

Weather Prediction Center Hydrometeorological Testbed Day 8-10 Experiment

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April 10, 2018

Presentation Outline

- **Overview of Experiment Goals and Operations**
- **Blended Forecast Options**
- **Application of Ensemble Clustering to Forecast Blend**
- **Forecast Verification**

Experiment Goals

2017 (completed)

- Explore the use of new forecast tools to inform forecasters of likelihood of anomalous weather events
- Explore the utility of daily forecasts of precipitation and temperature out to Days 8-10
- Evaluate probabilistic forecast products designed for forecasting high impact temperature and precipitation events at medium range
- Collaboration with social scientists to determine the most efficient and user friendly projection of Day 8-10 probabilistic forecasts

Experiment Goals

2018

- **Apply the use of ensemble clusters to the forecast process to improve forecaster input into the forecast**
- **Further test formats for depicting extreme weather events (Weather in Context – record, analogues, etc.)**
- **Further Probabilistic Product Development**
- **Event Verification (MET MODE, Anomaly Verification)**
- **Enhance tools and training for forecasters to enable application of new tools into the forecast process**

Experiment Operations

- Ongoing experiment since January, 2017 with sessions conducted 2nd and 4th Thursday each month
- Onsite and remote participants include:
 - Weather Prediction Center (WPC) and WPC-HMT developers
 - Climate Prediction Center (CPC) forecasters
 - Environmental Modeling Center (EMC) developers
 - Alaska Climate Test Bed
 - Academic Partners
- Each session opens with an extensive half hour verification analysis of the previous session forecast, as well as monthly and seasonal verification of forecasts.
- CPC forecasters provide an overview of the current state of ENSO, the Madden Julian Oscillation (MJO), annular modes, and how they may influence the forecast in the upcoming Day 8-10 time period.
- WPC-HMT team facilitate the preparation of the experimental Day 8-10 forecast

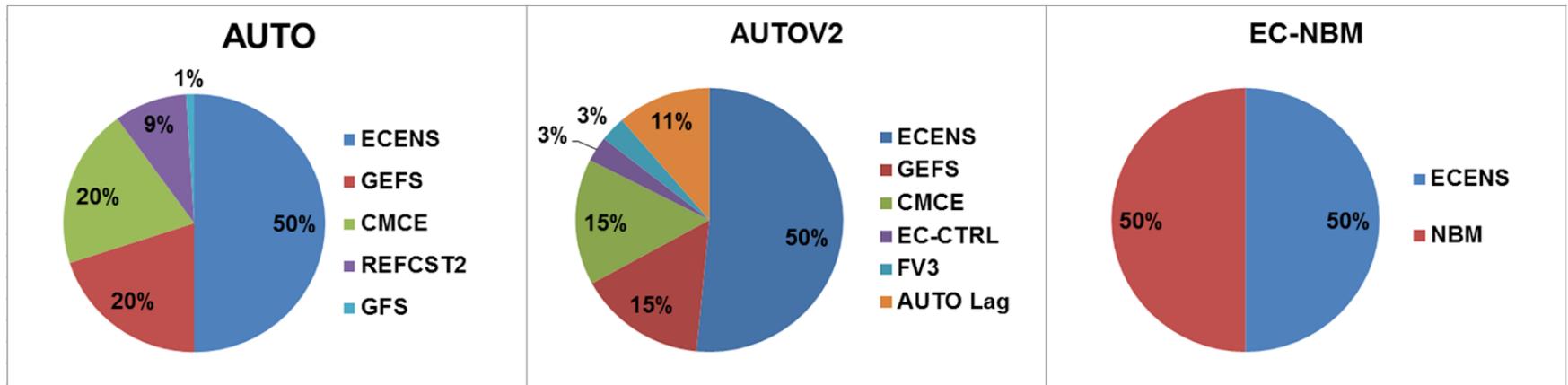
Forecast Process During 2017

Automated Experimental Forecast Blends

AUTO – standard auto-blend

AUTOV2 – version 2 of auto blend (January 2018)

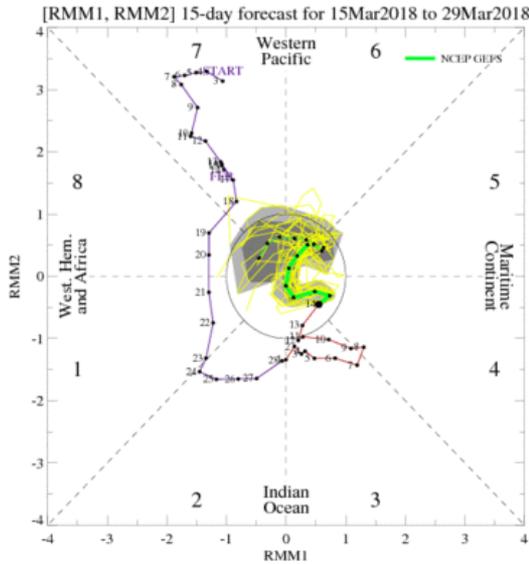
EC-NBM (aka ENBM)



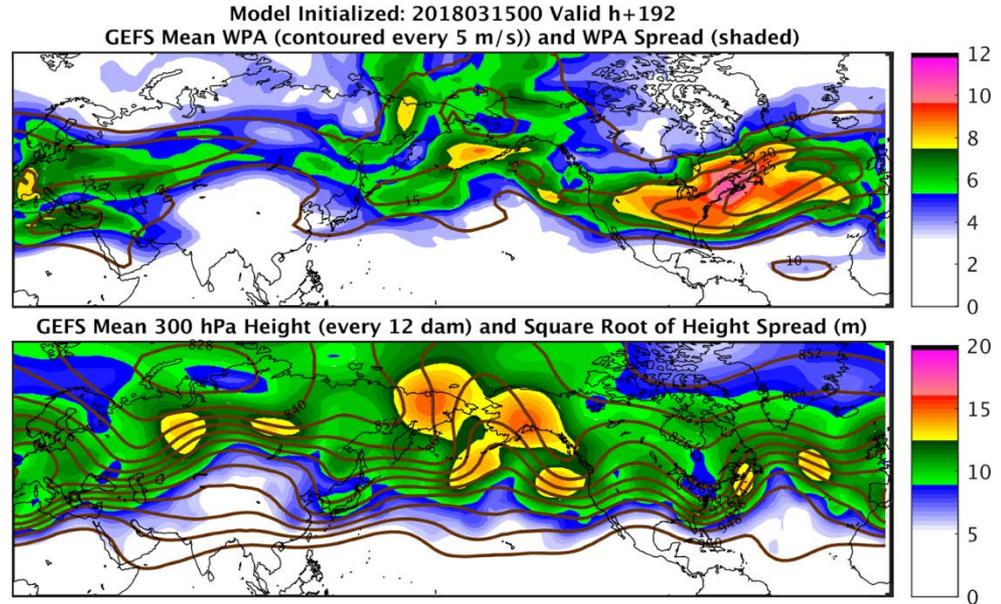
Manual Forecaster Blend

Forecaster Role → goal is to redistribute weights of the above inputs based on what experimental canonical tools and model forecasts

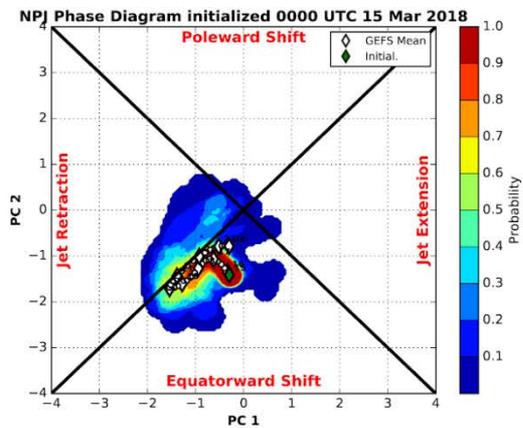
Current Experimental Forecast Tools



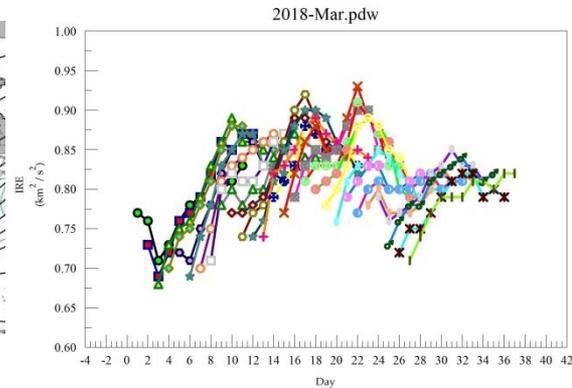
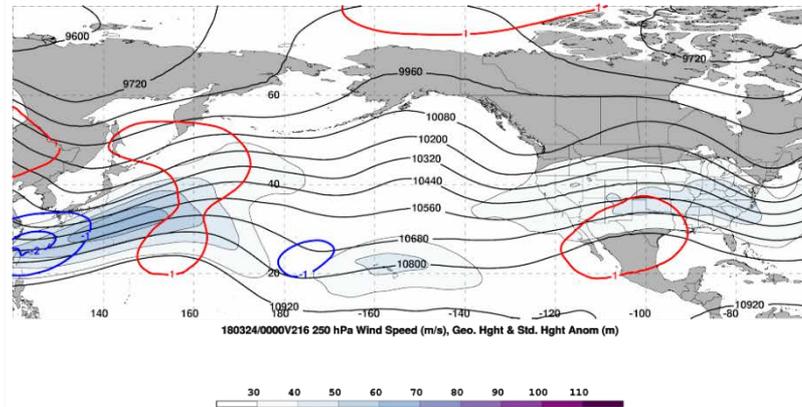
Current phase of MJO and forecast for week 2



Rossby Wave Packet Tool for GEFS (Stony Brook University)

