Bridging the gap in NOAA's extended and long range prediction systems through the development of new forecast products for weeks 3 and 4

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NGGPS/MAPP PIs Meeting 2017
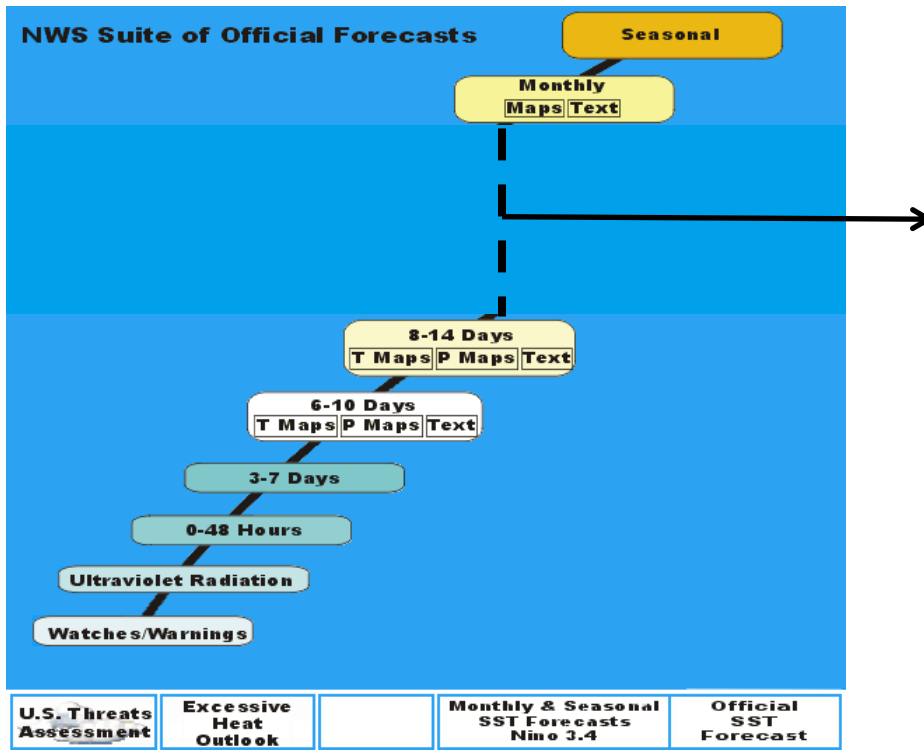
[1]*Princeton University*
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[3]*NOAA/NCEP Climate Prediction Center*
[4]*Scripps Institution of Oceanography, University of California, San Diego*
[5]*Penn State University*

Bridging the forecast gap in weeks 3-4

NWS Suite of Official Forecasts

Seasonal

Monthly — Maps | Text

8-14 Days — T Maps | P Maps | Text

6-10 Days — T Maps | P Maps | Text

3-7 Days

0-48 Hours

Ultraviolet Radiation

Watches/Warnings

| U.S. Threats Assessment | Excessive Heat Outlook | | Monthly & Seasonal SST Forecasts Nino 3.4 | Official SST Forecast |

Experimental Week 3-4 Outlooks
Valid: 24 Oct 2015 to 06 Nov 2015
Updated: 09 Oct 2015

Further information about the Experimental Week 3-4 Outlooks can be found HERE. Please provide comments using the online survey.
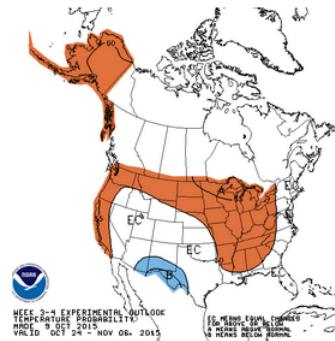
Temperature Probability | Precipitation Probability
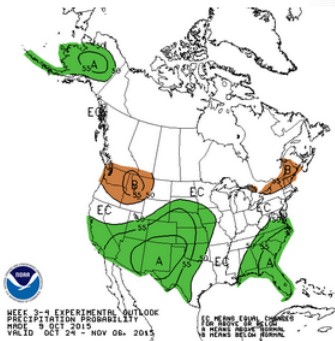
Click HERE for information about how to read Week 3-4 outlook maps

http://www.cpc.ncep.noaa.gov/products/predictions/WK34/

Primary objectives:

➢ To transition a statistical MJO/ENSO phase model into an operational CPC week 3-4 temperature and precipitation outlook for all seasons

➢ To develop additional hybrid dynamical/statistical forecast tools for weeks 3-4

