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

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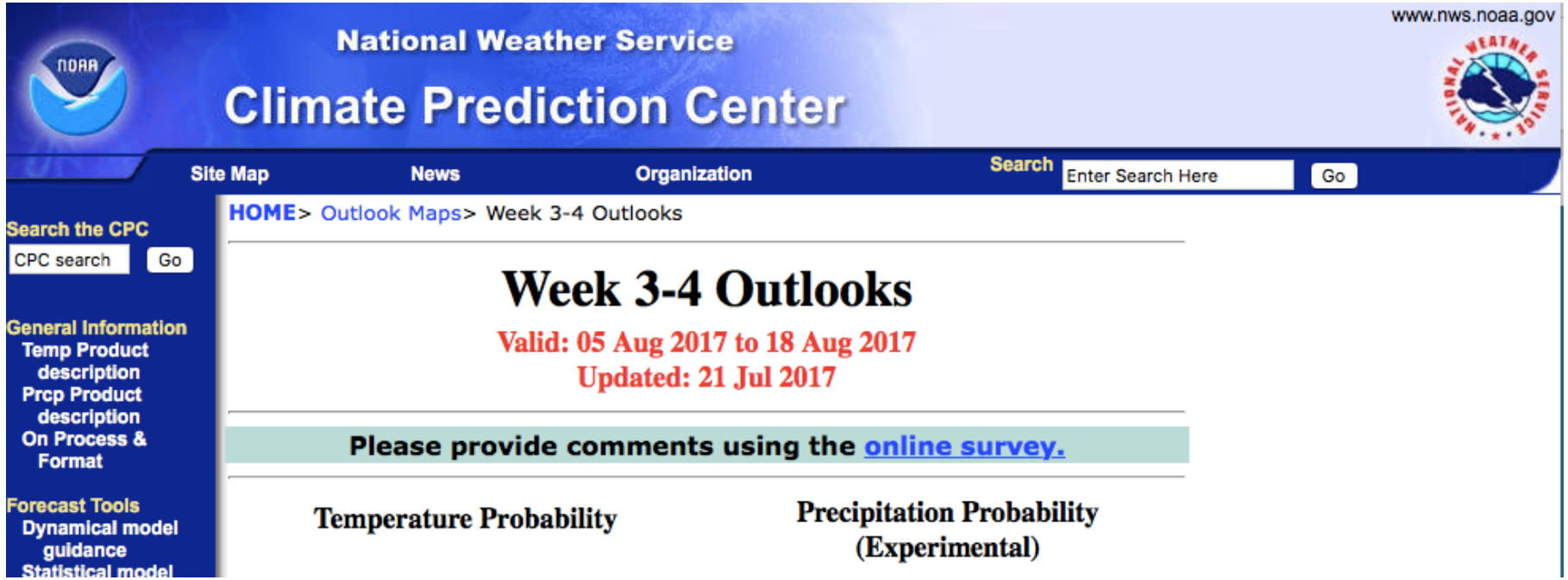
Outline

- 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

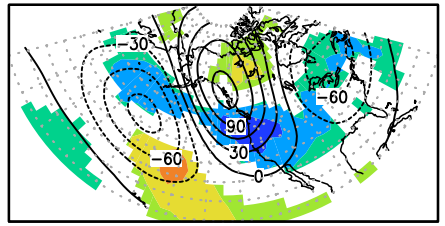
*Harnos et al. 2016

Scientific Motivation

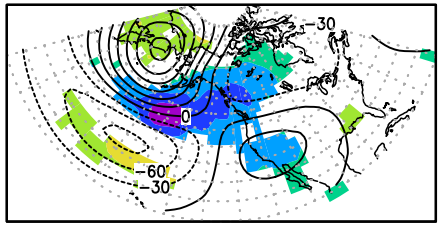
Northern Hemisphere Midlatitude Variability

