Post-Processing to Help Forecasters Better Understand Upstream Uncertainty, Scenarios, and Ensemble Performance

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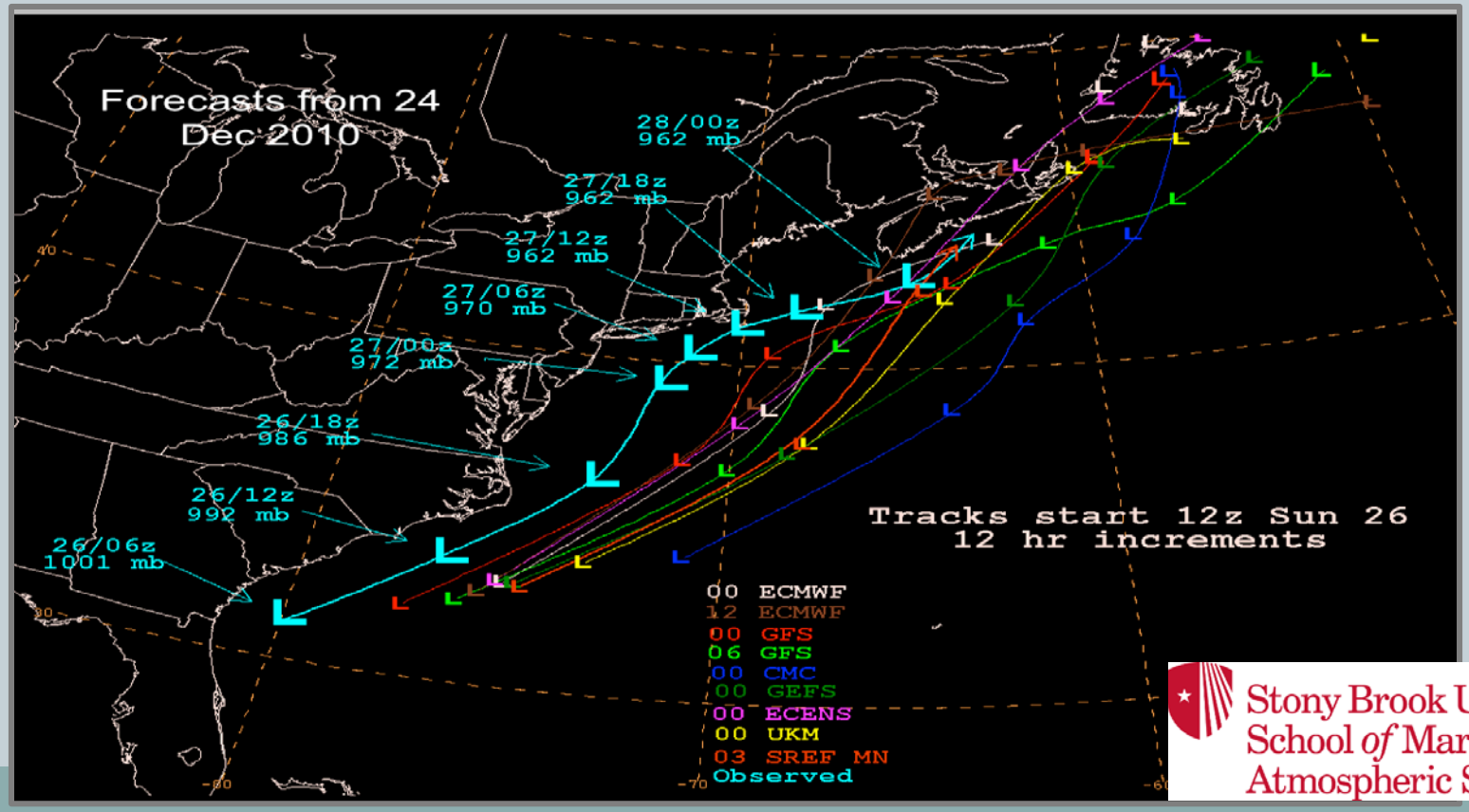


Stony Brook University
School *of* Marine and Atmospheric Sciences

Issue: What is the role of forecasters using ensemble data ("man – machine mix" issue)?

-- "adjust" the blended post-processed grids and communication of results?

-- obtain more situational awareness of the dynamical features of interest, improve forecasts through understanding of ensemble biases for certain phenomena, ensemble scenario identification, and confidence metrics?