Johnson et al. (2014): Skillful wintertime temperature forecasts with statistical model for some initial states of the MJO and ENSO
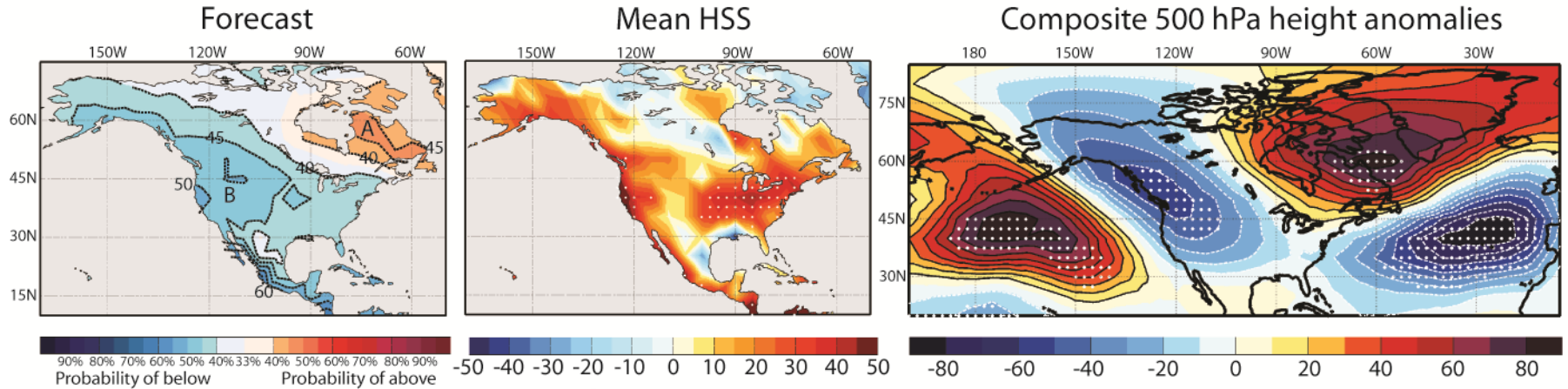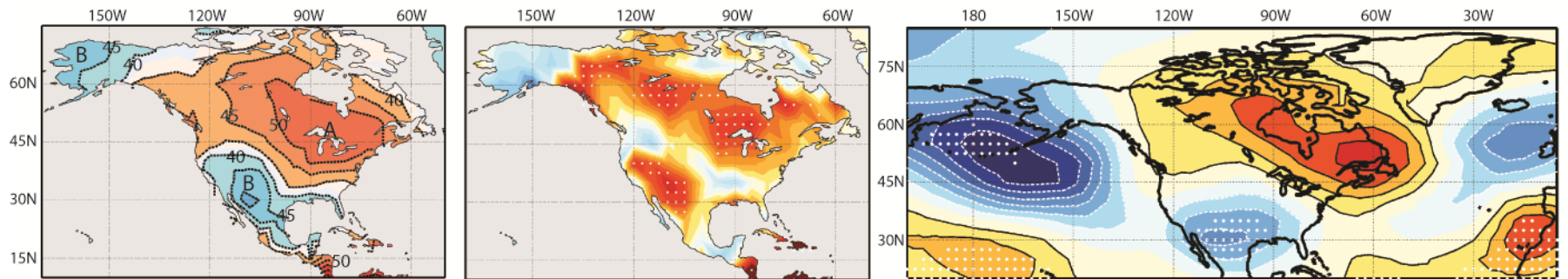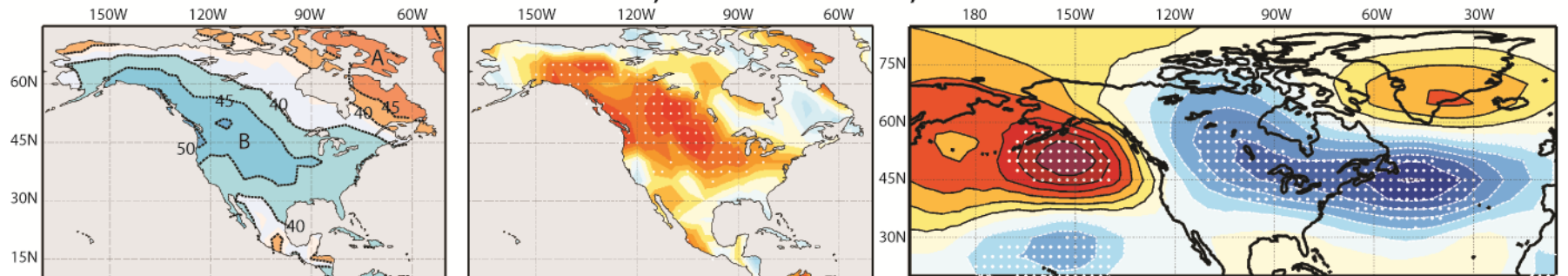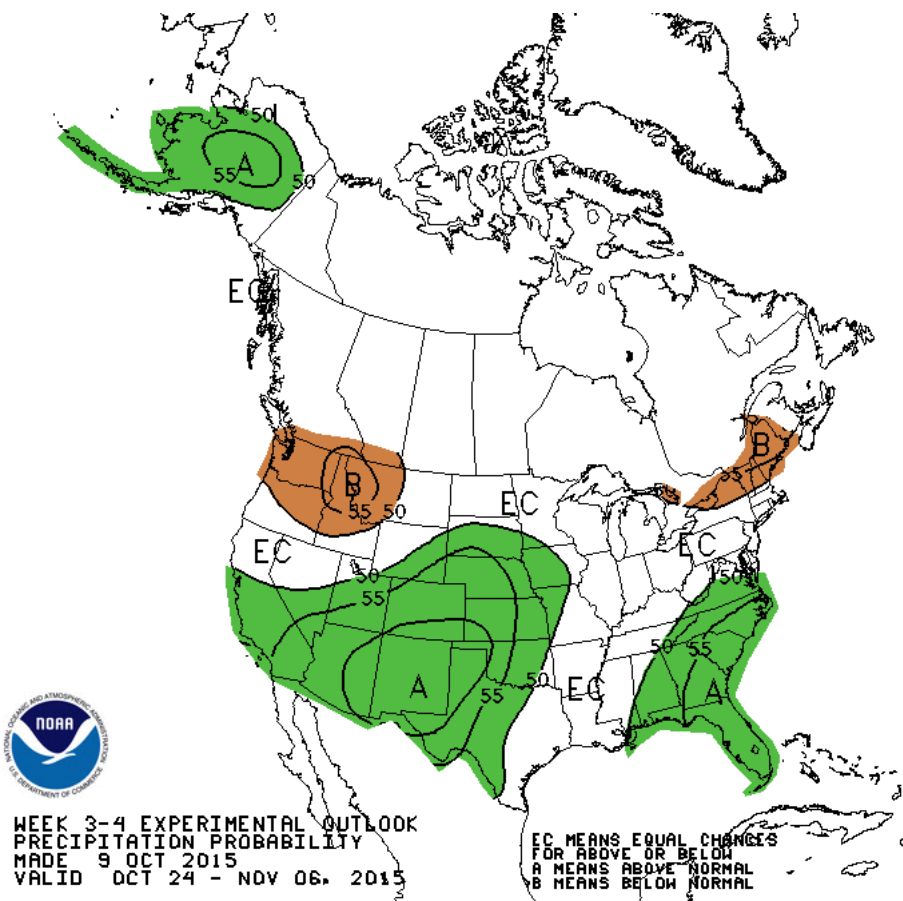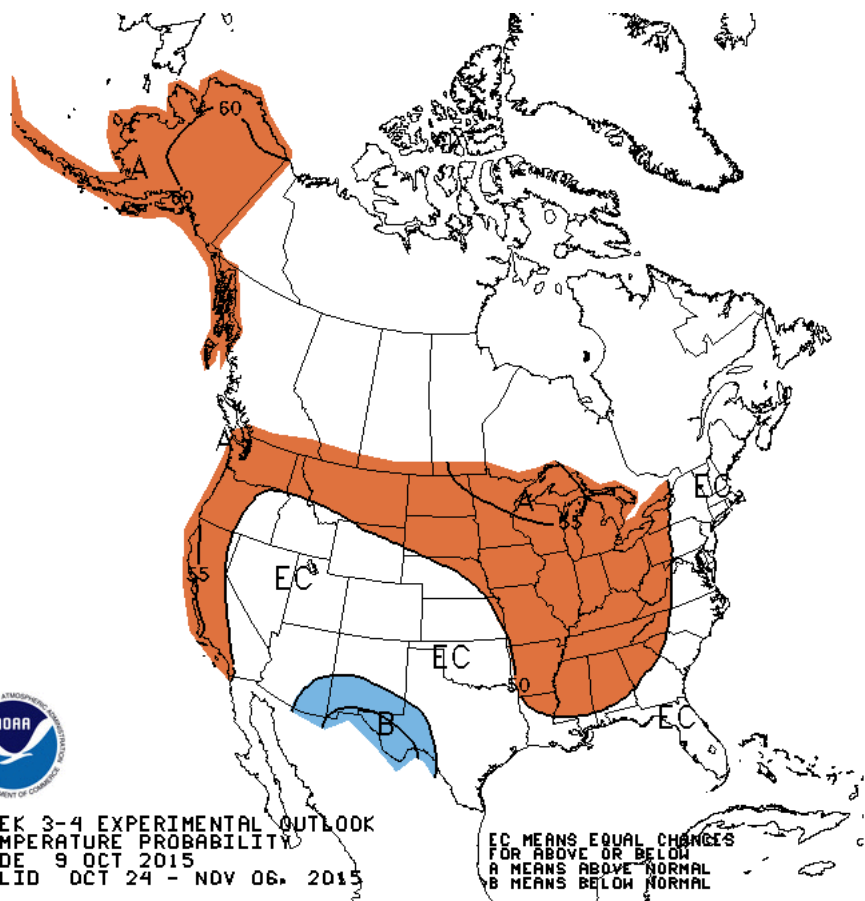
Operational Adaptation (Led by Dan Harnos)