Flow Regimes

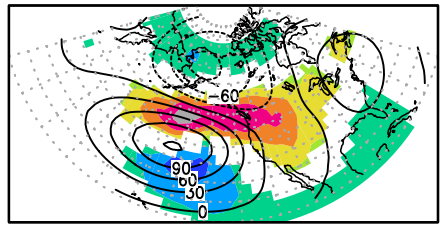
PNA



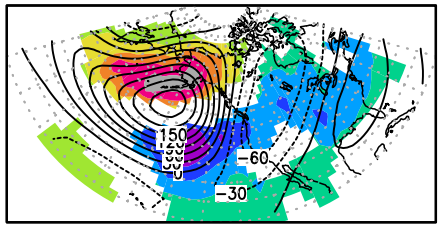
Arctic High



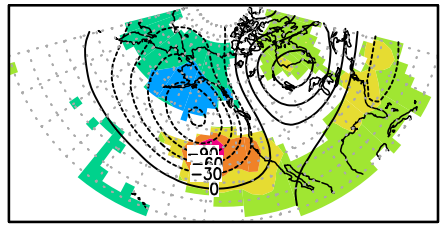
Arctic Low

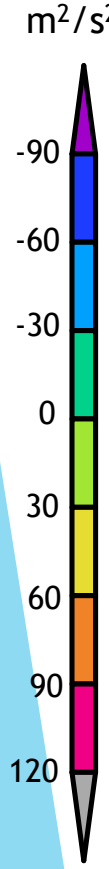


Alaska Blocking



Pacific Trough



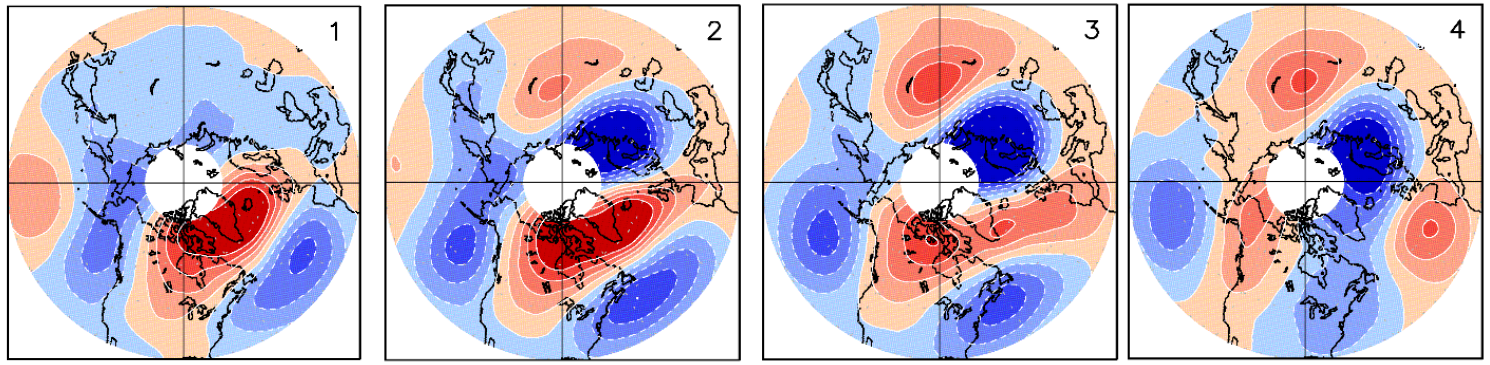


Contours: Cluster centroids based on 5-day running means of Z500 for DJF from reanalyses.

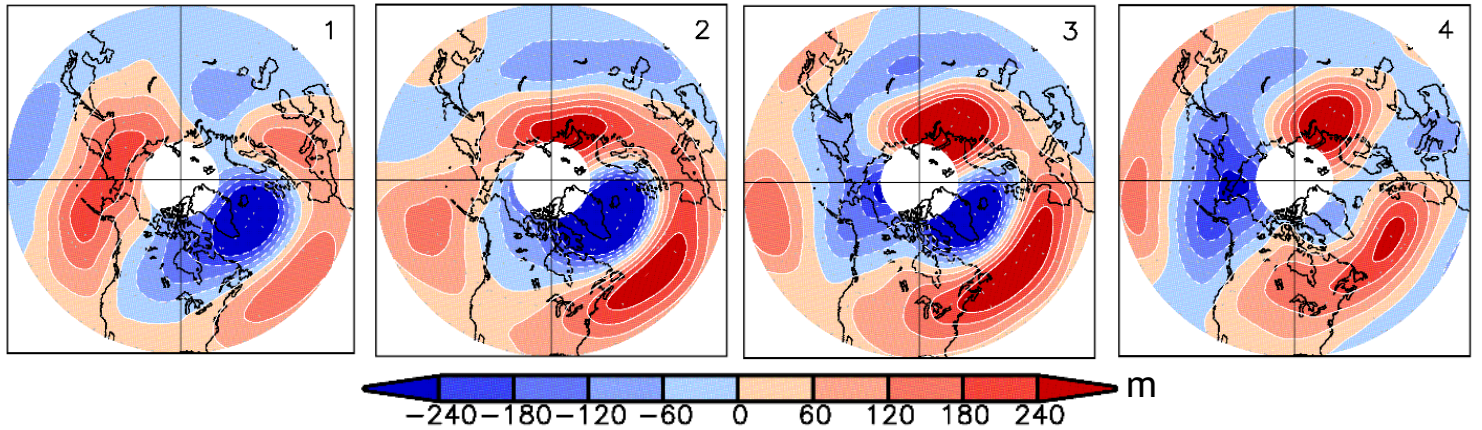
Shading: Shift in 300 hPa storm tracks (significant using boot-strap)

Intra-seasonal and Seasonal Oscillations

45-day Oscillation (PNA)