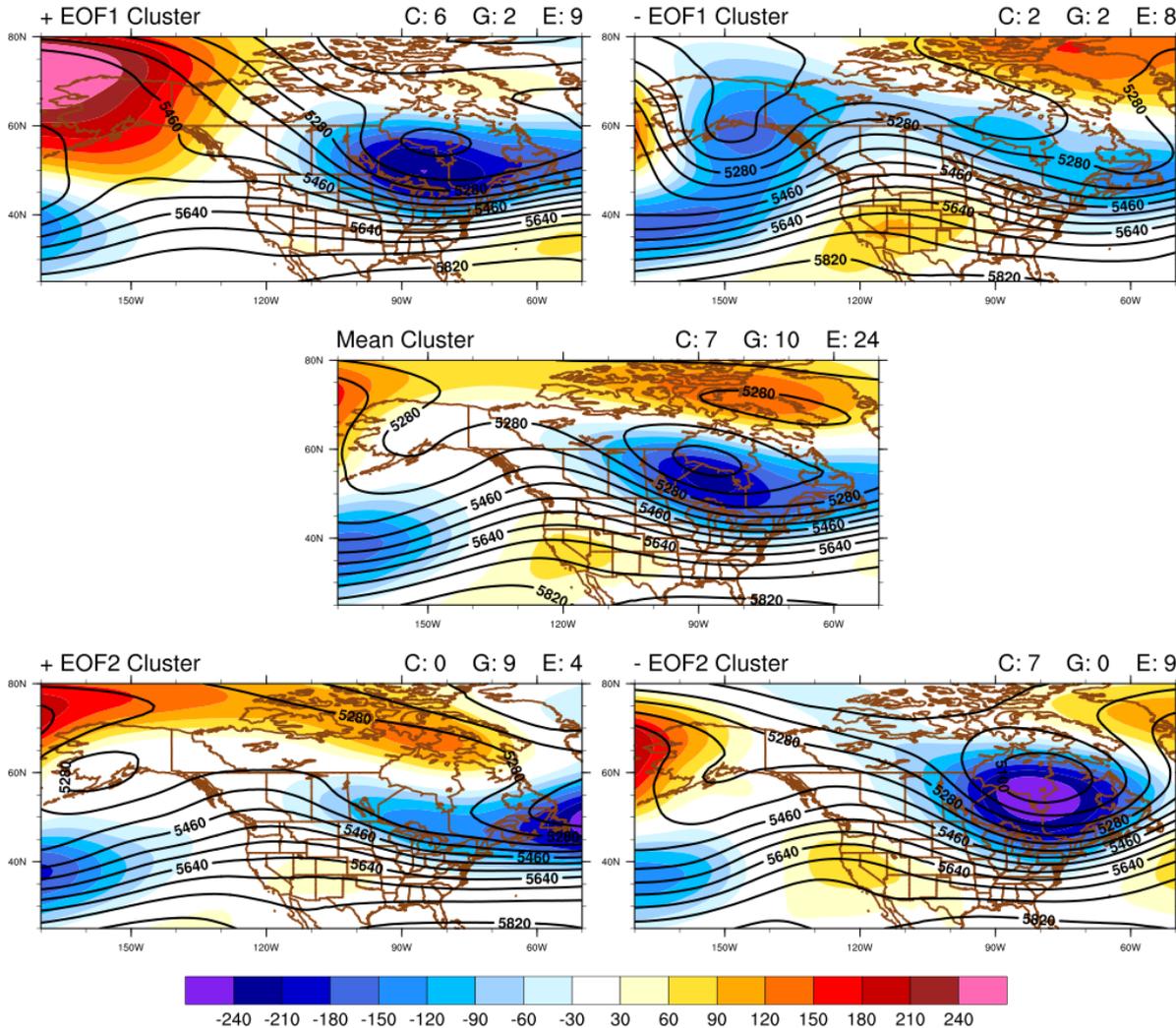


North Pacific Jet (NPJ) Tool (provided by Andrew Winters - University at Albany)



Integrated Regional Entrophy Blocking Tool (University of Missouri)

New Tools for 2018



Cluster Tool

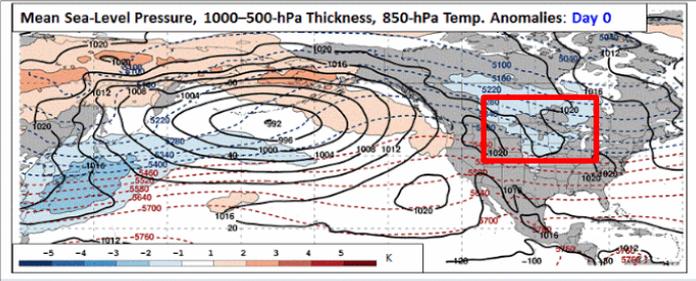
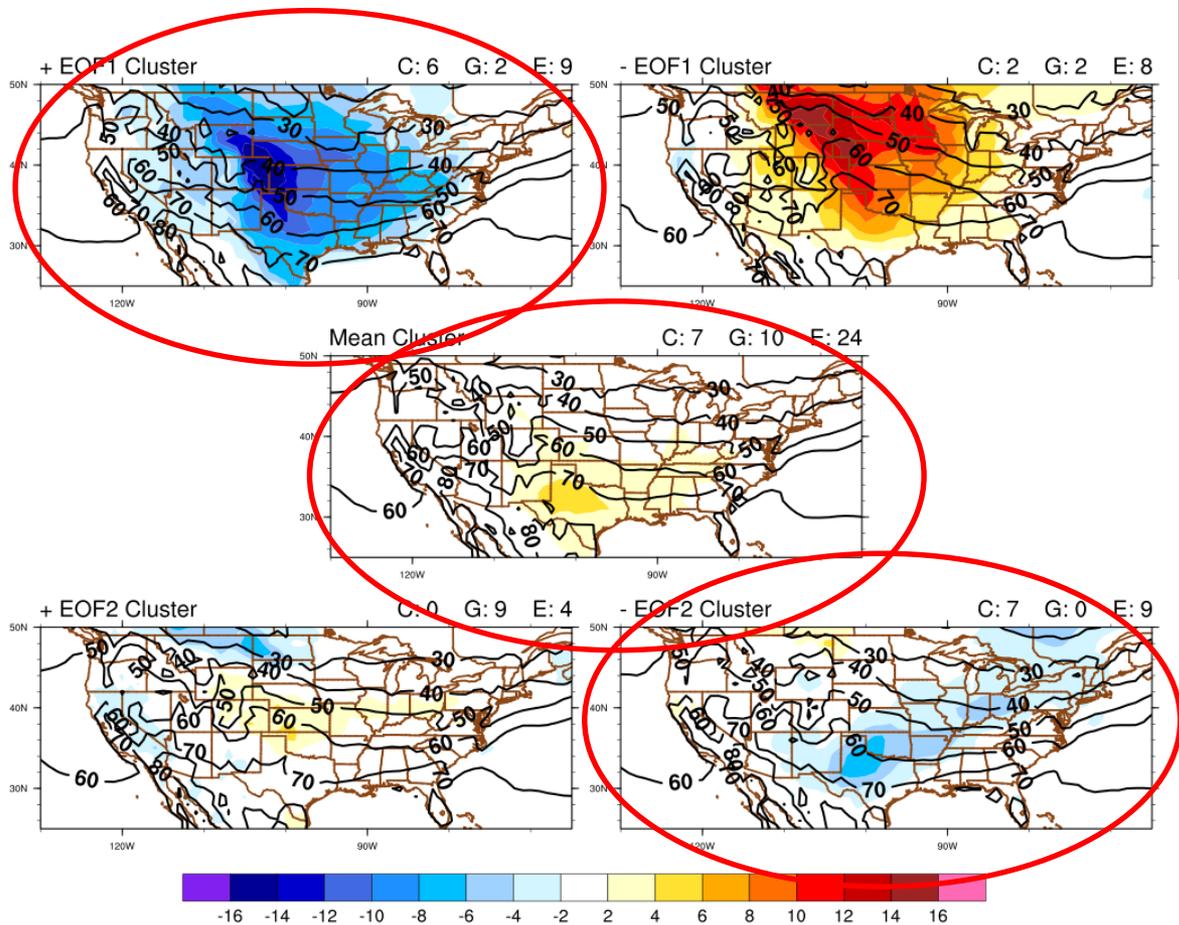
EOF1 and EOF2
computed for 500 hPa
geopotential height field

A mean cluster, plus
positive and negative sign
of each principal
component

Forecasters have option
to blend individual
clusters to make forecast
as opposed to ensemble
means and deterministic
model solutions.

**Cluster Forecasts of 8-10 Day Mean 500 hPa Heights and Anomalies
Initialized 0000 UTC March 27, 2018**

Application of Clusters to Forecast Process



Canonical composite of MSLP, 1000-500 hPa Thickness, and 850 hPa Temperature anomalies

Based on canonical NPJ Tool, the forecast phase space of jet extension, pattern does not support a big warm up for central and eastern U.S.

Therefore the Mean Cluster, EOF1 positive, and EOF2 negative were blended to make the forecast

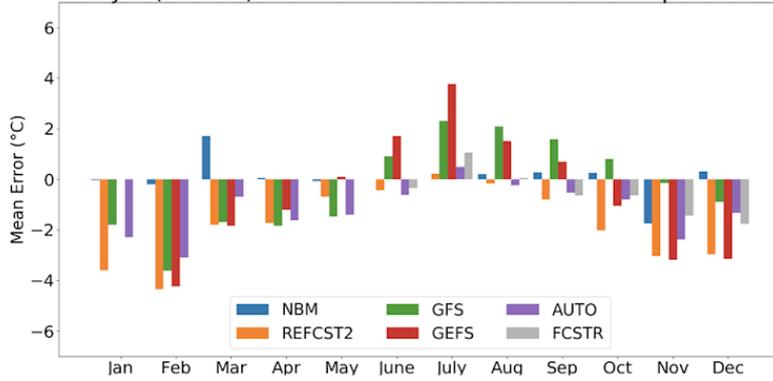
Cluster Forecasts of Day 9 Maximum Temperature (contours) and Difference Between Cluster Mean and 90-Member Ensemble Mean Model Cycle 0000 UTC March 27, Forecast for April 5

Monthly Verification: Monthly Average Error Scores for Maximum Temperature

Day 8

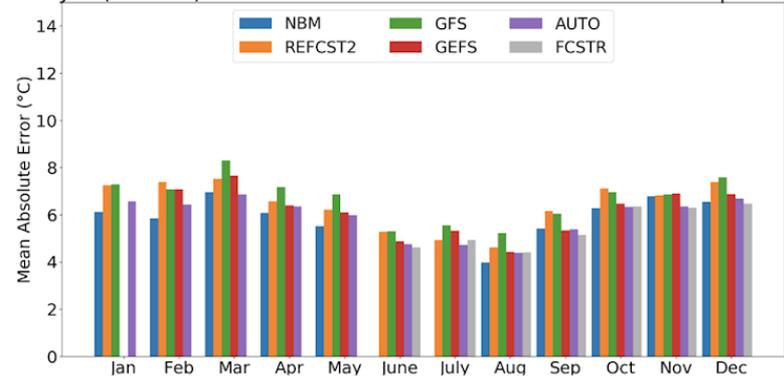
Mean Error

Day 8 (FH 192) Mean Error of 24-h Maximum Temperature



Mean Absolute Error

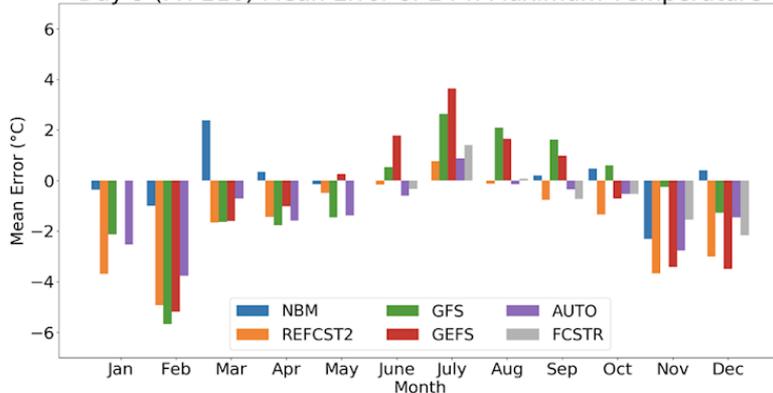
Day 8 (FH 192) Mean Absolute Error of 24-h Maximum Temperature



