The subseasonal-to-seasonal variability of Northern Hemisphere midlatitudes and its influence on forecasts for weeks 3-4

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Outline

- Brief project description
- Scientific motivation
- Dynamical models results
- Statistical model results
- Future work
Project Description

Objectives

- Improve the MLR
- Develop advanced diagnostics to be applied to the dynamical models output

Dynamical Models
- CFS
- GEFS
- ECMWF

Statistical Models
- MLR*

*Harnos et al. 2016
Scientific Motivation

Northern Hemisphere Midlatitude Variability

Flow Regimes

- PNA
- Arctic High
- Arctic Low
- Alaska Blocking
- Pacific Trough

Intra-seasonal and Seasonal Oscillations

- 45-day Oscillation (PNA)
- 120-day Oscillation (NAO/AO)

Contours: Cluster centroids based on 5-day running means of Z500 for DJF from reanalyses.

Shading: Shift in 300 hPa storm tracks (significant using bootstrap)
How to use this potential source of predictability?
Dynamical Models (CFSv2 5-member Ensemble)

- CFS reforecast
- 5 Ensemble members
- Initial condition: 01Jan2012

Reanalysis flow regime

Ensembles with pattern correlation > 0.5

Ensembles with pattern correlation > 0.4
Statistical Model

Dynamical Models
- CFS
- GEFS
- ECMWF

Statistical Models
- MLR*

*Harnos et al. 2016
Multi-linear Regression Model (MLR)

**Predictors:**
- RMM1 and RMM2 for MJO
- 2-week mean Nino 3.4 anomaly for ENSO
- Daily index for linear long-term trend

**Predictands:**
- 2-meter Temperature anomalies
- Precipitation anomalies

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- RMM1 and RMM2 for MJO
- 2-week mean Nino 3.4 anomaly for ENSO
- Daily index for linear long-term trend
- Daily index for the 45-day oscillation
- Daily index for the 120-day oscillation

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- 2-meter Temperature anomalies
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Operations

Off-line
The impact of the 45-day oscillation predictor on 2m temperature

Correlations between Observed Wk 3-4 2m Temperature Anomalies and Temperature Anomalies Forecasted from MLR with added PNA Predictor

NDJ MJJ
All Phases of ENSO and Phase 6 of MJO

Correlation between observed and predicted 2m temperature anomalies
The impact of 120-day oscillation predictor on the 2-meter temperature

- Heidke Skill Score aggregated over US (including Alaska) grid points

\[
HSS = \frac{\text{Hits} - \text{Expected}}{\text{Total} - \text{Expected}}
\]

Statistical significance: percentage of grid points across the US that exceed the 95% significance test based on the F-stat.
The impact of 120-day oscillation predictor on precipitation

- The low skill suggests that precipitation outlook may instead be better focused on extreme values rather than total anomalies.
The impact of 120-day oscillation predictor on 2m temperature

Correlations between Observed Wk 3-4 2m Temperature Anomalies and Temperature Anomalies Forecasted from MLR with added NAO Predictor

All Phases of ENSO and Phase 6 of MJO

Correlation between the observed and predicted 2m temperature anomalies
Variance explained by the 4-predictor vs. 3-predictor MLR model

The 120-day oscillation predictor demonstrated forecast of opportunity, where periods of statistically significant enhancements to forecast skill can occur for the week 3-4 outlook.
The Next Steps

- Explore various options for expending the operational MLR model to account for oscillatory modes describing the intra-seasonal and seasonal variability of the Northern Hemisphere midlatitudes.

- The impact of midlatitude variability on precipitation forecast skill will continue to be evaluated.

- The flow regimes diagnostics will be refined and developed into a prototype for operational workflow.
Thank you!
The impact of 120-day oscillation predictor on 2m temperature

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