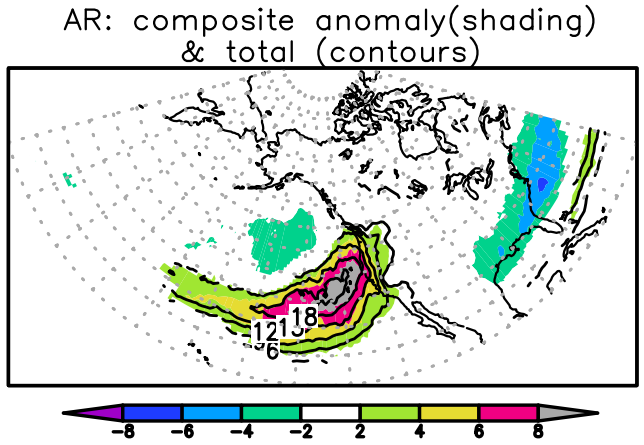
120-day Oscillation (NAO/AO)



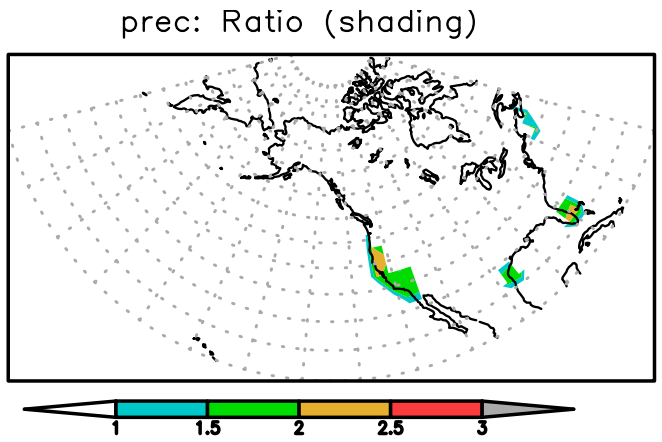
How to use this potential source of predictability?