Day 9

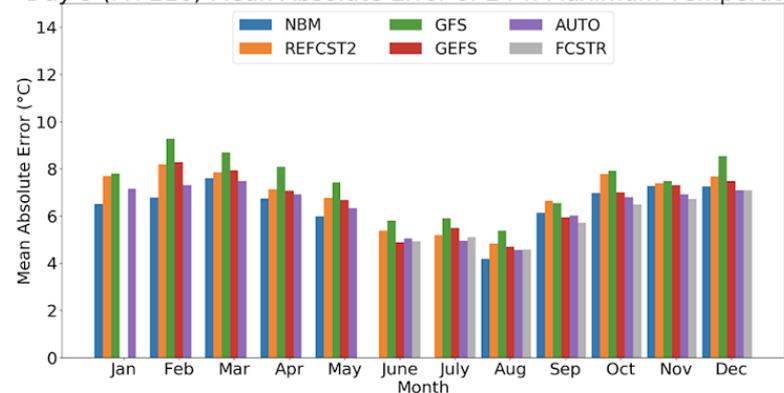
Mean Error

Day 9 (FH 216) Mean Error of 24-h Maximum Temperature



Mean Absolute Error

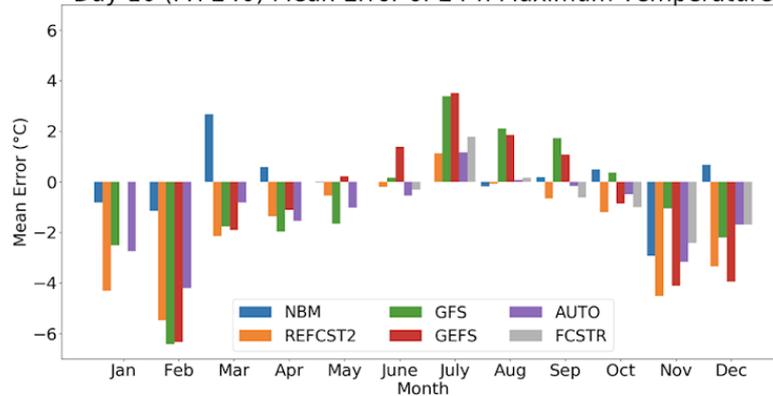
Day 9 (FH 216) Mean Absolute Error of 24-h Maximum Temperature



Day 10

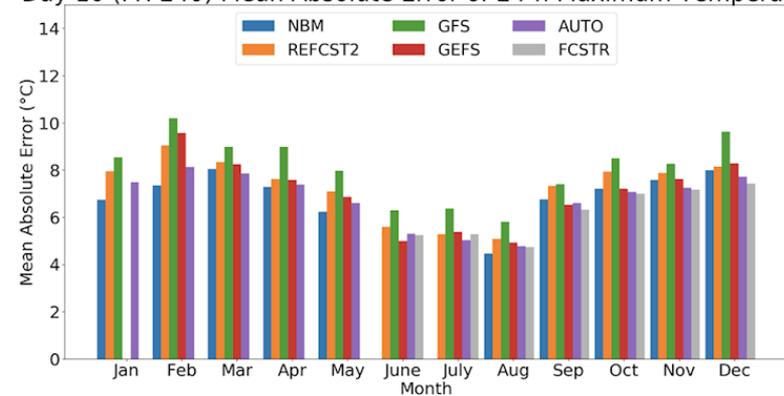
Mean Error

Day 10 (FH 240) Mean Error of 24-h Maximum Temperature



Mean Absolute Error

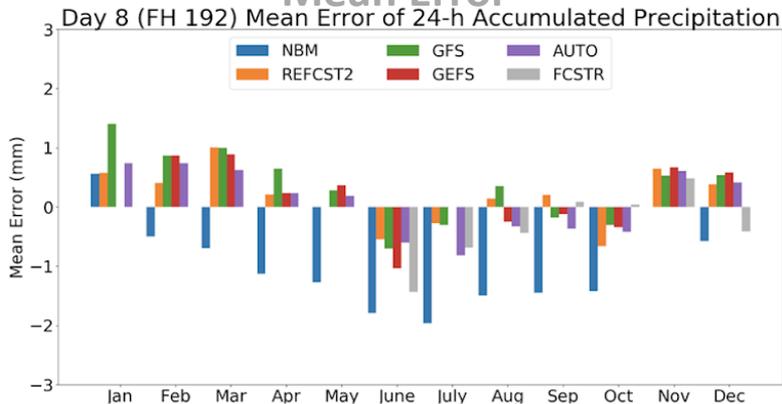
Day 10 (FH 240) Mean Absolute Error of 24-h Maximum Temperature



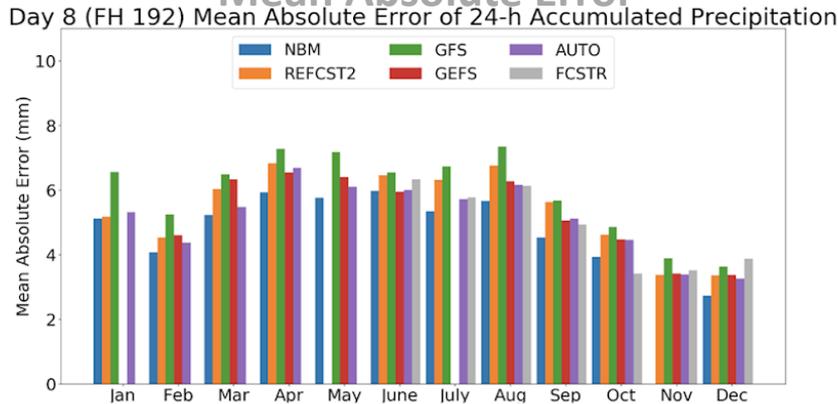
Monthly Verification: Monthly Average Error Scores for 24-h QPF