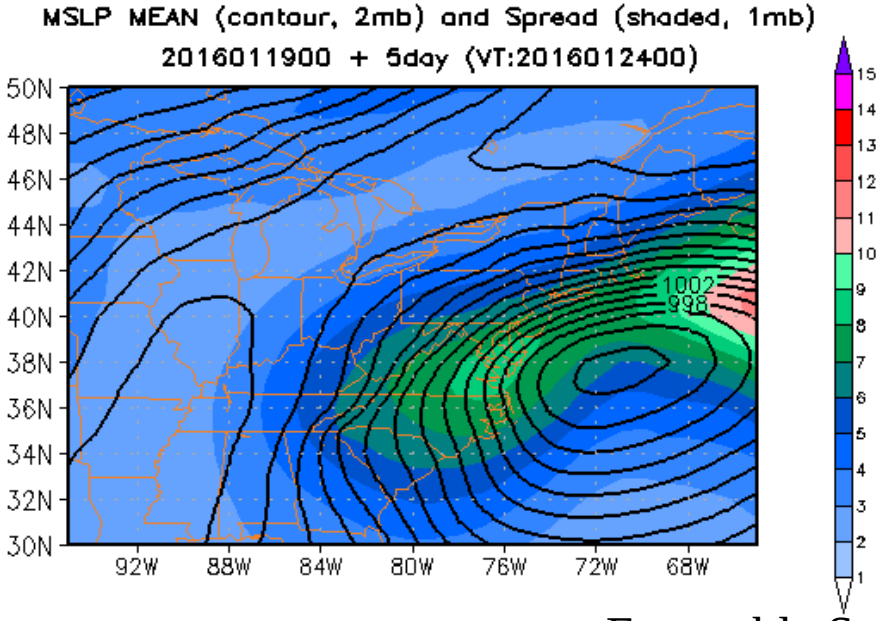
Goal: To develop post-processed tools for forecasters to help use ensembles.

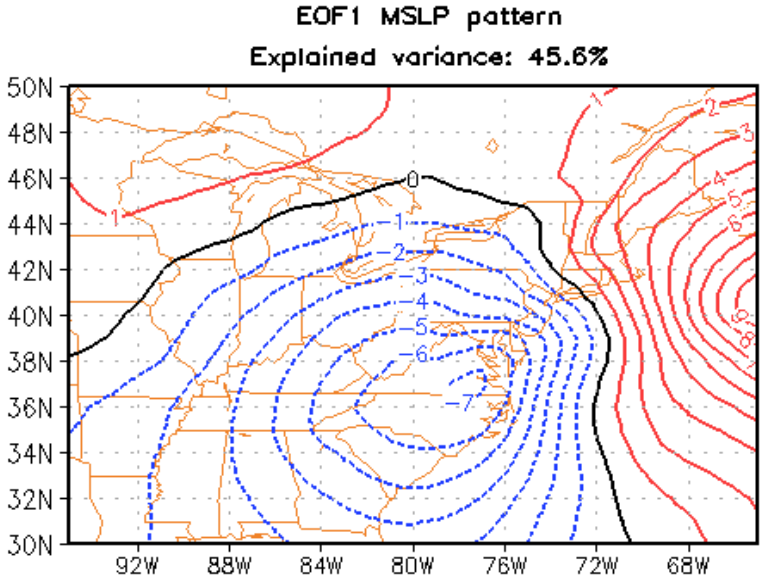
Challenges: Limited ensemble verification for various high impact weather phenomena (especially important mesoscale phenomena). Ensemble biases and lack of resolution.

Some of Our Approaches

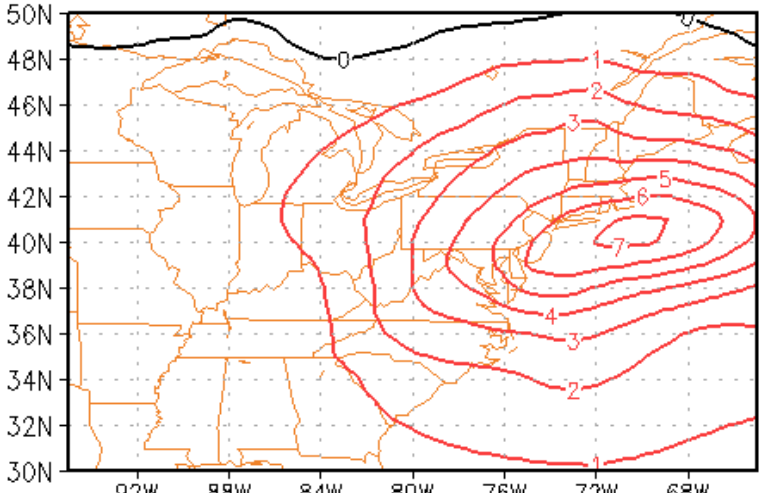
Stony Brook CSTAR: Some ensemble tools and verification of years of high impact events:

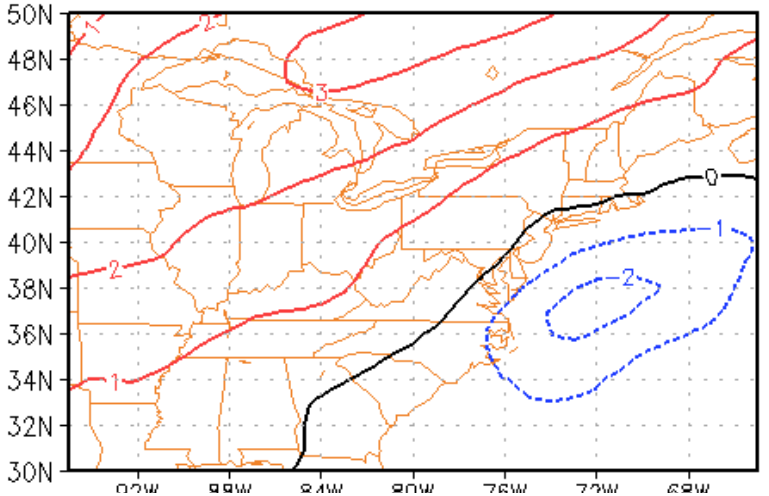
- Operational ensemble sensitivity analysis (see Zheng et al. 2014).
- Apply an efficient ensemble tool (fuzzy clustering analysis) to quickly separate forecast scenarios among the large ensemble set.
- Evaluate different ensemble models' performance in forecasting winter storms over East Coast for medium-range forecast (Korfe talk on Tues).
- Cyclone relative diagnostics for large error cases.
- Standardized spread anomalies (reforecast to train).