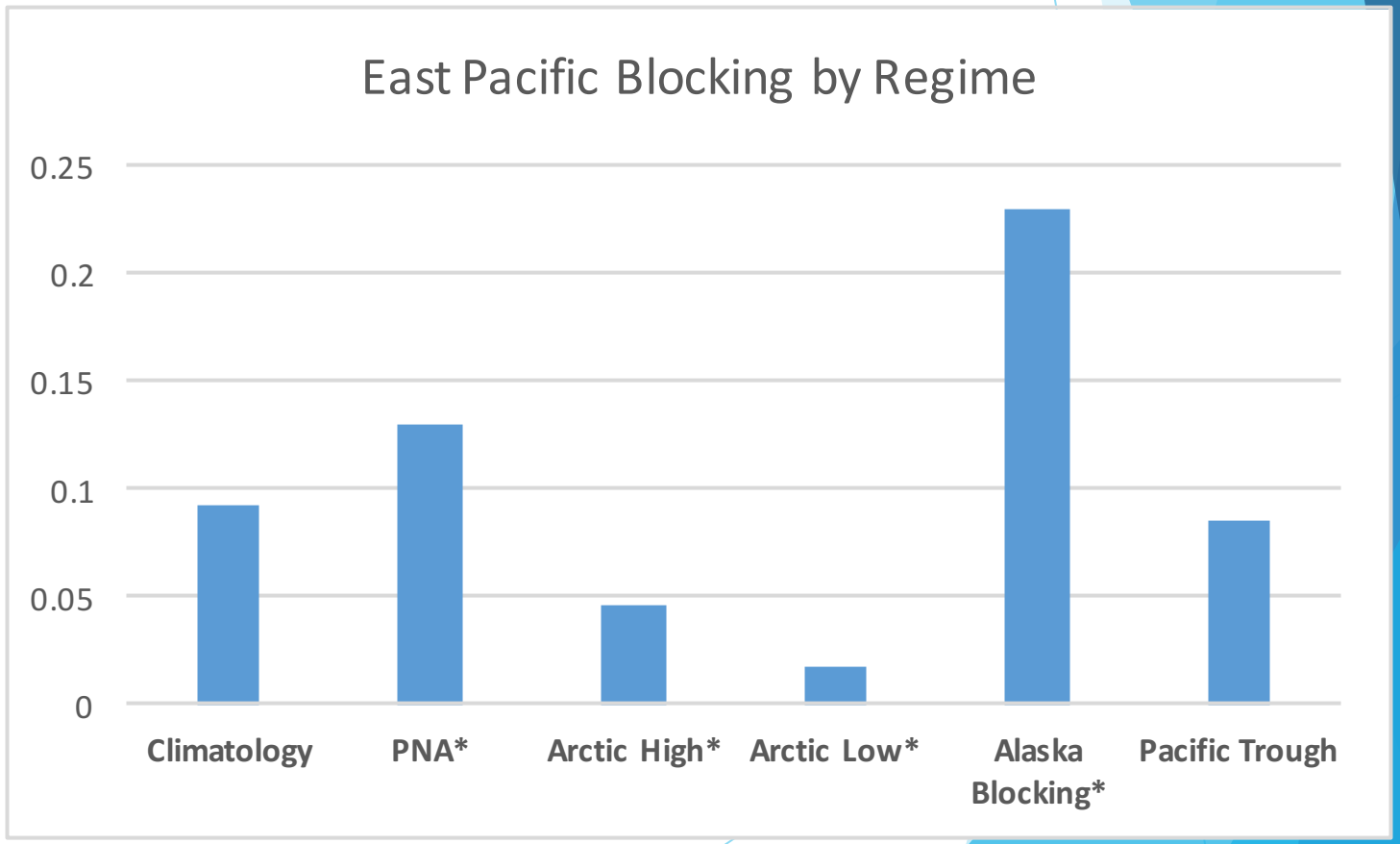
Pacific Trough

Atmospheric Rivers

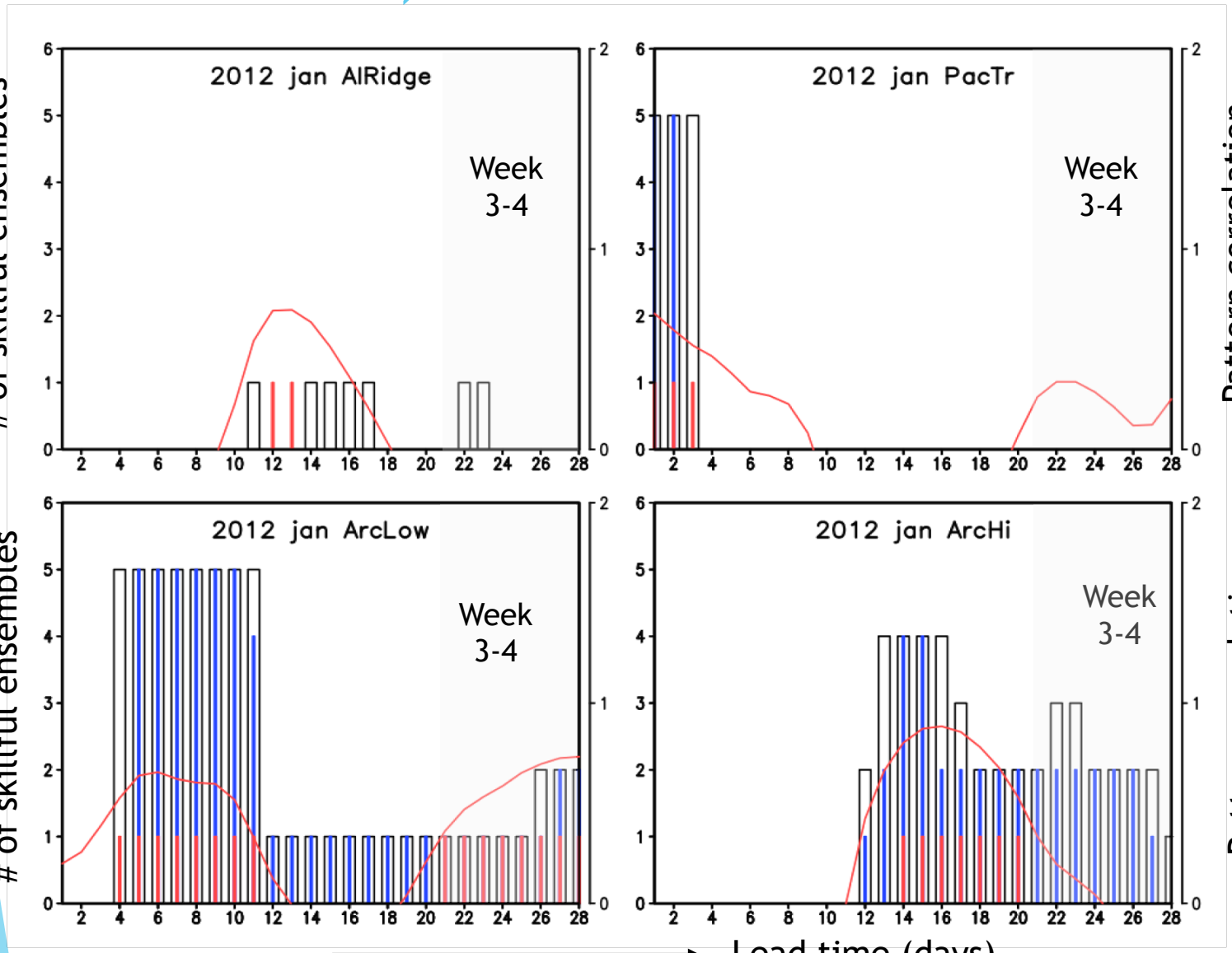


Precipitation





Dynamical Models (CFSv2 5-member Ensemble)