Day 8

Mean Error

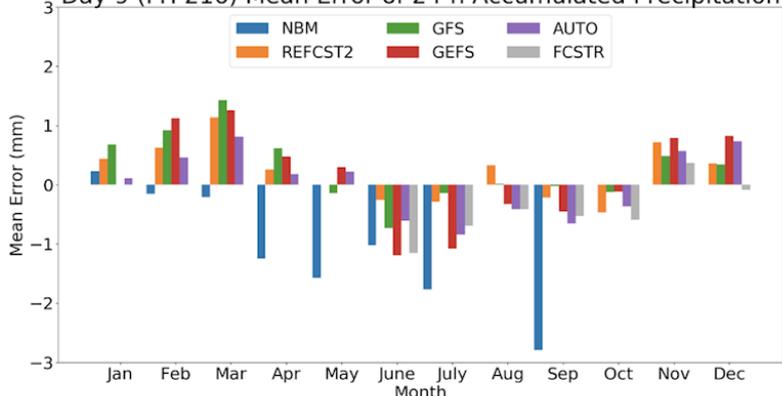


Mean Absolute Error

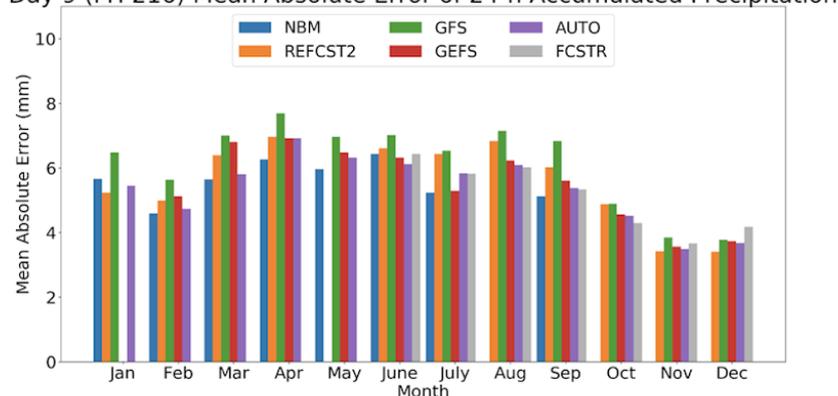


Day 9

Mean Error

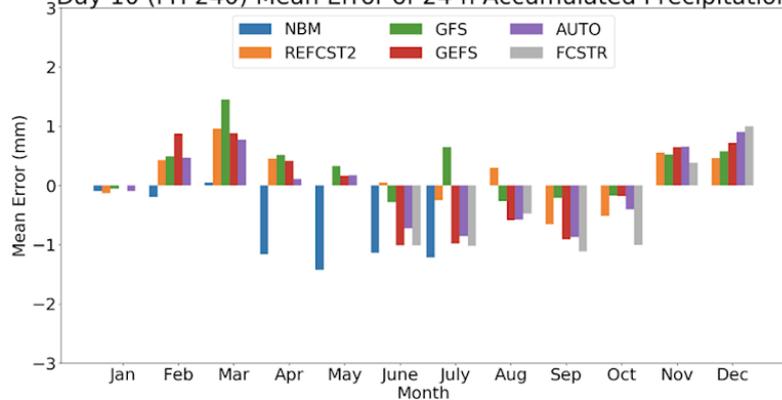


Mean Absolute Error

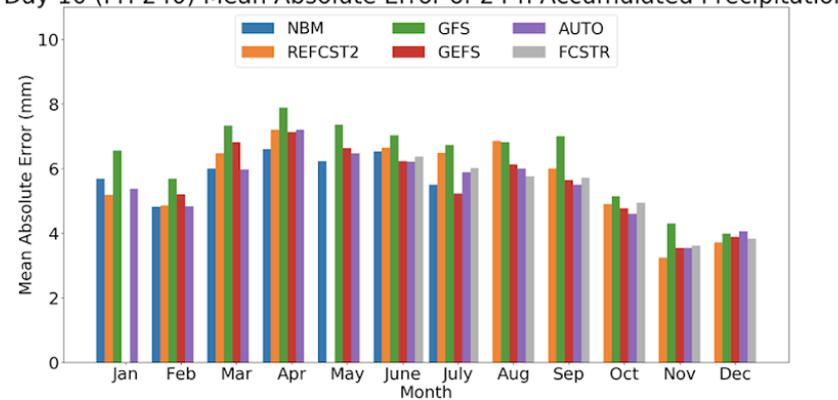


Day 10

Mean Error



Mean Absolute Error

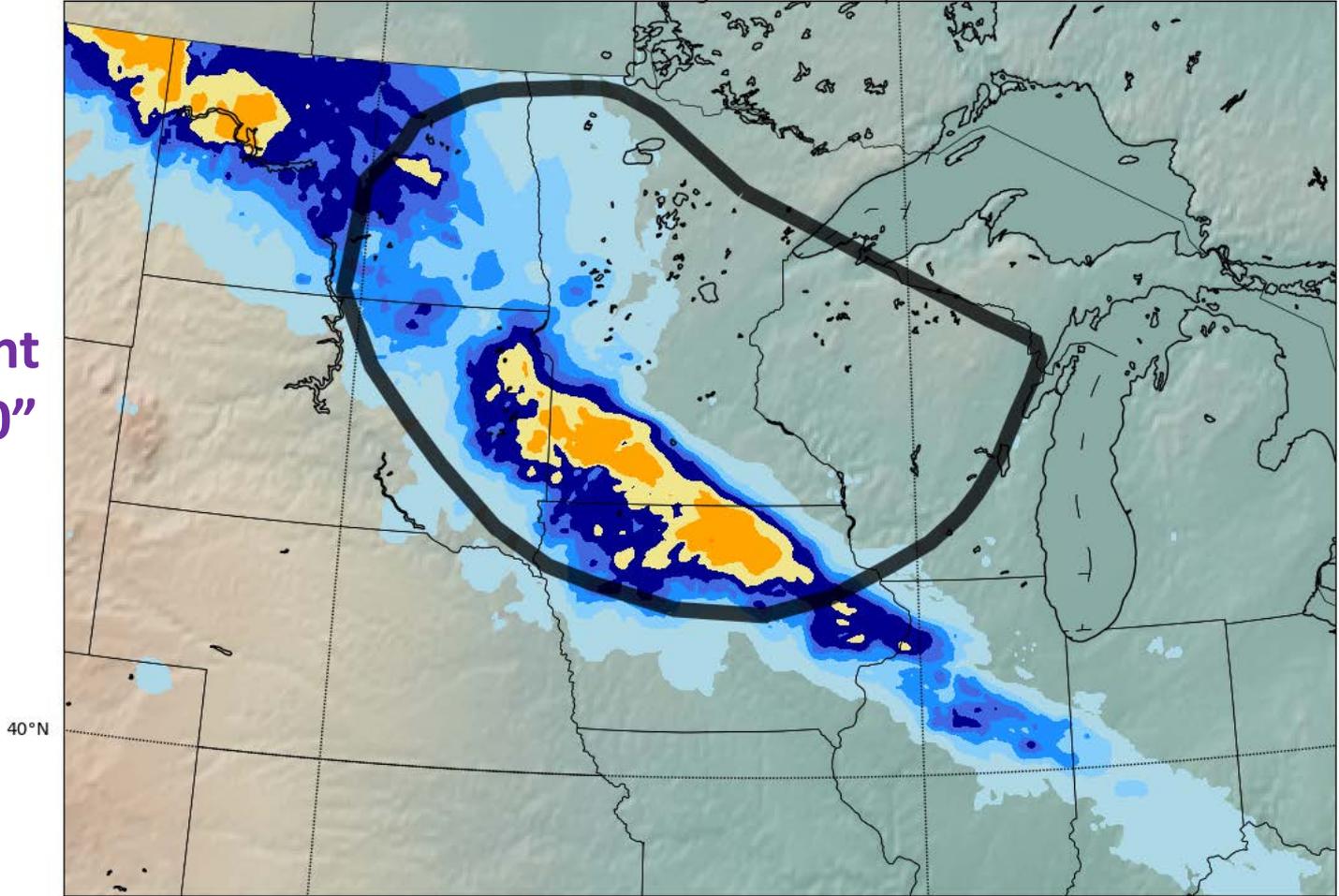


Days 8-10 Anomalous Weather Forecasts

**Days 8-10:
Chance Significant
Snow Event > 6.0''
in 24h**

**Day 9 favored
and verified**

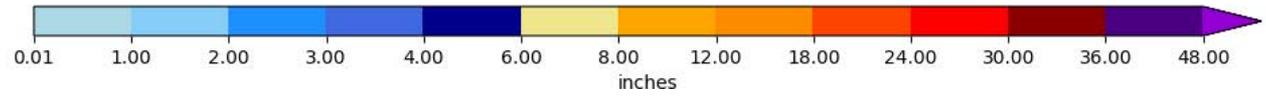
24-h NOHRSCv2 ending 2018032412 | Snow



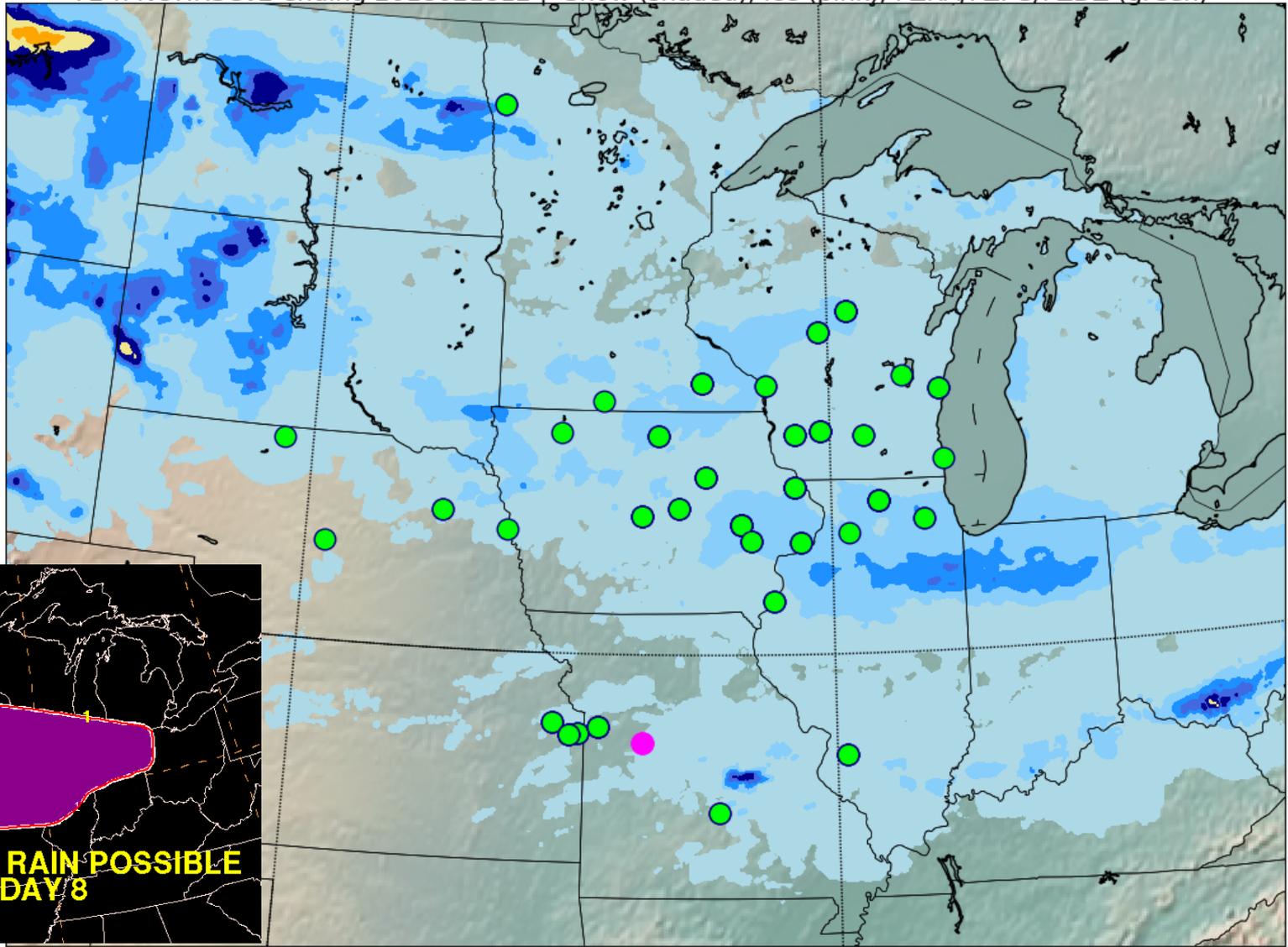
40°N

100°W

90°W

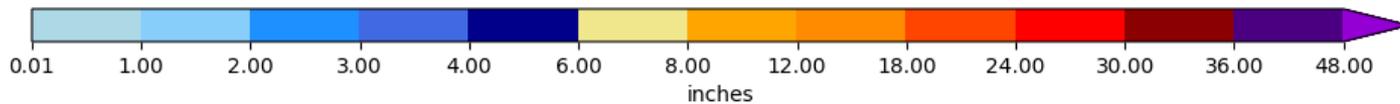


72-h NOHRScv2 ending 2018021812 | Snow (shaded), Ice (pink), FZRA/FZFG/FZDZ (green)



100°W

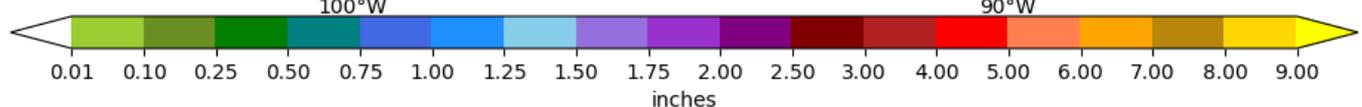
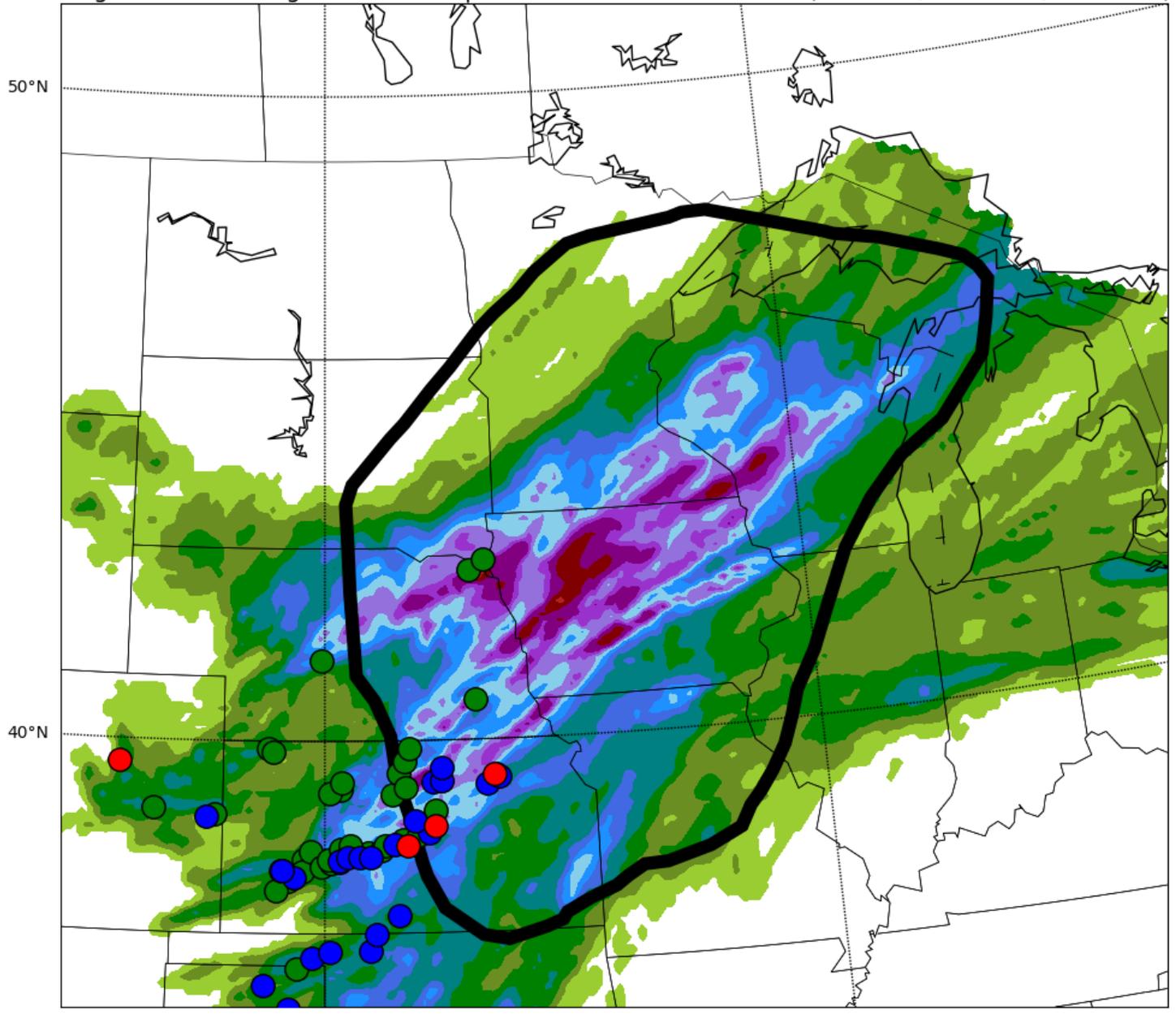
90°W