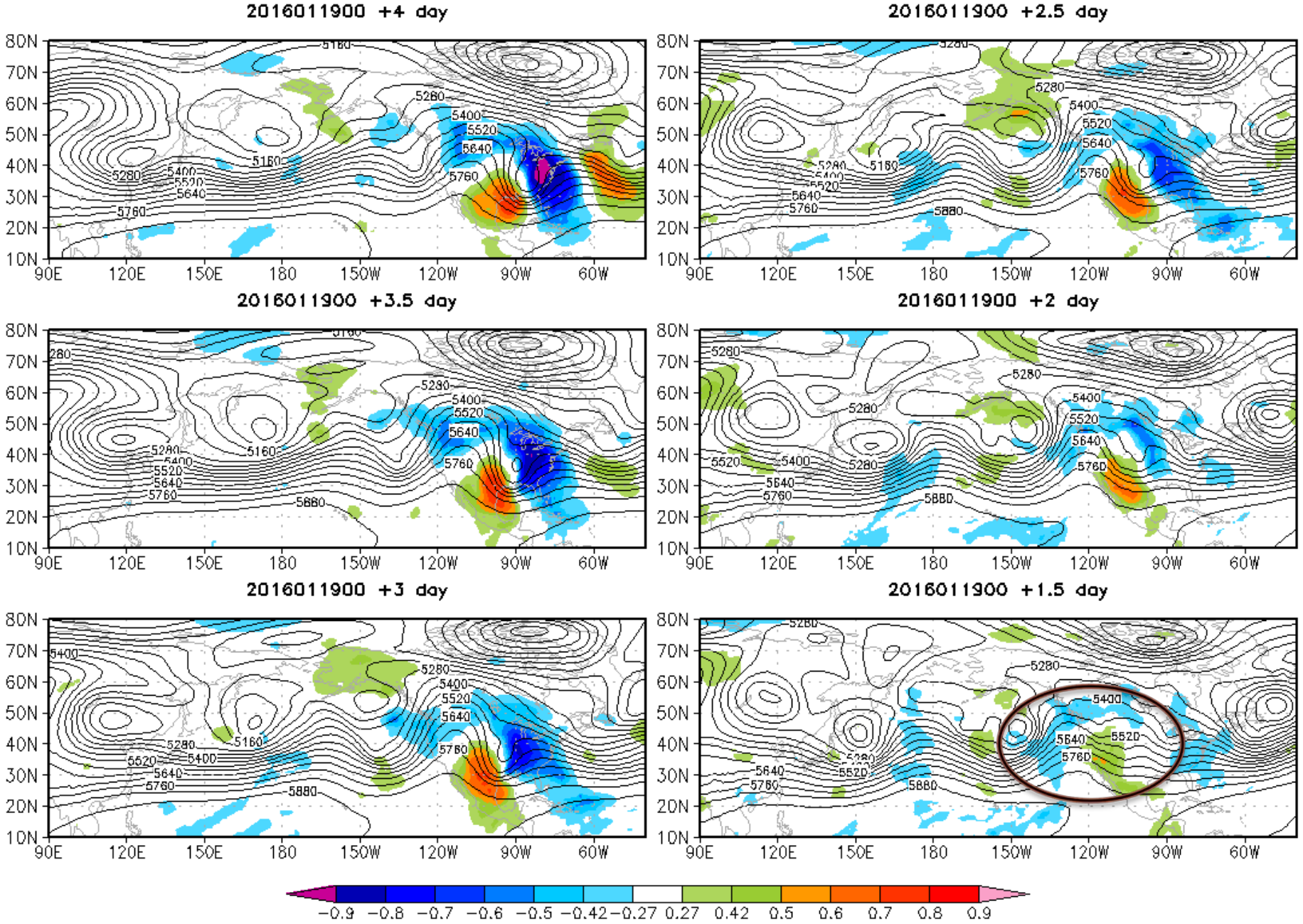
Ensemble Sensitivity Using PC Analysis of Ensemble Spread (for GEFS, CMC, and EC