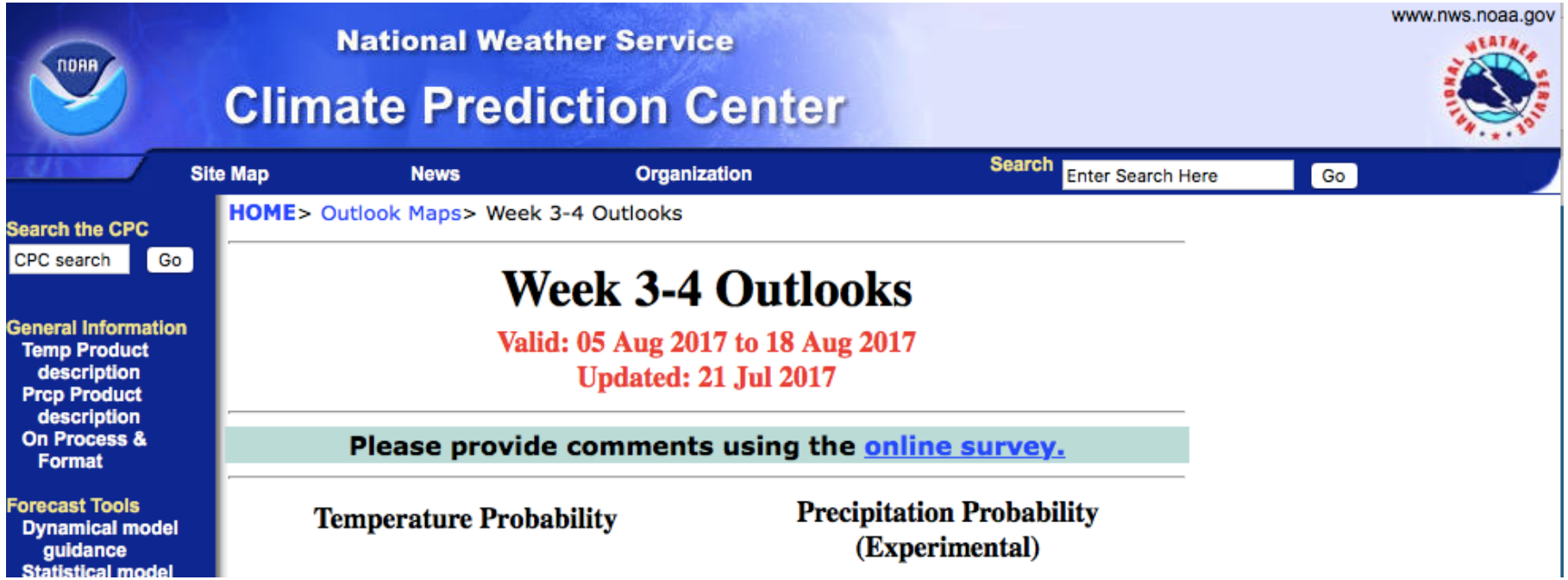
- CFS reforecast
- 5 Ensemble members
- Initial condition: 01Jan2012

Reanalysis flow regime

Ensembles with pattern correlation > 0.5

Ensembles with pattern correlation > 0.4

Statistical Model



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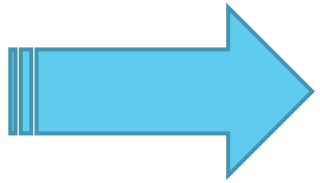
Multi-linear Regression Model (MLR)