**Days 8-10
Anomalous
Weather Forecasts**

**Day 8-9:
Chance for 1 inch
of rain in 24 h
valid
12Z 7 Oct 2017
+
Severe Weather
(TOR, WND, HAIL
from SPC filtered
reports)**

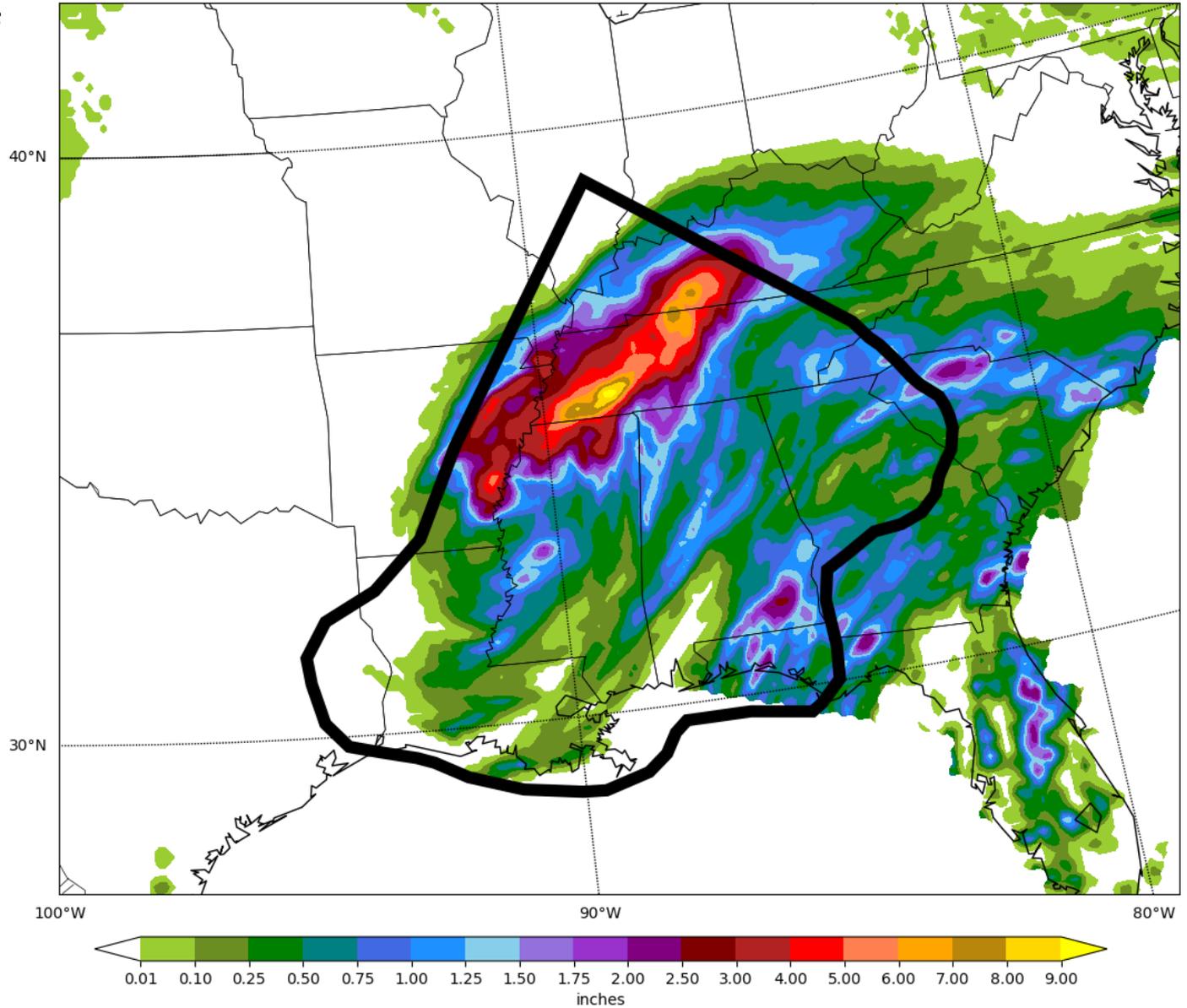
24-h Stage 4 APCP ending 2017100712 | 1.00" of Rain + Severe Wx (R = TOR, B = WND, G = HAIL)



Days 8–10 Anomalous Weather Forecasts

**Day 8:
Chance for 2 inches of
rain in 24 h valid 12Z
1 September 2017
(remains of Harvey)**

24-h Stage 4 APCP ending 2017090112 | 2.00" of Rain



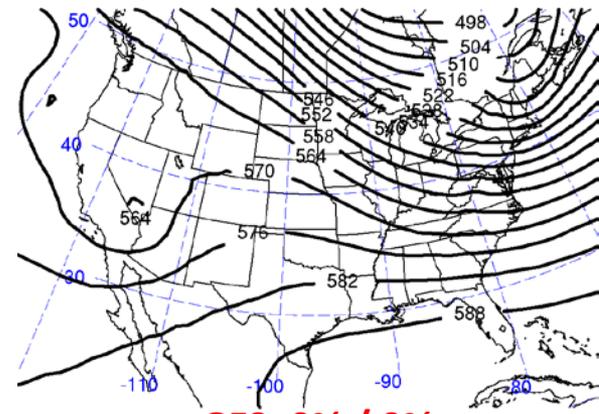
Verification:

Day 9 Forecast made February 8, for February 17

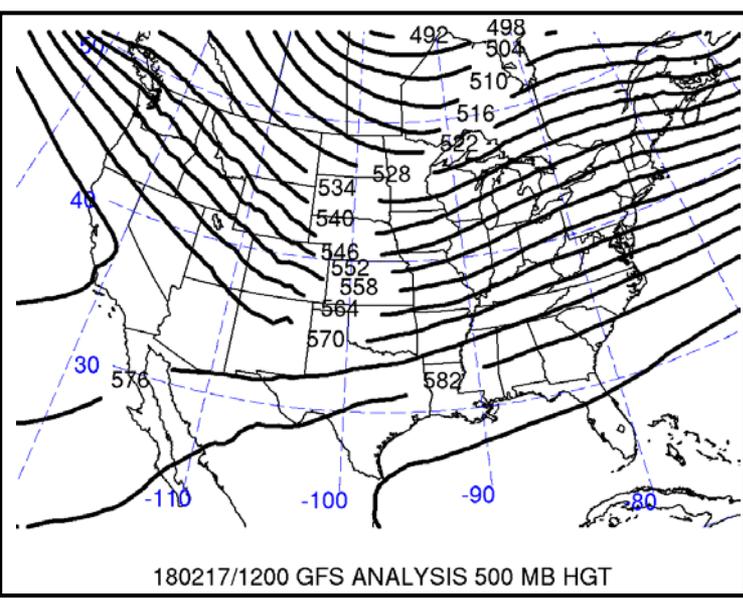
Day 9: Valid 2018-02-17 12Z

FCSTR Blend Weights (%)
Temp / QPF

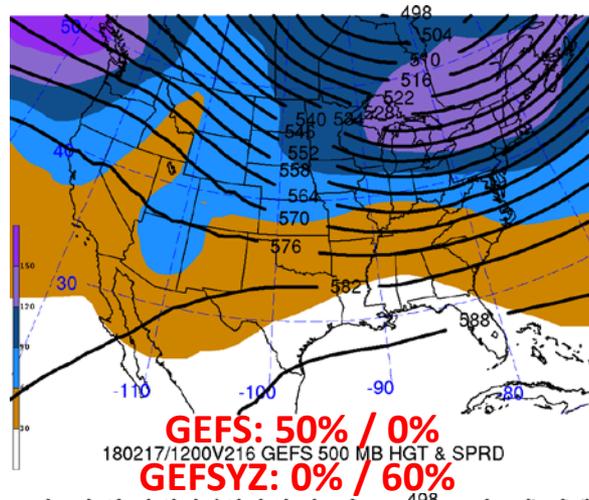
500 mb Heights



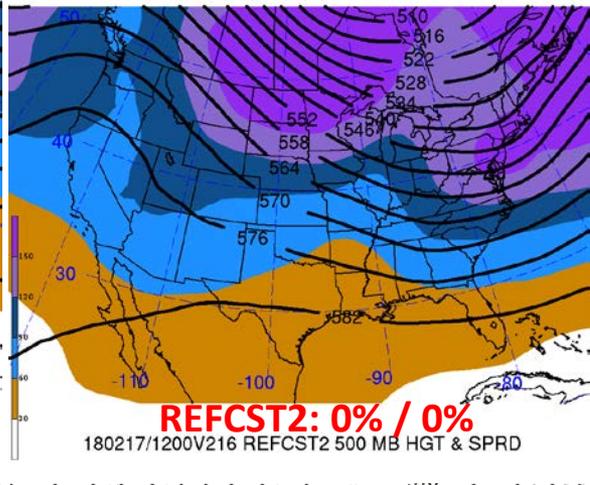
GFS: 0% / 0%
180217/1200V216 GFS 500 MB HGT