- Extended periods from DJFM to 12 running 3-month periods.

- Applied to precipitation as well as temperature

- Shifted from ERA-Interim to daily observations:
  - CPC Internal T2m Data (Janowiak et al. 1999)
  - CPC Unified Gauge-Based Analysis (Xie et al. 2010)
    - Fourth root taken to increase distribution normality.

- Shifted from three-class to two-class forecast.

- Combined product for Weeks 3 and 4.

- Developed a complementary linear regression-based product

WEEK 3-4 EXPERIMENTAL OUTLOOK
TEMPERATURE PROBABILITY
MADE 9 OCT 2015
VALID OCT 24 - NOV 06, 2015

EC MEANS EQUAL CHANCES
FOR ABOVE OR BELOW
A MEANS ABOVE NORMAL
B MEANS BELOW NORMAL

WEEK 3-4 EXPERIMENTAL OUTLOOK
PRECIPITATION PROBABILITY
MADE 9 OCT 2015
VALID OCT 24 - NOV 06, 2015

EC MEANS EQUAL CHANCES
FOR ABOVE OR BELOW
A MEANS ABOVE NORMAL
B MEANS BELOW NORMAL

Statistical guidance emphasizing the subseasonal ENSO footprint was strongly utilized.
This guidance, along with the dynamical consensus leads to a more confident
precipitation outlook relative to temperature. Above-median precipitation is favored