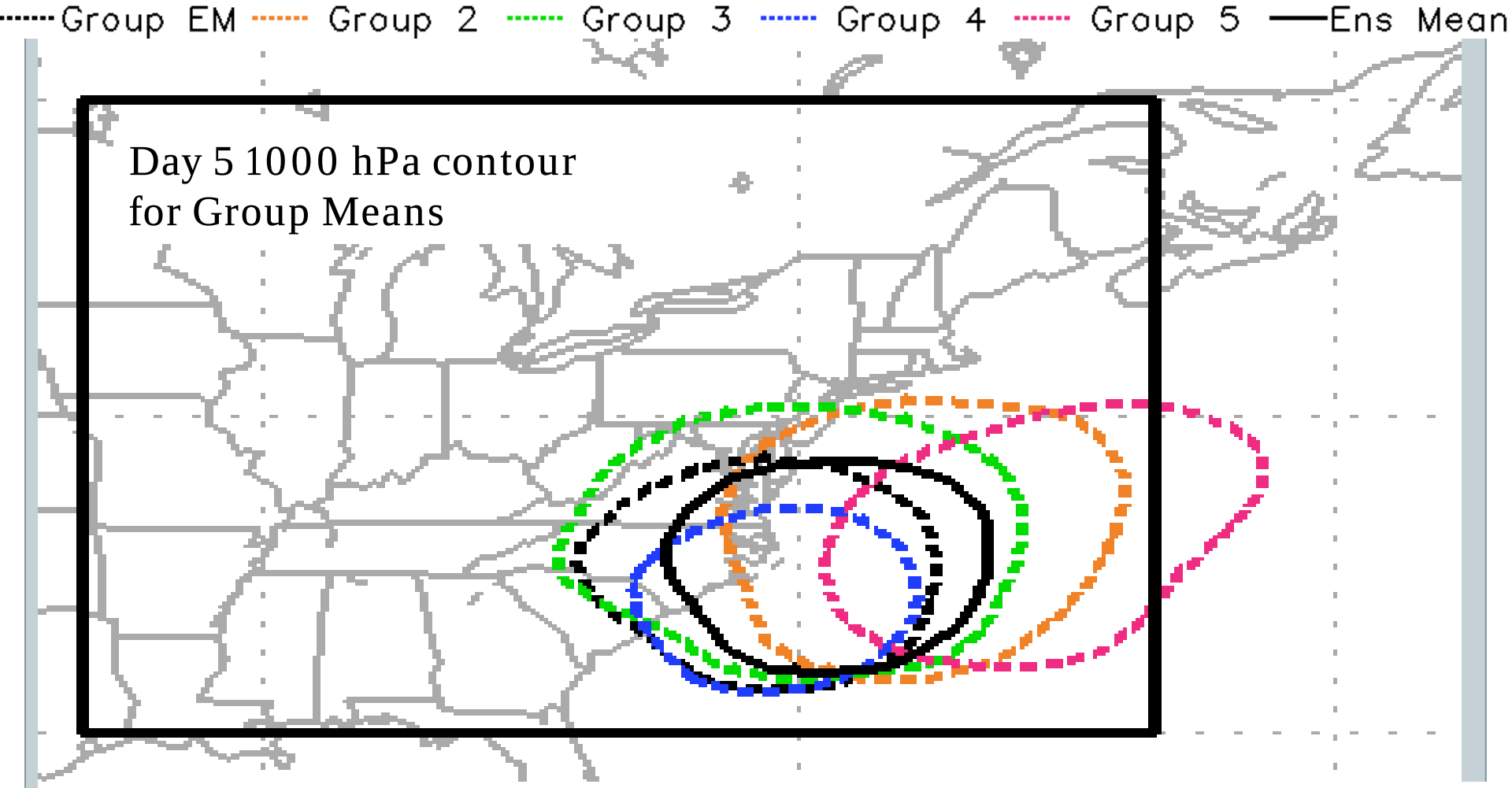


http://breezy.somas.stonybrook.edu/CSTAR/Ensemble_Sensitivity/EnSense_Main.html

Zheng et al. (2014)


2016011900 +4 day
2016011900 +2.5 day
2016011900 +3.5 day
2016011900 +2 day
2016011900 +3 day
2016011900 +1.5 day
80N
70N
60N
50N
40N
30N
20N
10N
90E
120E
150E
180
150W
120W
90W
60W
5160
5280
5400
5520
5640
5760
5880
−0.9 −0.8 −0.7 −0.6 −0.5 −0.42 −0.27 0.27 0.42 0.5 0.6 0.7 0.8 0.9
Sensitivity of EOF PC1 to Z500 field (Shaded)
ECMWF ensemble mean Z500 (Contour); unit(m); IT:2016011900
Valid area: LON from 79W to 62W, LAT from 32N to 45N; VT: 2016012300

Scenario Identification Using GEFS+CMC+EC: Project 90-Members onto the two leading PCs and apply a Fuzzy Clustering technique (+/- PC phase space) to objectively create different scenarios -- 20160118/12Z Run shown below: 1000 hPa contour of each cluster mean



http://breezy.somas.stonybrook.edu/CSTAR/Ensemble_Sensitivity/FC_Main.html

Need Some Sort of Confidence Metric to Complement the Situational Awareness Table