180217/1200 GFS ANALYSIS 500 MB HGT

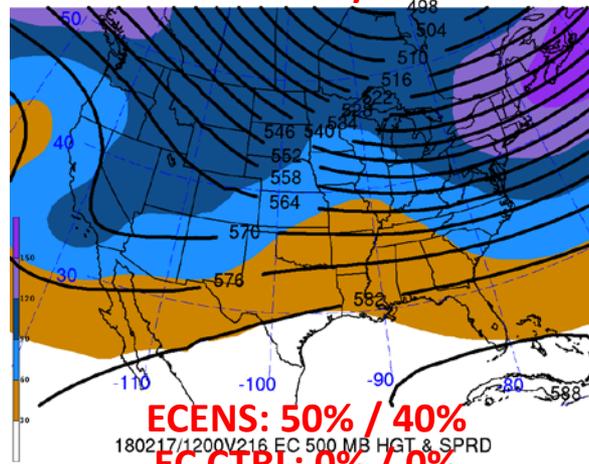


GEFS: 50% / 0%
GEFSYZ: 0% / 60%
180217/1200V216 GEFS 500 MB HGT & SPRD

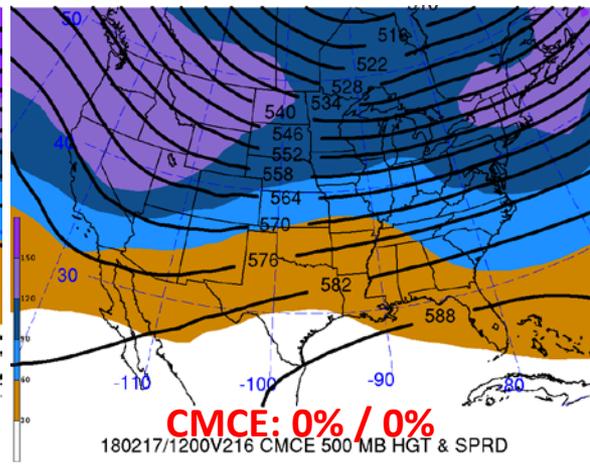


REFCST2: 0% / 0%
180217/1200V216 REFCST2 500 MB HGT & SPRD

CLIMO: 0% / 0%



ECENS: 50% / 40%
EC CTRL: 0% / 0%
180217/1200V216 EC 500 MB HGT & SPRD

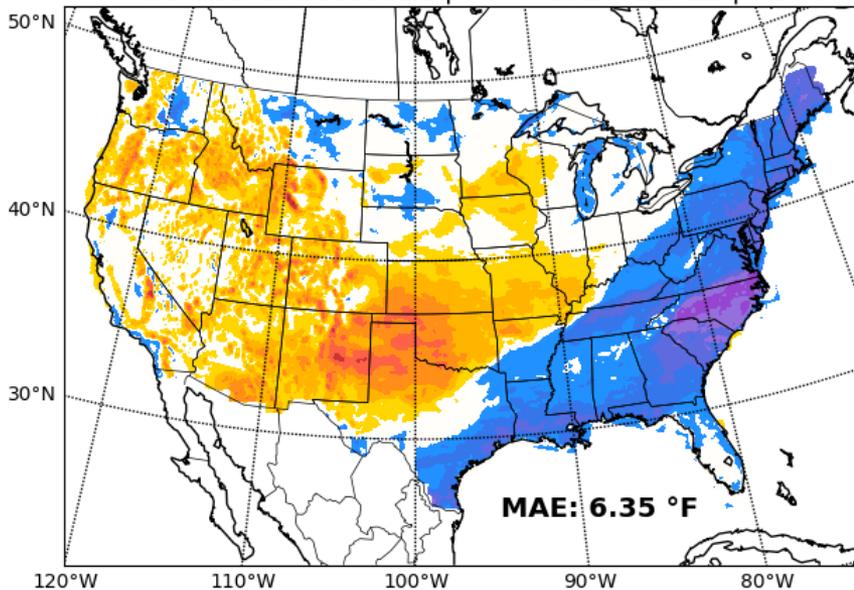


CMCE: 0% / 0%
180217/1200V216 CMCE 500 MB HGT & SPRD

Day 9

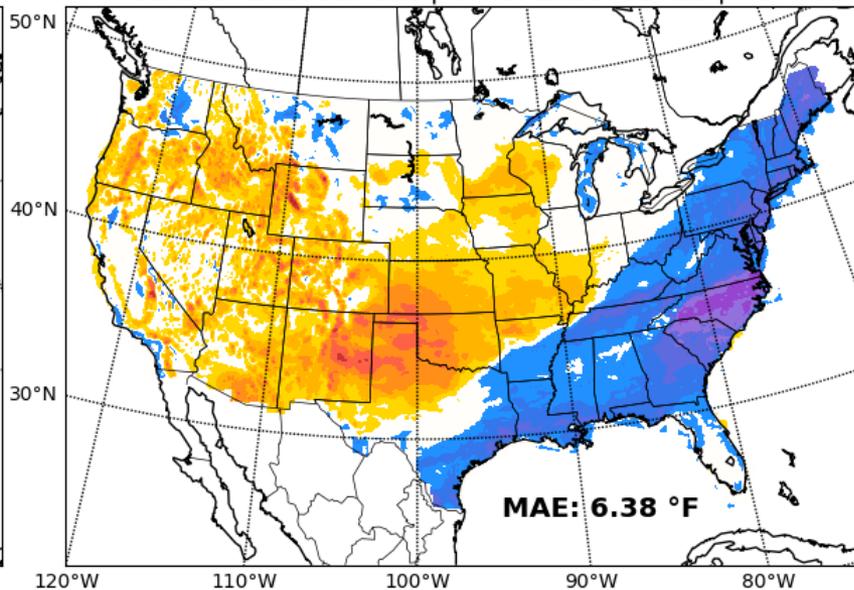
216 h TMAX forecast error (°F)

Initialized: 2018020812 | Valid: 2018021712 | AUTO



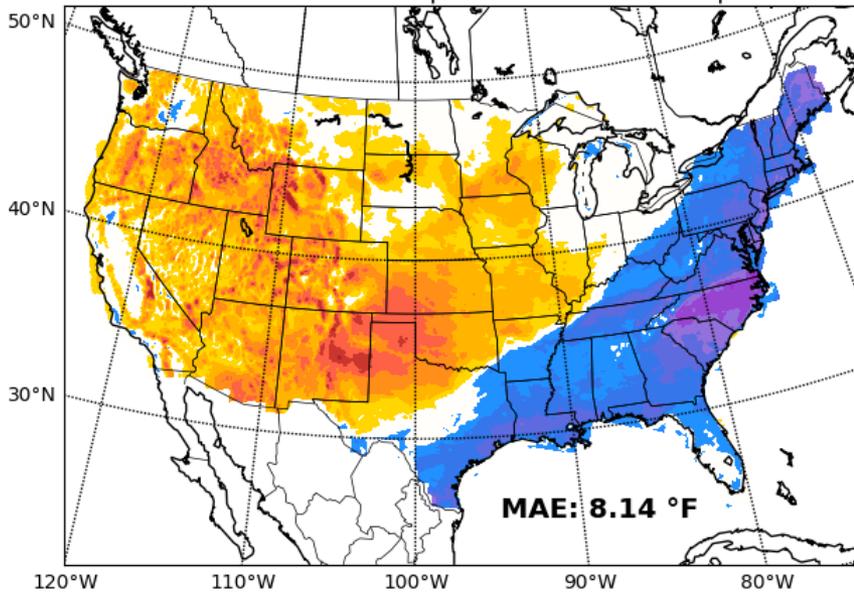
216 h TMAX forecast error (°F)

Initialized: 2018020812 | Valid: 2018021712 | AUTOv2



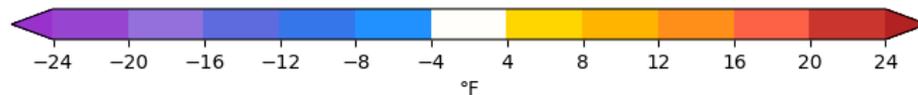
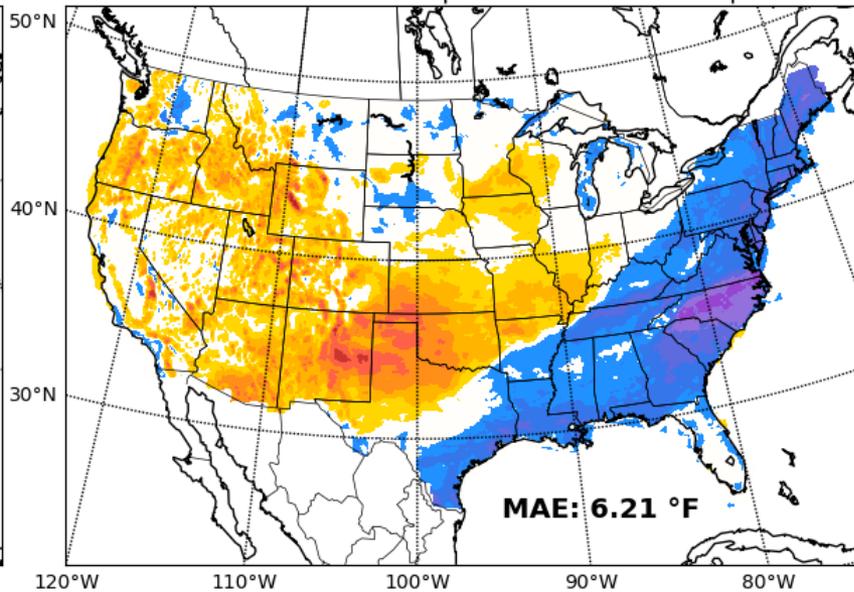
216 h TMAX forecast error (°F)

Initialized: 2018020812 | Valid: 2018021712 | EC-NBM



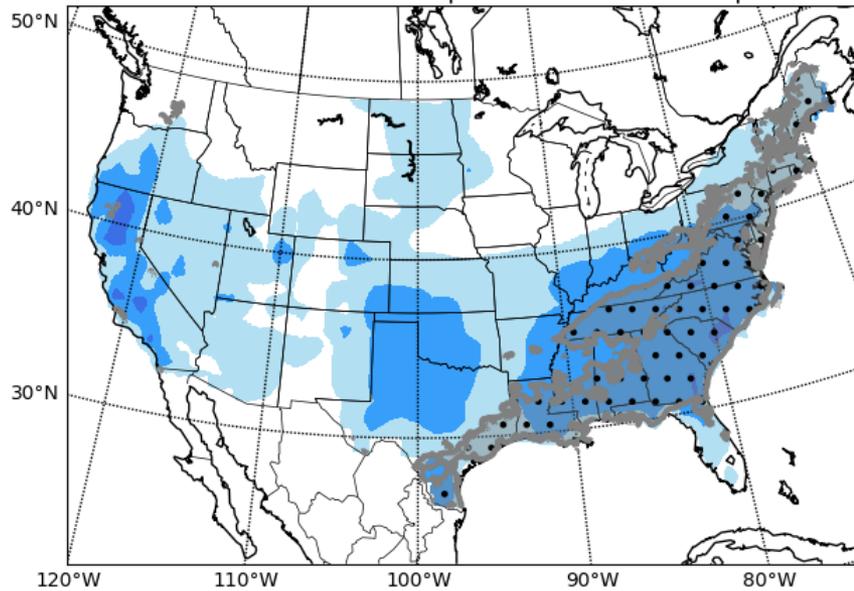
216 h TMAX forecast error (°F)