# How well have we done?
Temperature

Heidke Skill Scores

HSS Time Series

Experimental CPC Outlook

Dynamical Models

Equally Weighted Dynamical Models

Statistical Models
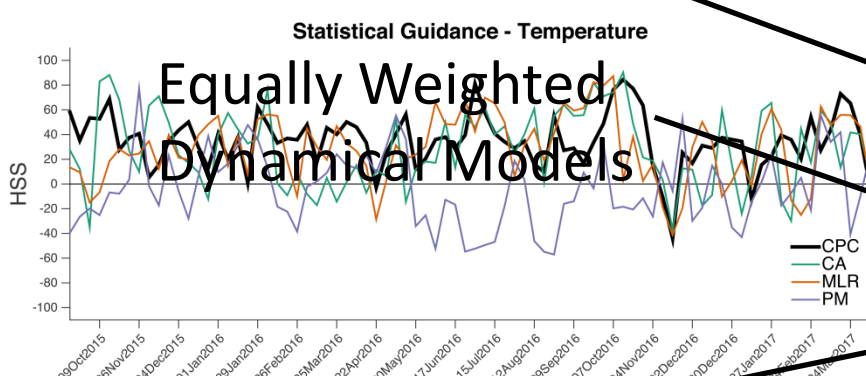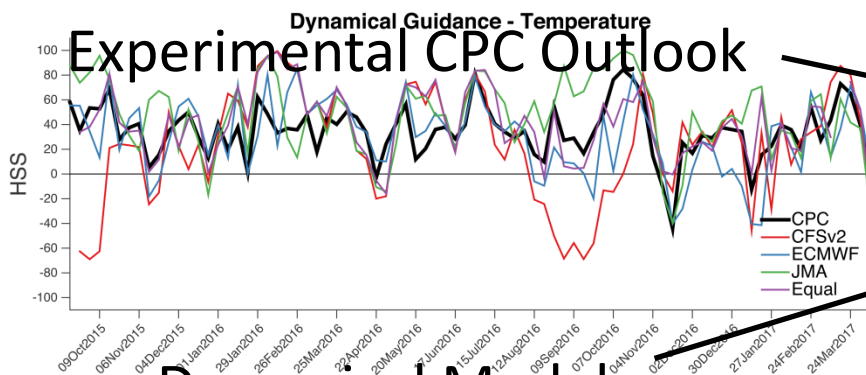
	9/2015 To 8/2016	9/2016 To 4/2017	All Dates
CPC	36.3	32.7	34.9
CFSv2	29.5	15.1	23.8
ECMWF	39.1	17.3	30.6
JMA	48.3	45.9	47.4
Eq. Wtd	46.7	30.8	40.5
MLR	29.9	28.3	29.3
PM	-4.8	-1.9	-3.6

How well have we done?
Precipitation

HSS Time Series

Dynamical Guidance - Precipitation
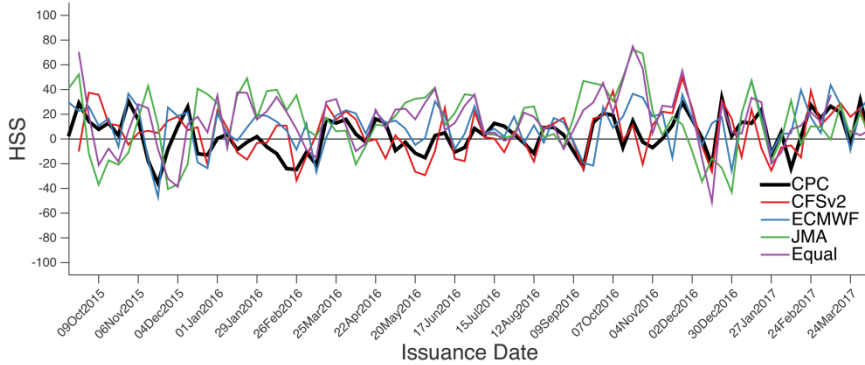
Statistical Guidance - Precipitation
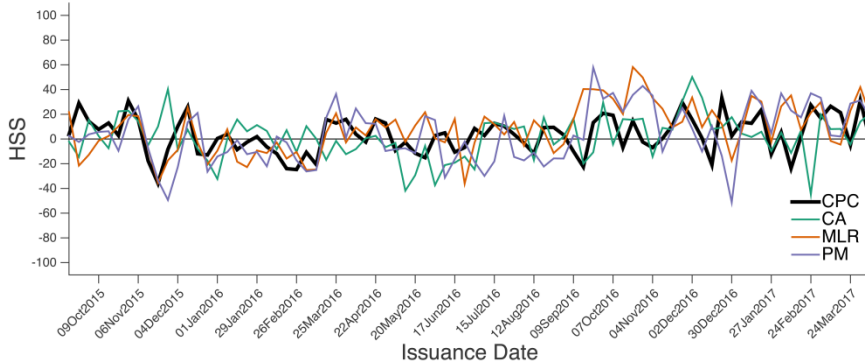
Heidke Skill Scores

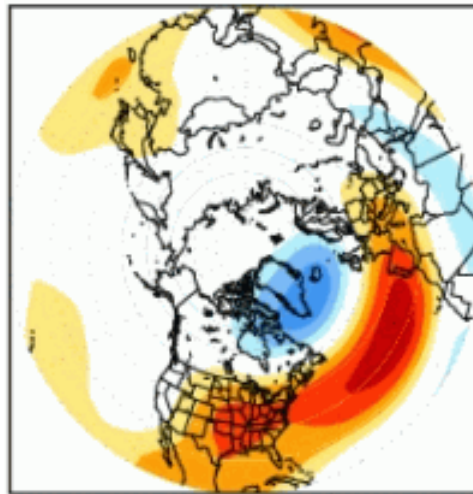|	9/2015 To 8/2016	9/2016 To 4/2017	All Dates
CPC	0.6	7.3	3.2
CFSv2	2.2	8.8	4.8
ECMWF	8.8	13.6	10.7
JMA	13.5	14.3	13.8
Eq. Wtd	12.6	17.5	14.5
MLR	-0.8	21.9	8.1
PM	-5.5	16.6	3.2