ENSEMBLE SITUATIONAL AWARENESS TABLE

NOAA / NATIONAL WEATHER SERVICE

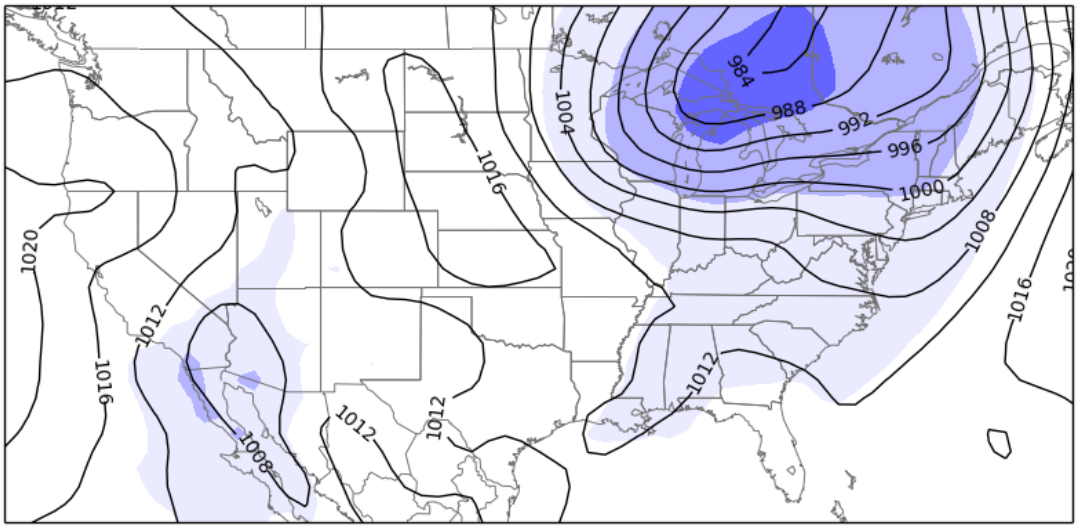
Verification | Horizontal Tables | Archive | Help | Permalink

Model Run: Oct 28, 2015 12Z | **Table Region:** Continental U.S. | **Plot Region:** Continental U.S. | **Output:** GEFS M-Climate Anomaly | View Table

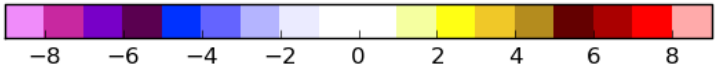
Fcst Hr: 24 Valid: Thu Oct 29 8:00 AM EDT

WFO Continental U.S. Table			Oct 28, 2015 12Z Run			
			Z	T	SLP	PW
0	Wed 28th	12Z	-2.0	2.4	-2.7	4.4
6		18Z	-2.7	1.9	-3.0	3.3
12	Thu 29th	00Z	-3.0	-2.5	-3.0	3.5
18		06Z	-3.0	2.2	-3.2	3.6
24		12Z	-2.7	2.1	-3.4	3.5
30		18Z	-2.3	2.3	-3.3	3.3
36	Fri 30th	00Z	-2.6	2.1	-4.3	2.8
42		06Z	-3.1	-1.9	-4.3	2.7
48		12Z	-3.5	-2.6	-3.5	2.9
54		18Z	-3.3	-2.8	-3.3	2.7
60	Sat 31st	00Z	-3.2	-2.6	-3.6	3.0
66		06Z	-3.1	-2.9	-2.2	3.1
72		12Z	-2.8	-3.1	-2.1	3.0
78		18Z	-2.3	2.4	-2.2	3.1
84	Sun 1st	00Z	2.3	2.5	-2.7	3.1
90		06Z	2.3	2.5	-2.0	2.8
96		12Z	2.4	2.5	2.0	2.8
102		18Z	3.5	2.8	-2.3	4.0
108	Mon 2nd	00Z	2.5	2.3	-2.2	2.9
114		06Z	2.8	2.2	-2.2	2.7
120		12Z	2.2	2.0	-2.2	2.2
126		18Z	2.3	1.9	-2.2	2.1
132	Tue 3rd	00Z	2.4	1.9	-3.5	2.1
138		06Z	2.1	2.0	-2.8	2.3
144		12Z	-2.4	2.0	-3.1	2.5
150		18Z	2.5	-2.1	-2.2	2.1
156	Wed 4th	00Z	2.5	2.2	-2.8	2.6
162		06Z	2.8	2.2	-1.6	2.9
168		12Z	2.8	-2.2	1.8	2.7
174		18Z	3.2	-2.2	2.0	2.8
180	Thu 5th	00Z	3.0	2.1	0.4	3.2
186		06Z	3.1	2.2	1.8	3.5
192		12Z	3.0	2.3	2.2	3.5

GEFS Mean MSLP (hPa) and M-Climate Anomaly
HOUR 024 - VALID 12:00 UTC Thu Oct 29 2015



relative to 24-h GEFS reforecasts
initialized 19-Oct to 09-Nov (1985-2012)