Initialized: 2018020812 | Valid: 2018021712 | FCSTR

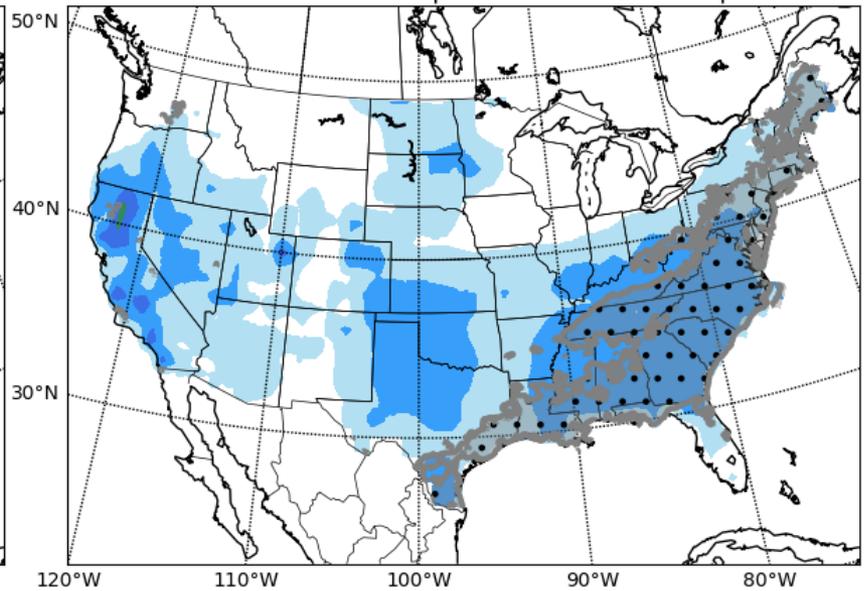


Day 9

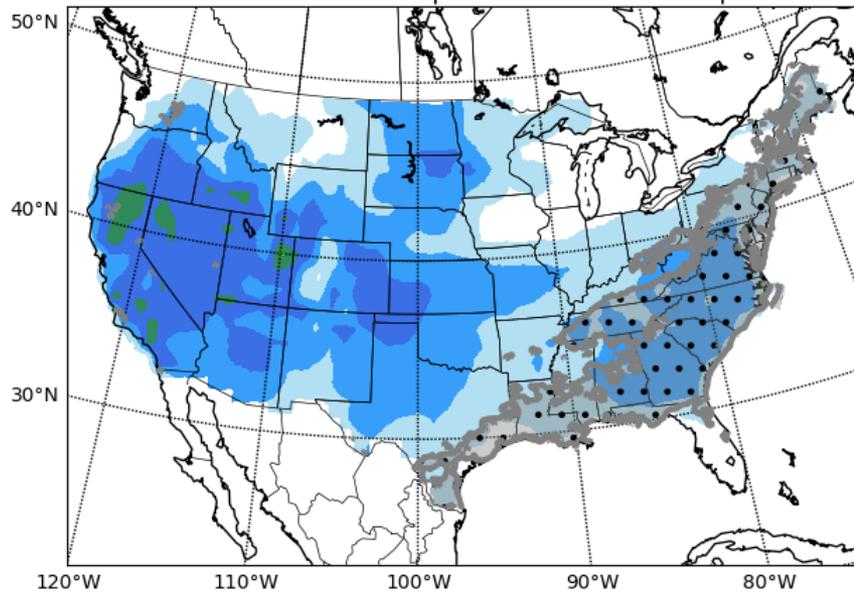
216 h fcst of the probability of TMAX anomaly > 10°F
Initialized: 2018020812 | Valid: 2018021712 | AUTO



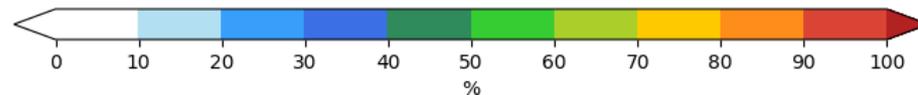
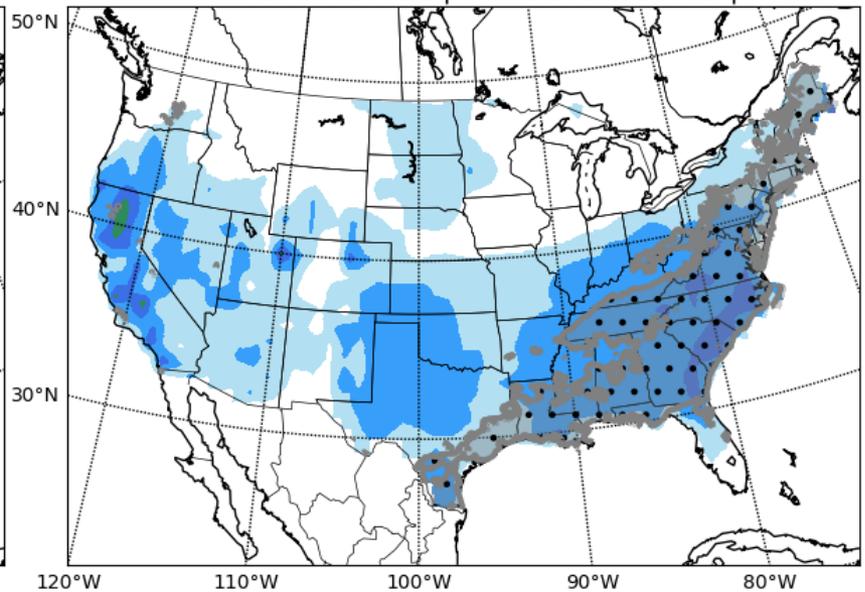
216 h fcst of the probability of TMAX anomaly > 10°F
Initialized: 2018020812 | Valid: 2018021712 | AUTOv2



216 h fcst of the probability of TMAX anomaly > 10°F
Initialized: 2018020812 | Valid: 2018021712 | EC-NBM



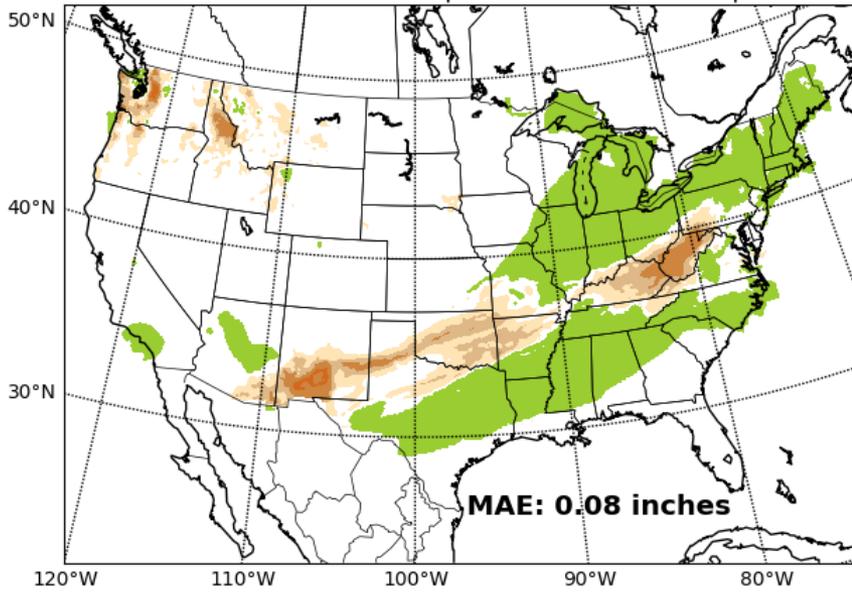
216 h fcst of the probability of TMAX anomaly > 10°F
Initialized: 2018020812 | Valid: 2018021712 | FCSTR



Day 9

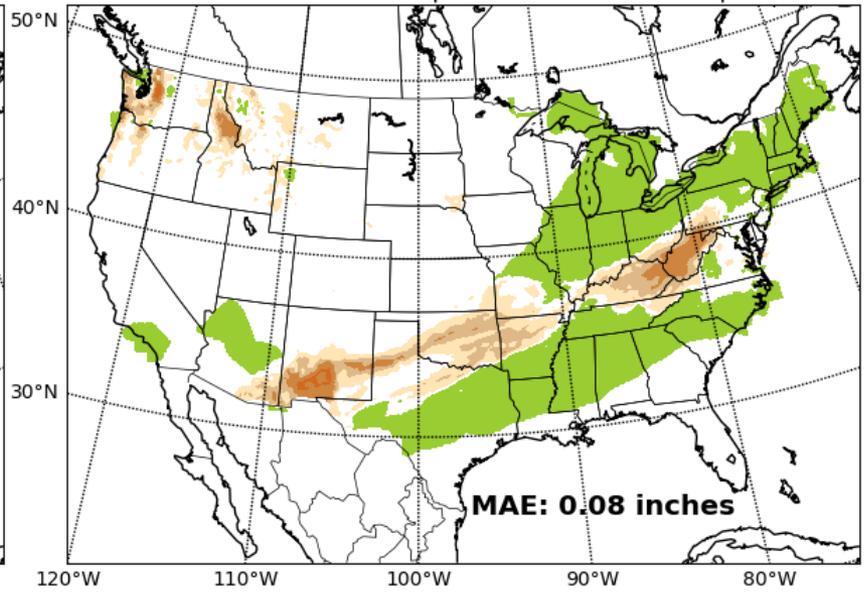
216 h ACP24 forecast error (inches)