Going beyond MJO, ENSO, and trend:
Statistical forecasts of teleconnection pattern indices

Pacific/North American Pattern (**PNA**)
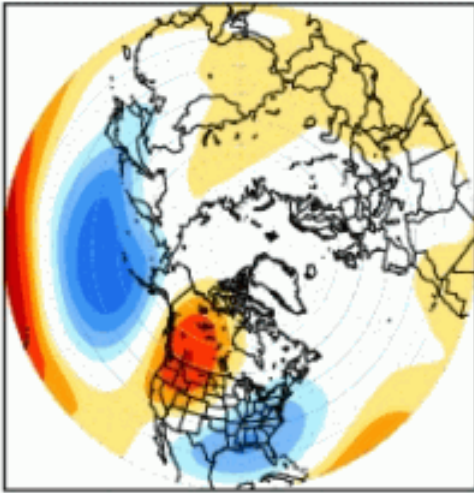
North Atlantic Oscillation (**NAO**)
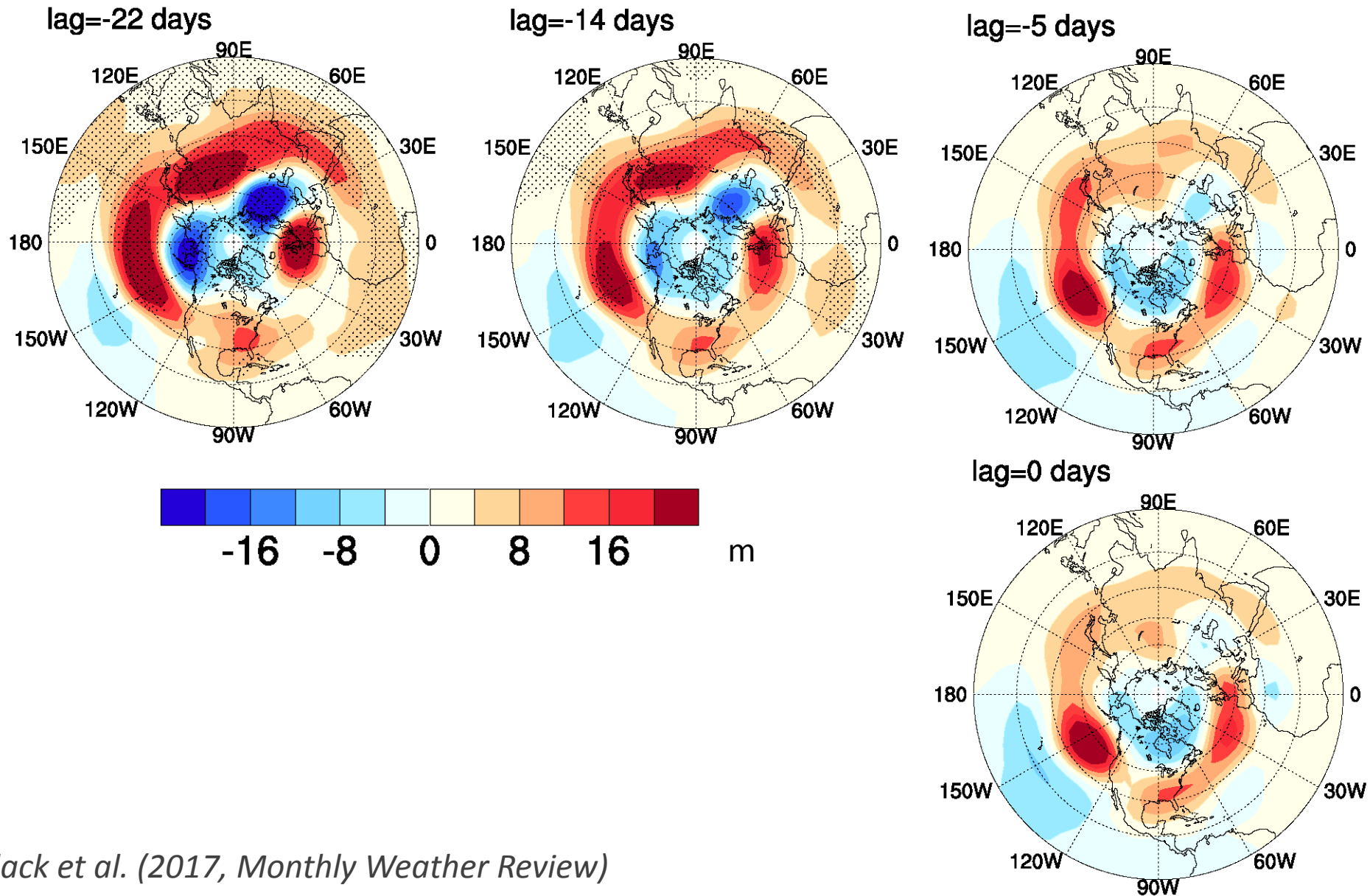
Arctic Oscillation (**AO**)
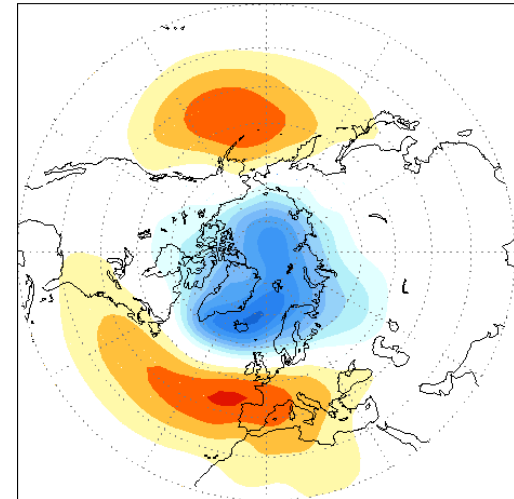
- Forecasts of two-week mean indices in DJF (1980-2013) with a statistical forecast model (partial least squares regression)
- **Predictors**: tropical convection, upper tropospheric circulation, stratospheric circulation