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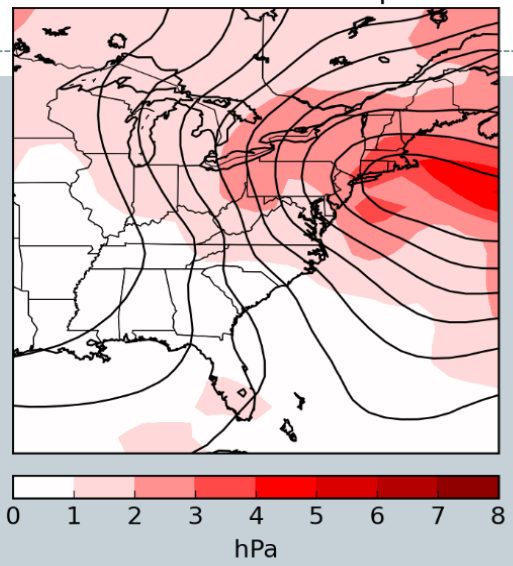
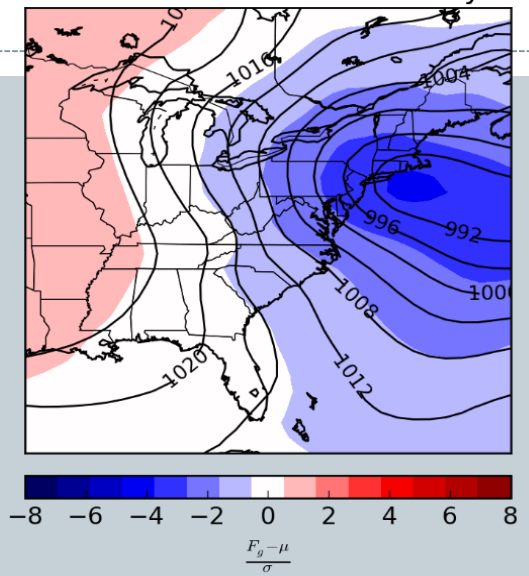
GEFS Mean, Spread, SA, and M-Climate Anomaly
96h Forecast Valid 0000 UTC 11 Feb 2010

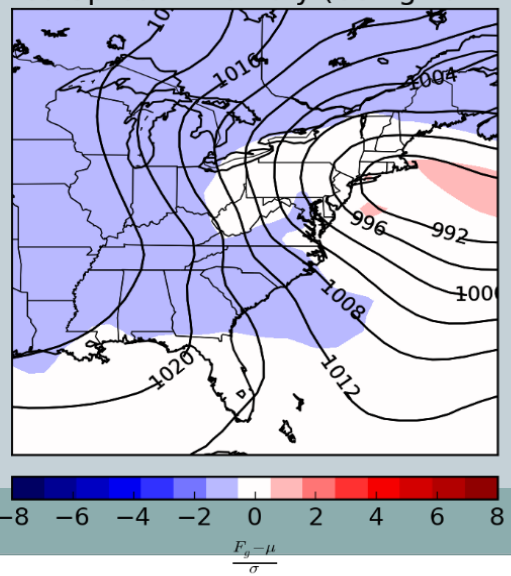
Ensemble Mean and Spread



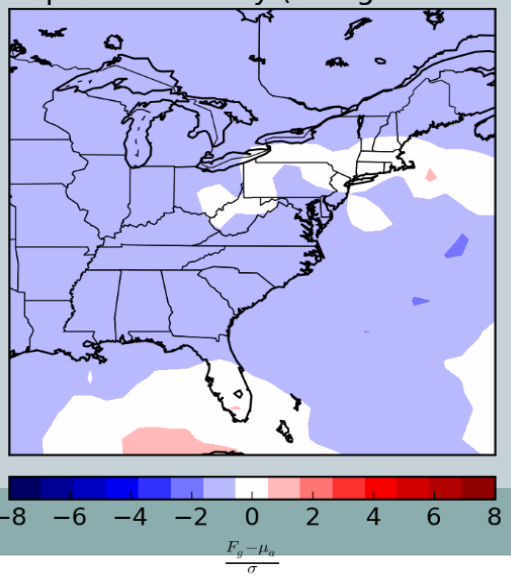
Standardized Mean Anomaly



Standardized Spread Anomaly (Using Full M-Climate)

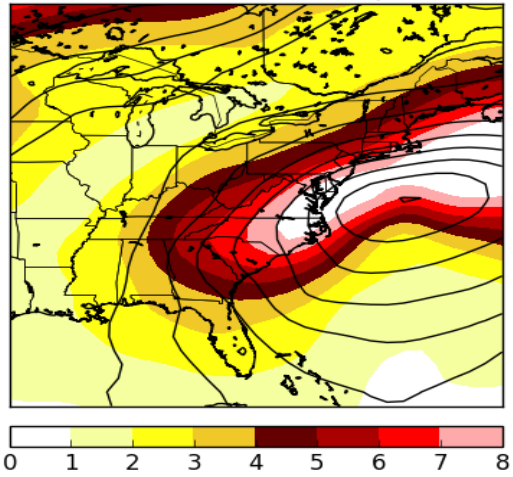


Standardized Spread Anomaly (Using M-Climate Anomaly)

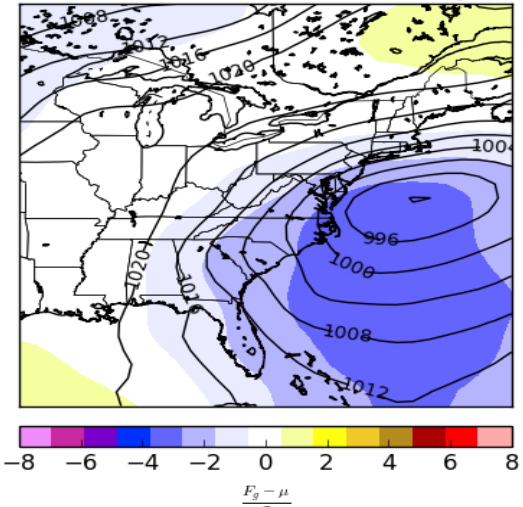


GEFS Mean, Spread, SA, and M-Climate Anomaly
108h Forecast Initialized 12z 19 Jan 2016