Initialized: 2018020812 | Valid: 2018021712 | AUTO



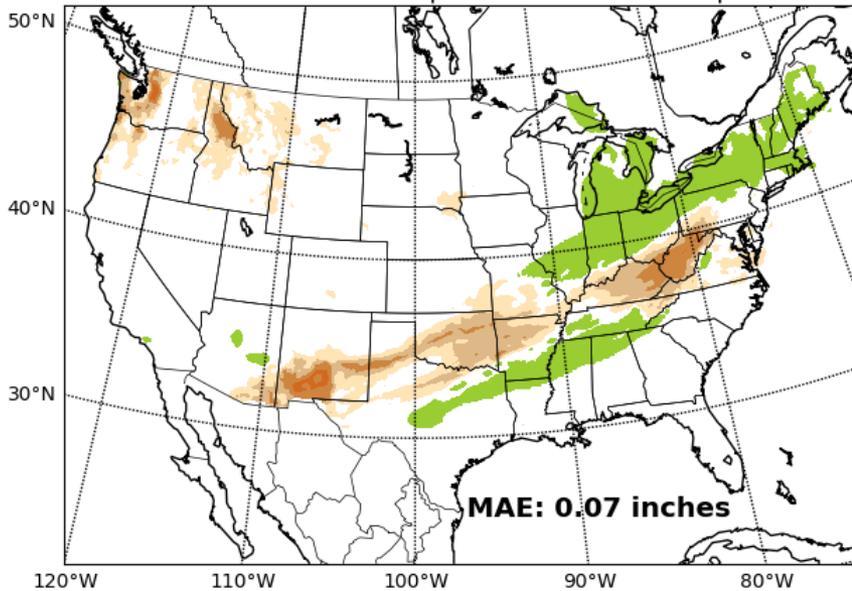
216 h ACP24 forecast error (inches)

Initialized: 2018020812 | Valid: 2018021712 | AUTOv2



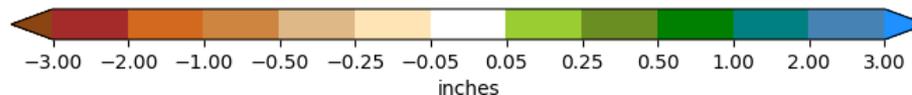
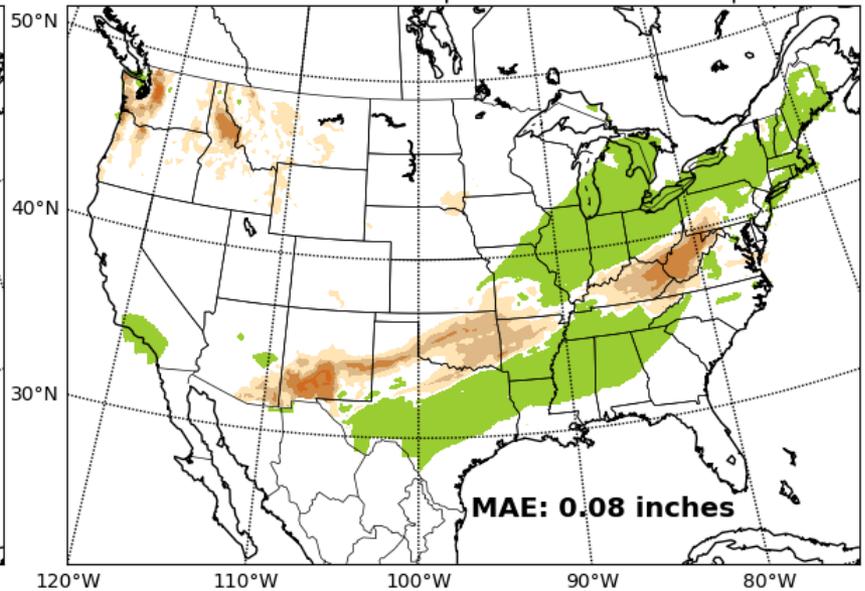
216 h ACP24 forecast error (inches)

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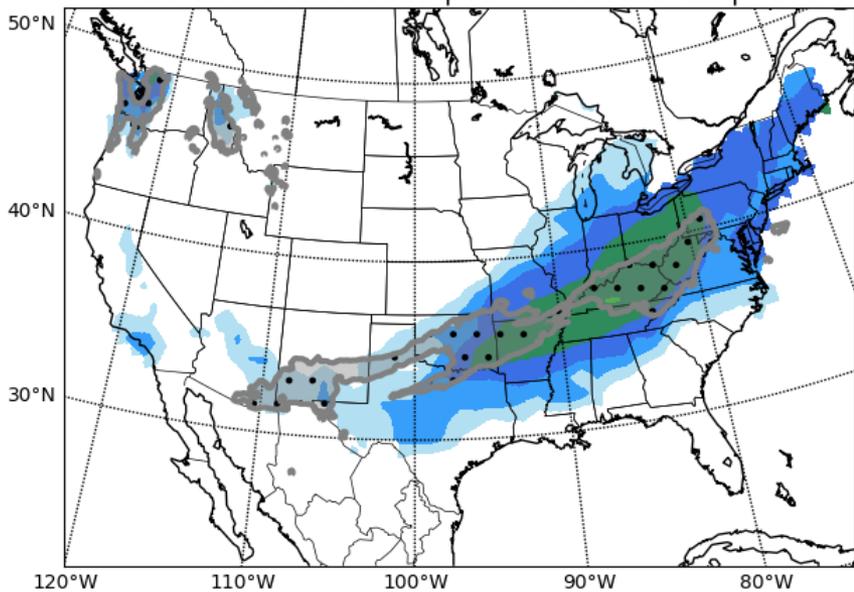
216 h ACP24 forecast error (inches)

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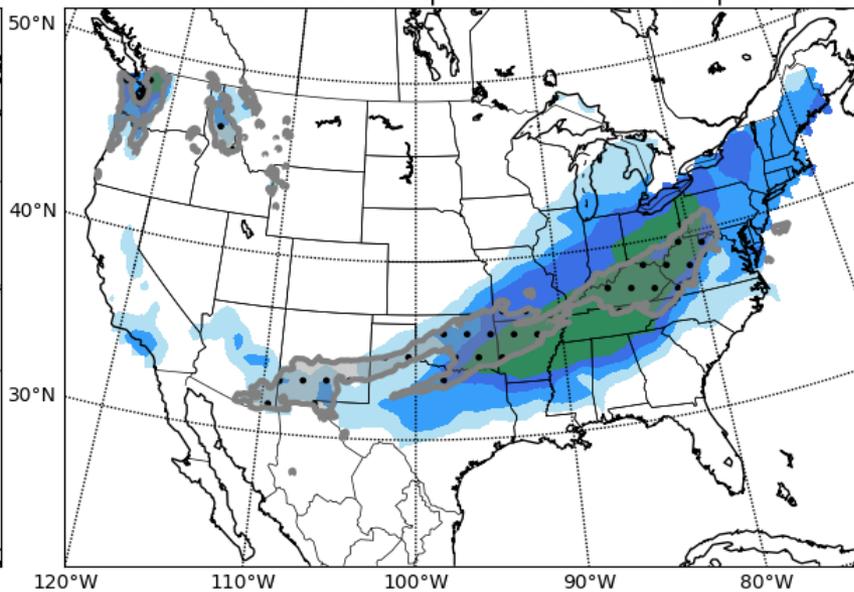


Day 9

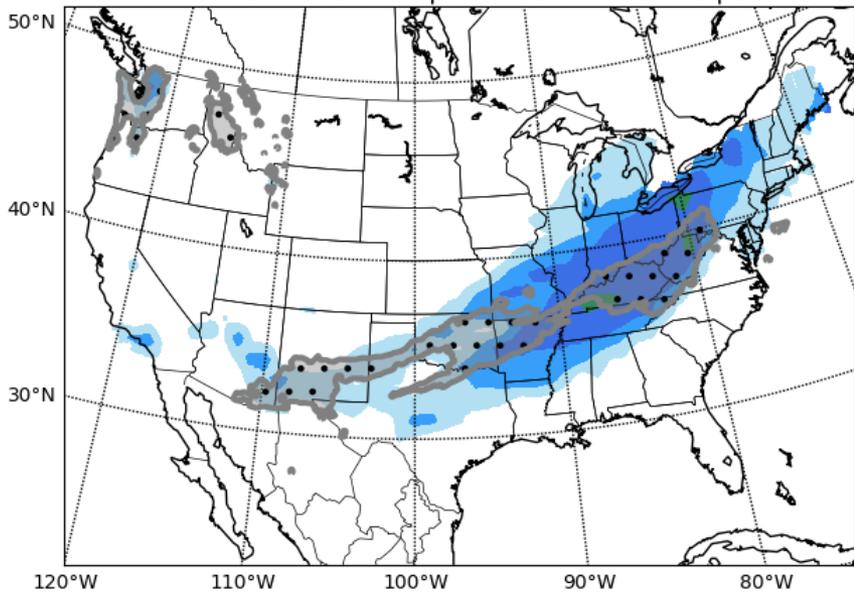
216 h fcst of the probability of 24 h APCP > 0.25"
Initialized: 2018020812 | Valid: 2018021712 | AUTO



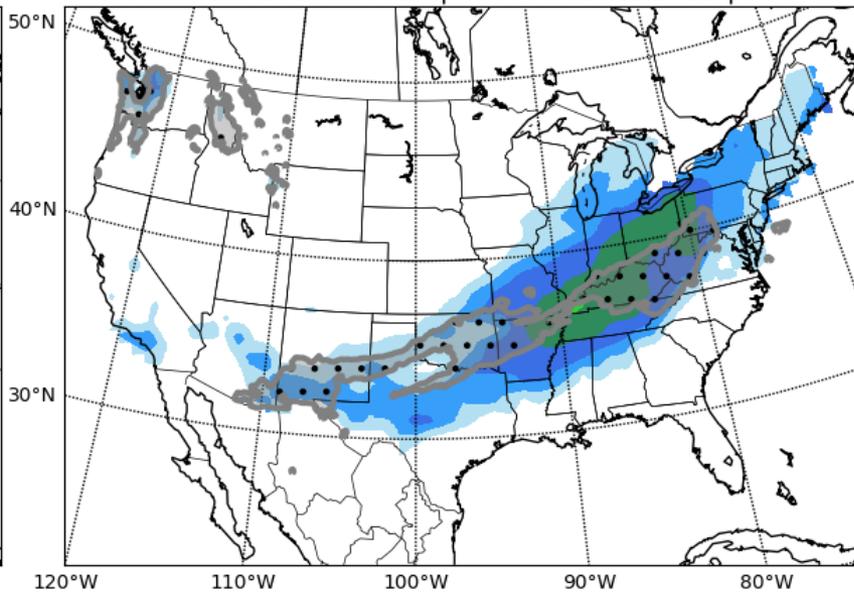
216 h fcst of the probability of 24 h APCP > 0.25"
Initialized: 2018020812 | Valid: 2018021712 | AUTOv2



216 h fcst of the probability of 24 h APCP > 0.25"
Initialized: 2018020812 | Valid: 2018021712 | EC-NBM



216 h fcst of the probability of 24 h APCP > 0.25"
Initialized: 2018020812 | Valid: 2018021712 | FCSTR



Future Work: Verifying Probabilities from a Day 8 QPF Forecast

Blue: Stage 4 Observed amounts $\geq 0.50''$

Red: AUTO blend probability of exceeding $0.50'' \geq 40\%$

Purple: Where Forecast = Observed

24h APCP > 0.50" | R = AUTO | B = ST4 | 20180217 FH 192 valid 20180225