Black et al. (2017, Monthly Weather Review)

DJF forecast skill of teleconnection pattern indices

Comparison with the dynamical forecast model (CFSv2)

Black et al. (2017, Monthly Weather Review)
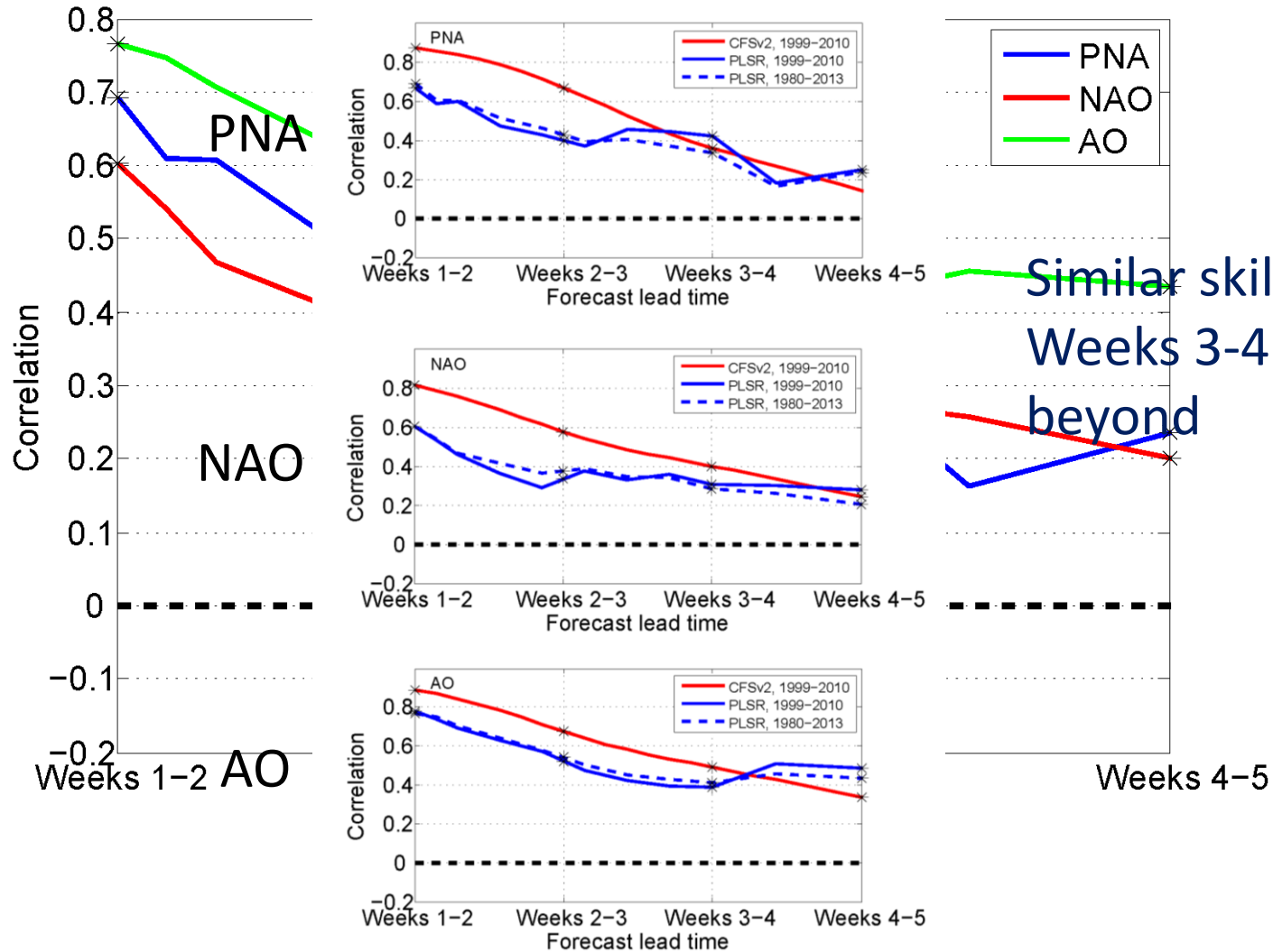
An important z300 predictor of the AO in weeks 3-4

Black et al. (2017, Monthly Weather Review)