- *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

Operations

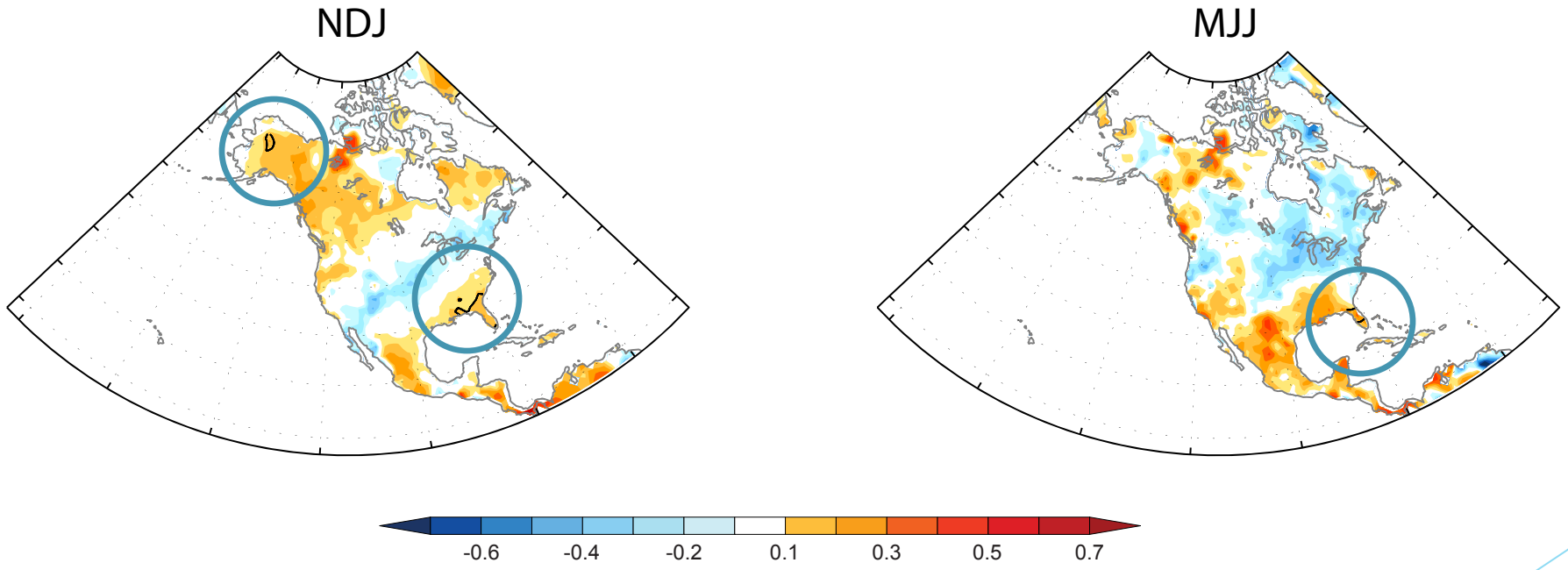


- *Predictors:*
  - RMM1 and RMM2 for MJO
  - 2-week mean Nino 3.4 anomaly for ENSO
  - Daily index for linear long-term trend
  - Daily index for the 45-day oscillation
  - Daily index for the 120-day oscillation
- *Predictands:*
  - 2-meter Temperature anomalies
  - Precipitation anomalies

Off-line

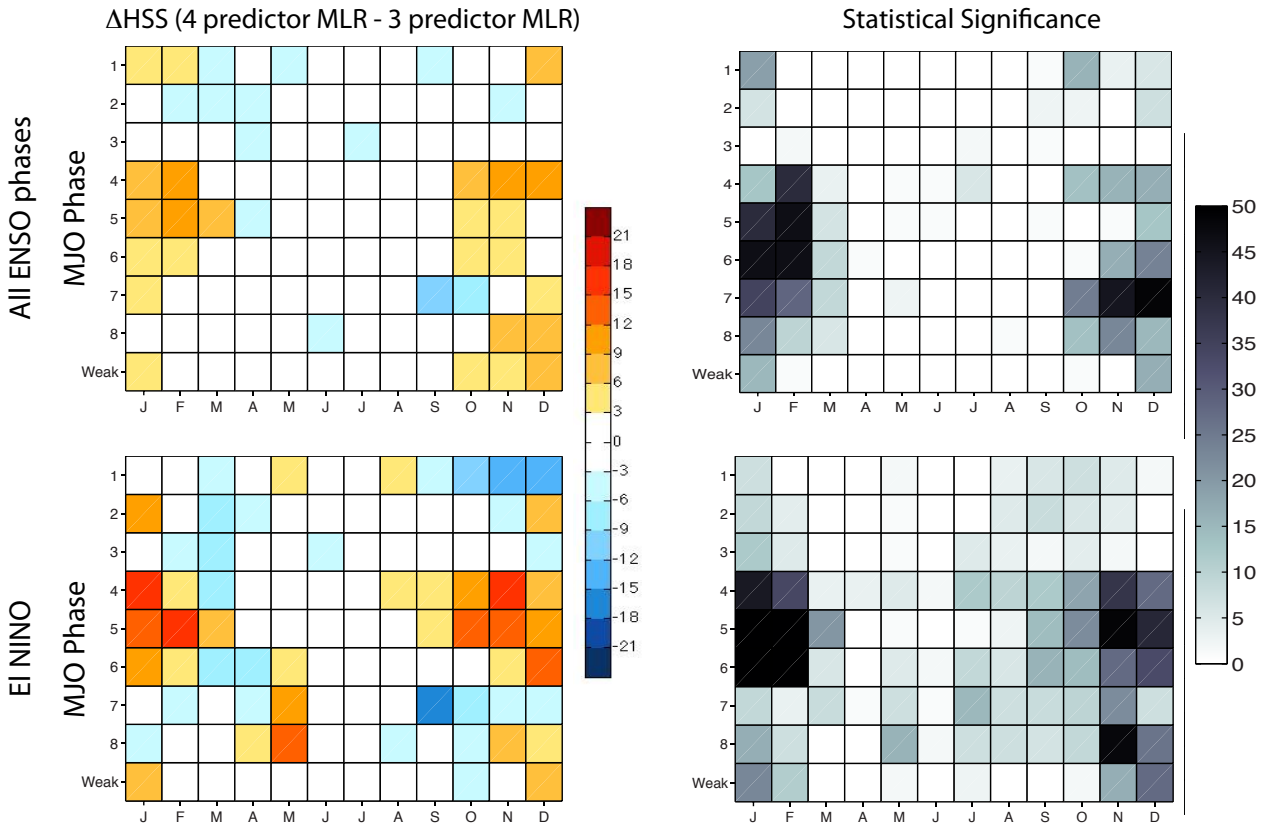
The impact of the 45-day oscillation predictor on 2m temperature

