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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Bridging the forecast gap in weeks 3-4

**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
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

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<th>9/2016 To 4/2017</th>
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<td>PM</td>
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### Experimental CPC Outlook

- **Dynamical Guidance - Temperature**
- **Statistical Guidance - Temperature**

### Dynamical Models

- CPC
- CFSv2
- ECMWF
- JMA

### Equally Weighted Dynamical Models

- Eq. Wtd

### Statistical Models

- MLR
- PM
How well have we done?
Precipitation

Heidke Skill Scores

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</table>
Going beyond MJO, ENSO, and trend: Statistical forecasts of teleconnection pattern indices

- **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

PNA

NAO

AO

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

$K = 4$

Forecast z500 cluster 1

Verified z500 for cluster 1

Forecast z500 cluster 2

Verified z500 cluster 2

Forecast precip

Verified precip

Forecast precip

Verified precip
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