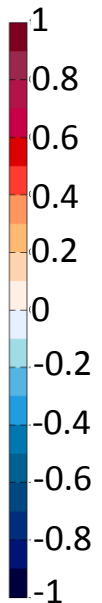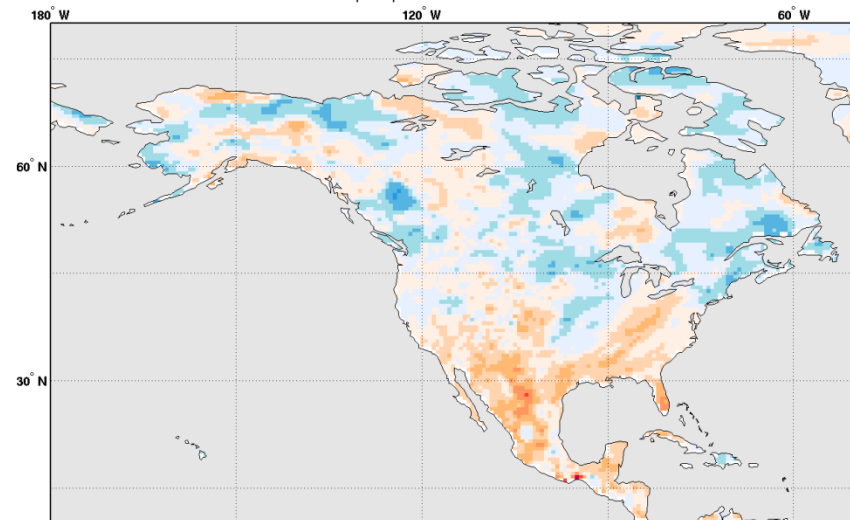# Preliminary exploration of hybrid dynamical-statistical modeling with Weather Types (WTs)

- NOAA GFDL Forecast-oriented Low Ocean Resolution (FLOR) model DJF hindcasts 1981-2016

- Initialized on first of the month

- Atmosphere ICs: nudged toward MERRA reanalysis

- 12 ensemble members

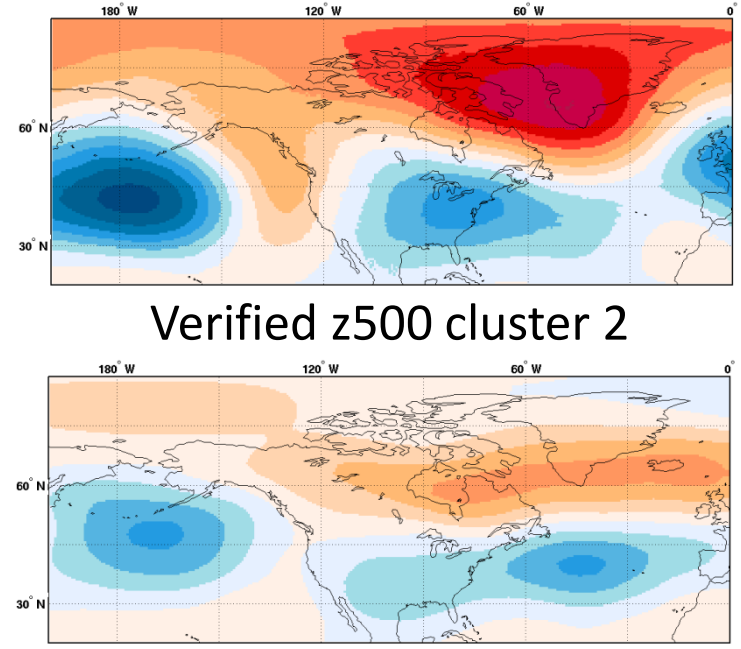**Correlation between week 3-4 forecast and verification**
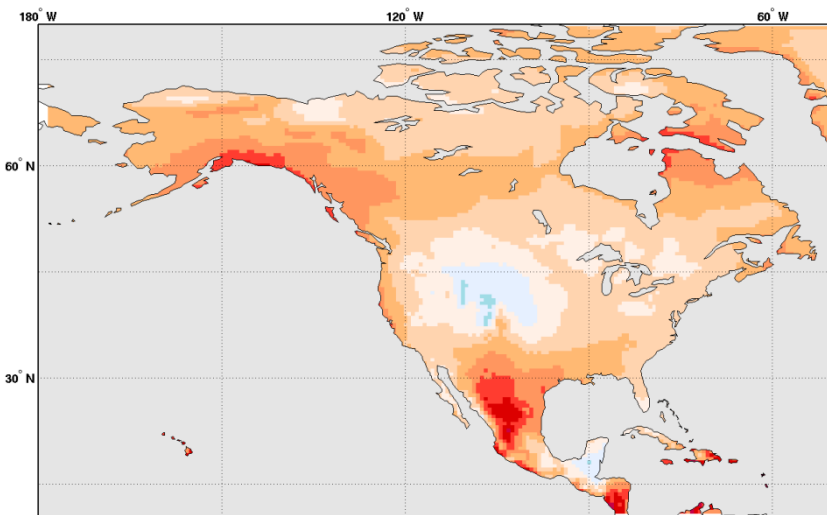
T2m   precip

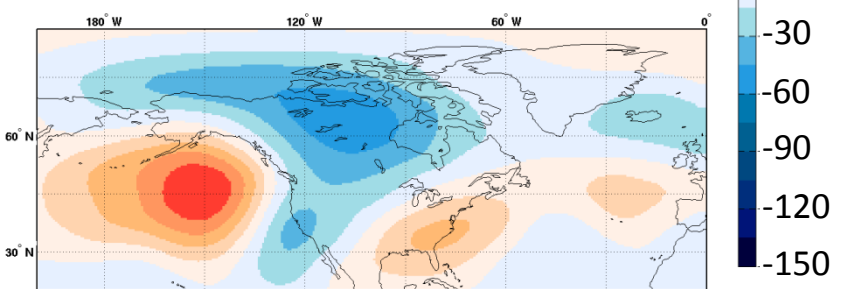# Forecast WTs: K-means cluster analysis of week 3-4 PNA region 500 hPa height (z500) anomalies