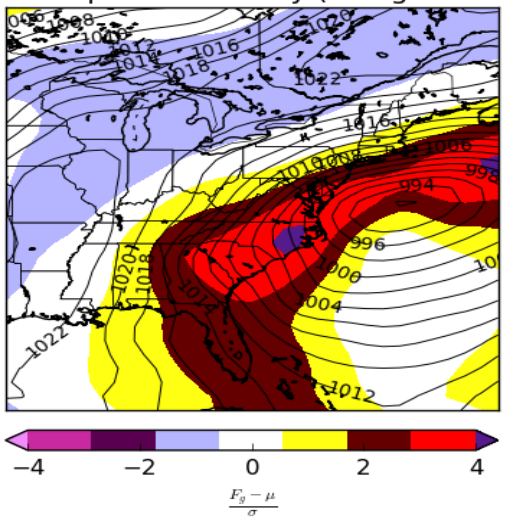
Ensemble Mean and Spread



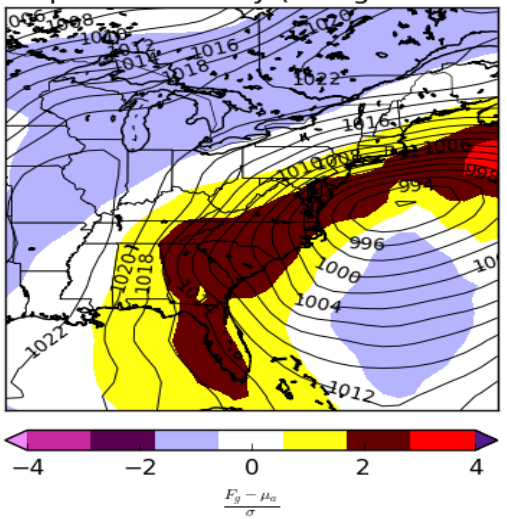
Standardized Mean Anomaly



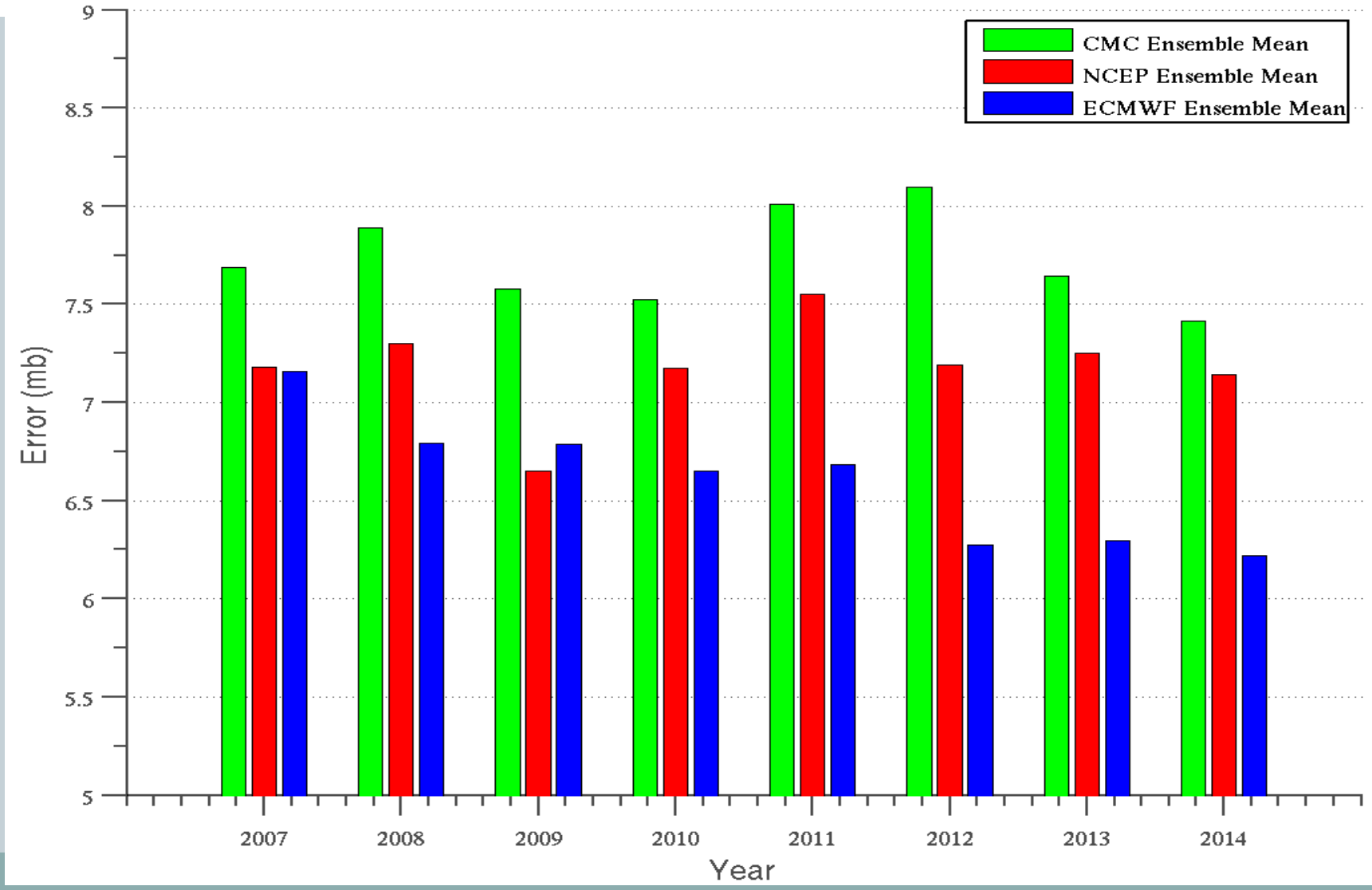
Standardized Spread Anomaly (Using Full M-Climate)