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

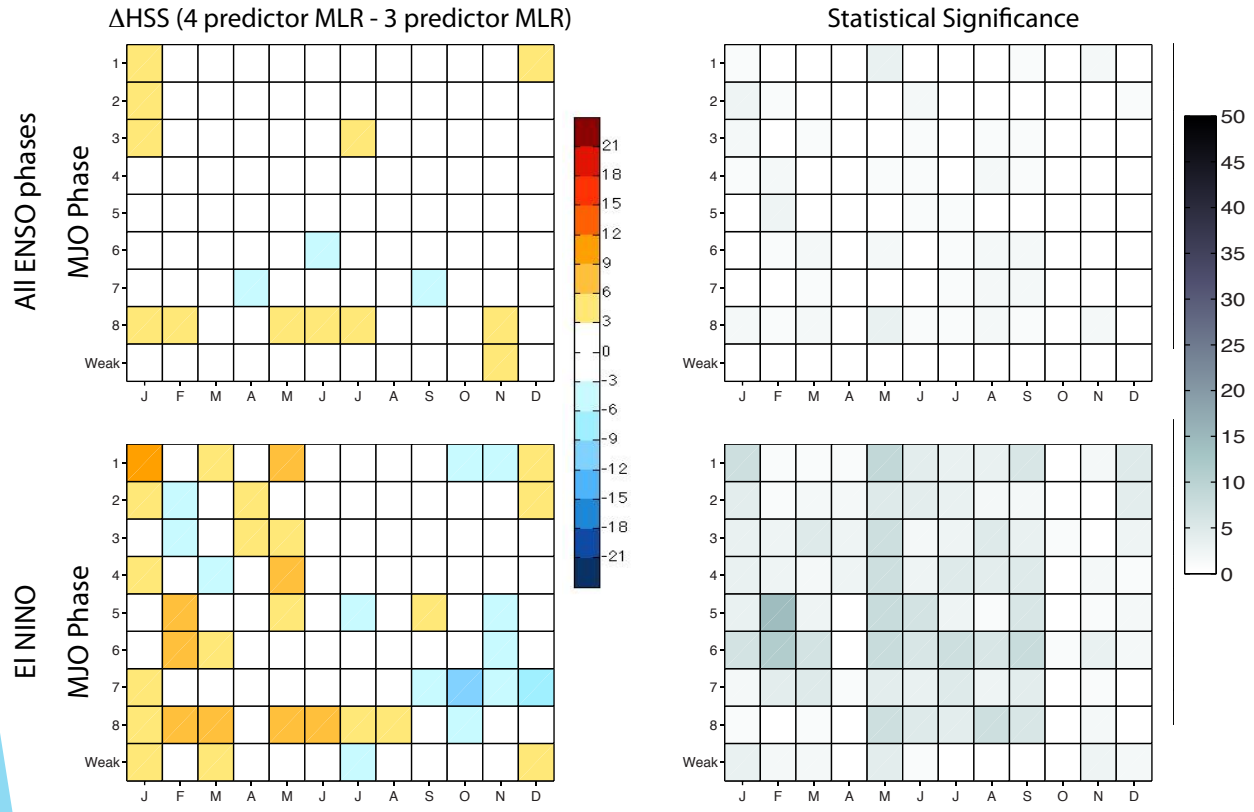


- Heidke Skill Score aggregated over US (including Alaska) grid points

$$HSS = \frac{Hits - Expected}{Total - Expected}$$

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

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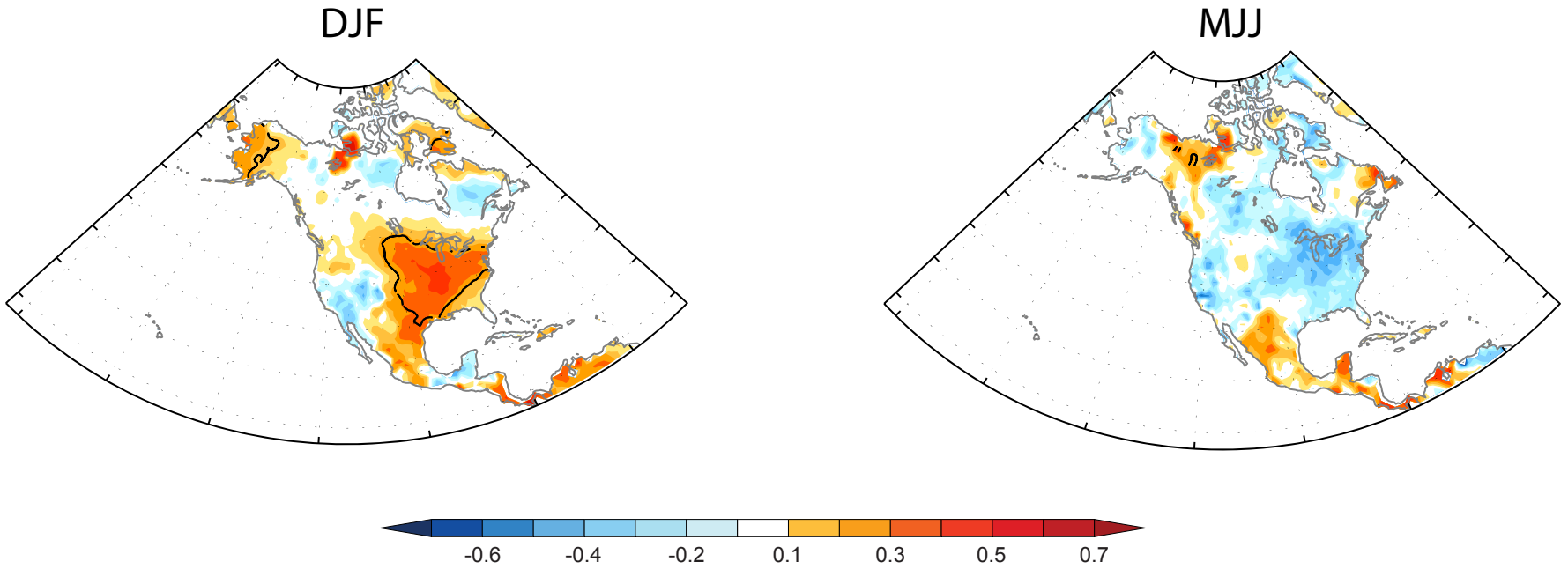
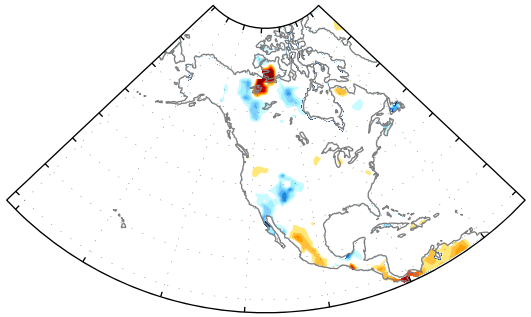


Correlation between the observed and predicted 2m temperature anomalies