K = 4
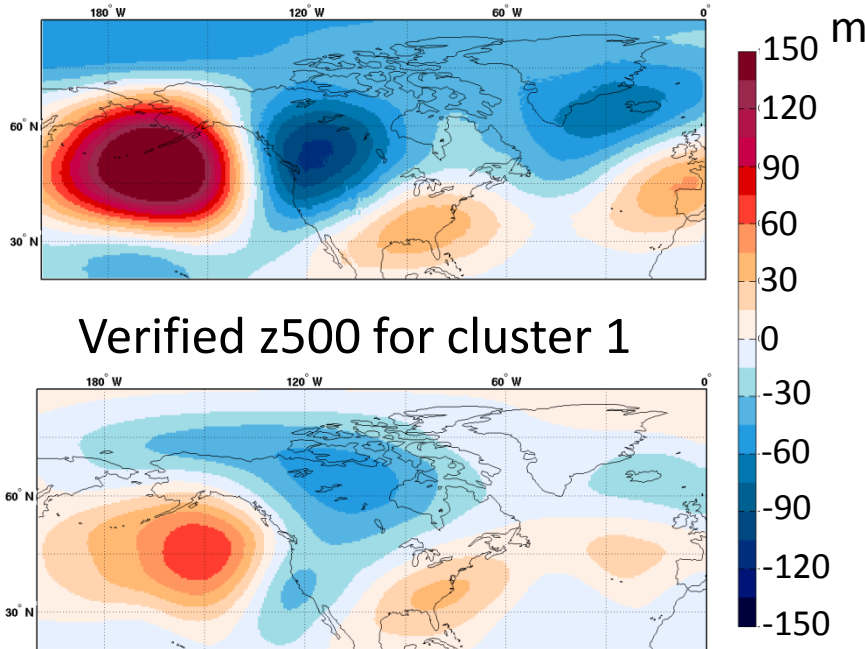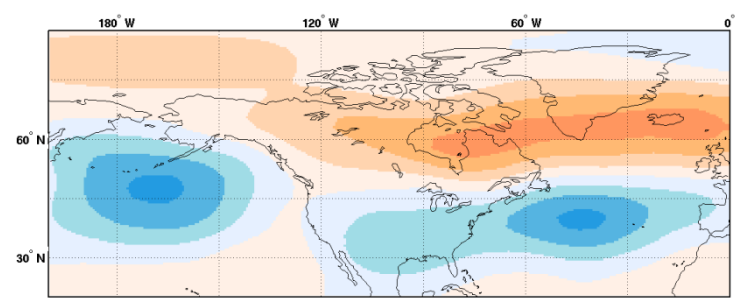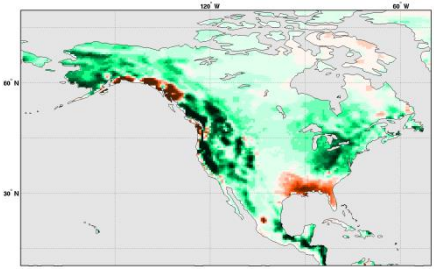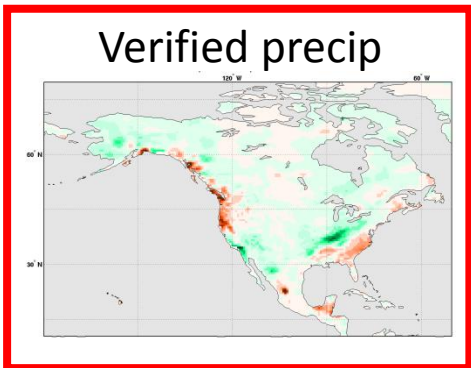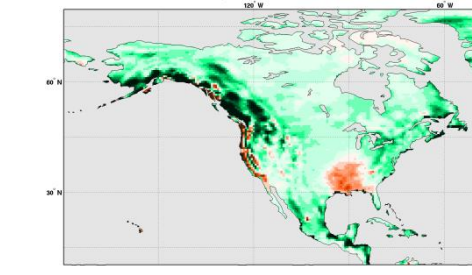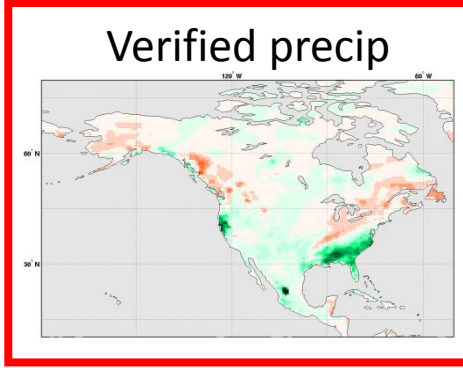
Summary

- Statistical week 3-4 forecast guidance successfully transitioned to CPC's experimental and operational outlooks

- Statistical guidance competitive with dynamical guidance in weeks 3-4

- Week 3-4 skill: temperature encouraging, precipitation marginal

- Hybrid dynamical forecast system with weather types in exploratory stage