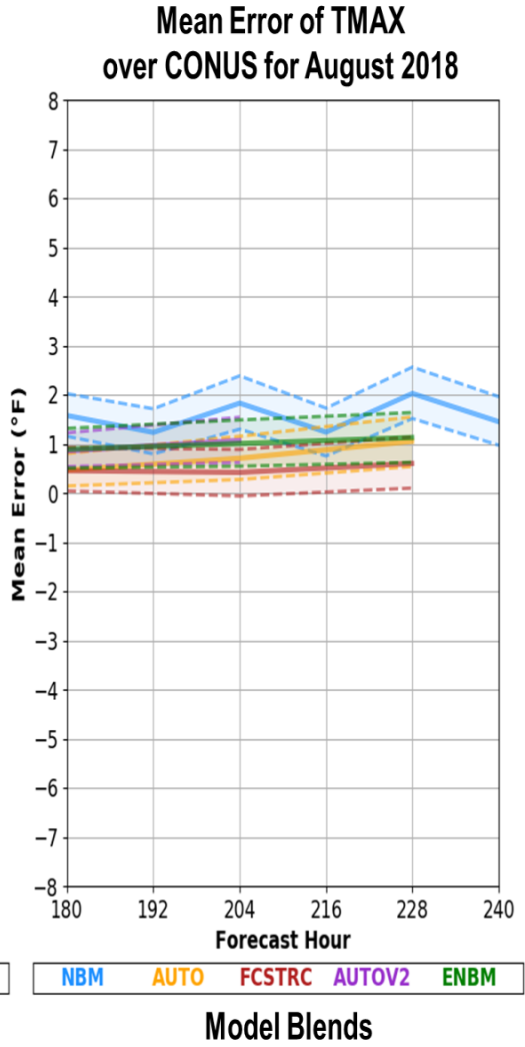


5) WPC-HMT Extended Range Forecast Experiment

Grid Stat + Stat Analysis Examples



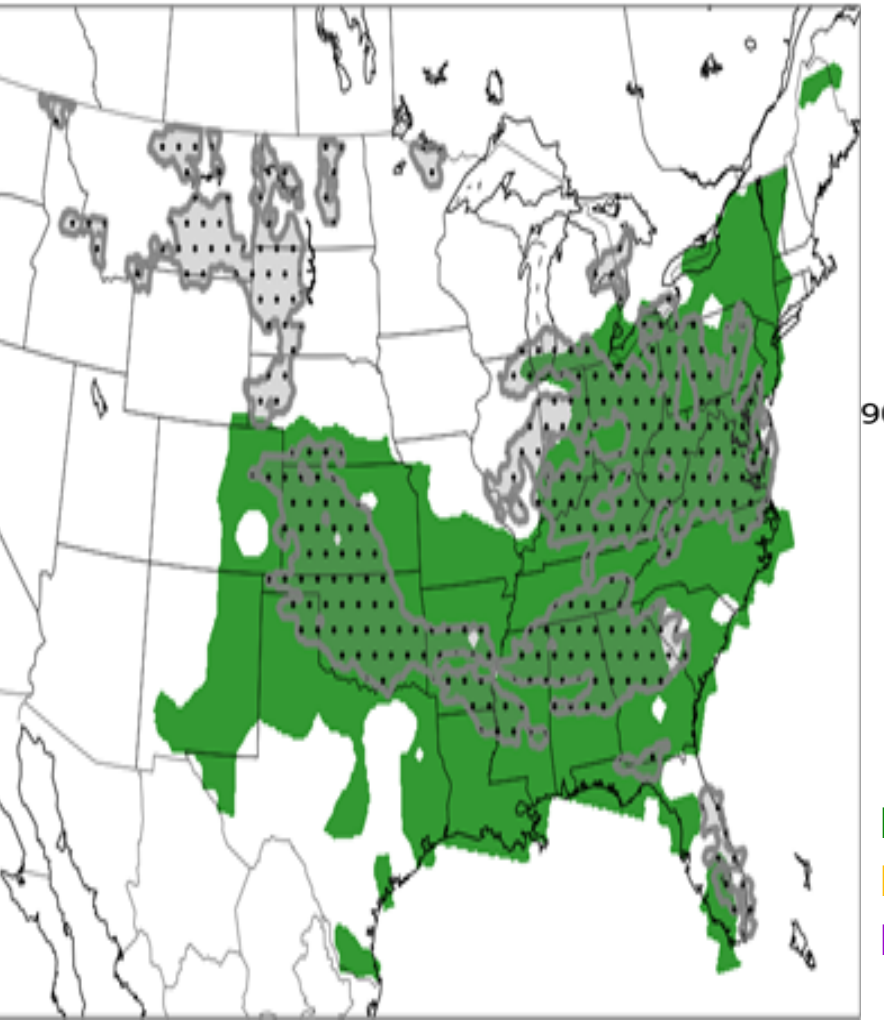




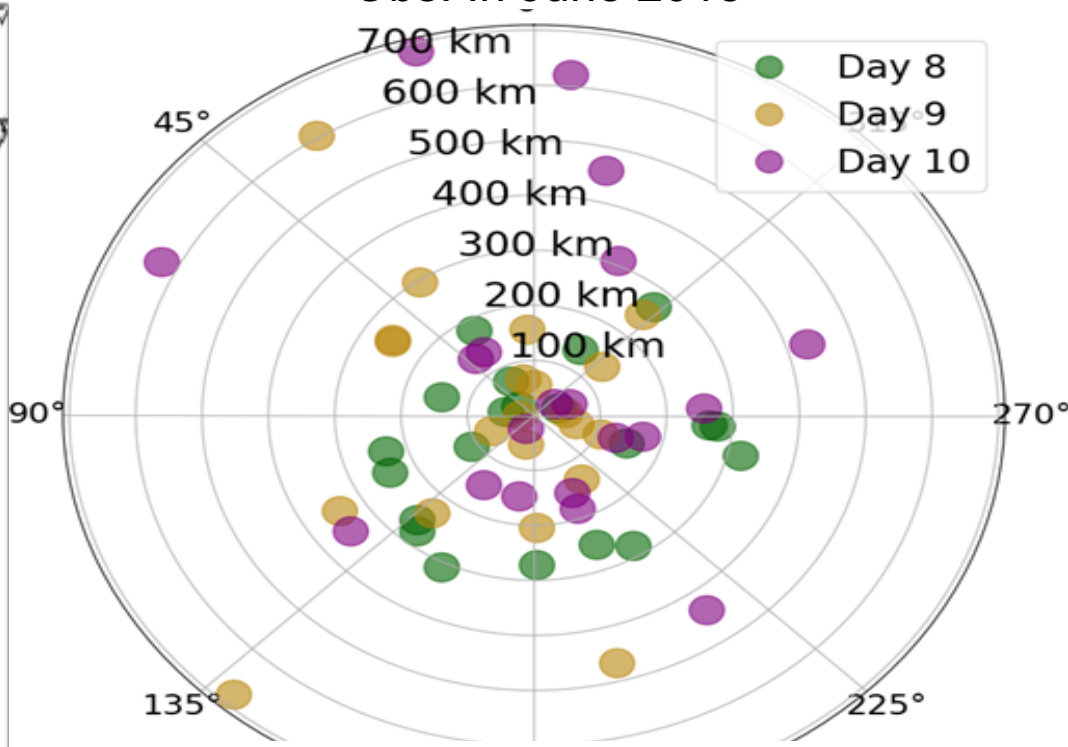
5) WPC-HMT Extended Range Forecast Experiment

MODE Example

Example of Forecast >30% (shaded) and Obs (hatched) for a Day 9 forecast from 20180614



Centroid Position Error - 24-h QPF Experimental Blend of >30% Probability of >0.25”– Relative to Obs. In June 2018



Day 8 → forecasts displaced to the SW of obs.

Day 9 → forecasts more evenly dispersed @ origin

Day 10 → forecasts displaced to the east of obs.