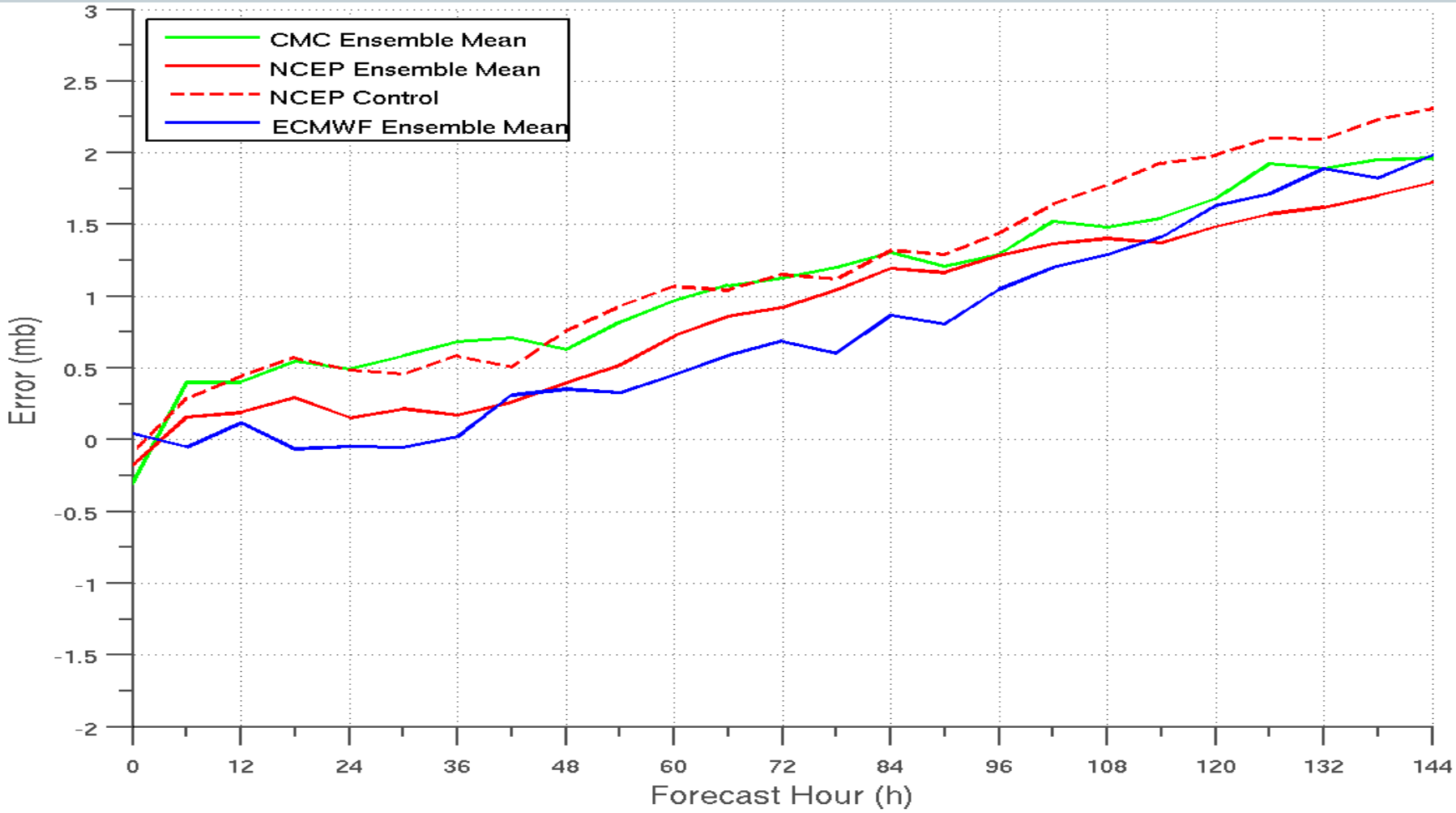
Standardized Spread Anomaly (Using M-Climate Anomaly)



Cool Season Cyclone Intensity MAE Day 4-6 for CMC, GEFS, and EC Ensemble Mean



Cyclone Intensity Mean Error Deep Cyclones (> 1 stnd ~ 995 hPa)



Cyclone Relative Diagnostics: Post-Processing to Understand more of Why the Model Error

(925 hPa temperature gradient – contoured and mean error shaded at 30-48 h for overpredicted and unpredicted cyclones during 108-120 h