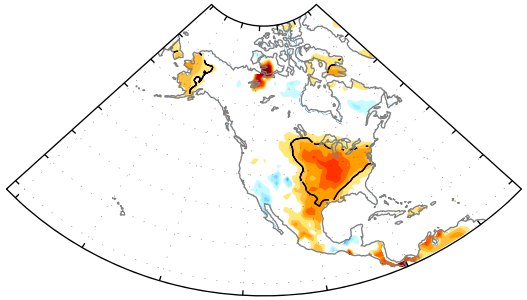
Variance explained by the 4-predictor vs. 3-predictor MLR model

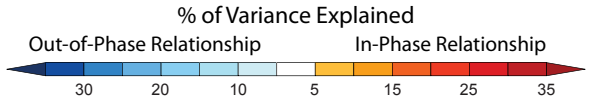
All ENSO Phases and MJO Phase 6
DJF

3 Predictor MLR
(ENSO, MJO, Trend)



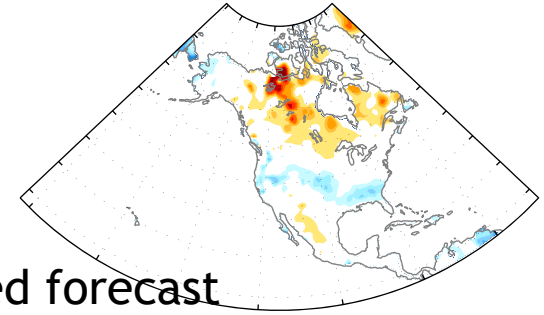
4 Predictor MLR
(ENSO, MJO, Trend, NAO)





All ENSO Phases and MJO Phase 7
OND

3 Predictor MLR
(ENSO, MJO, Trend)



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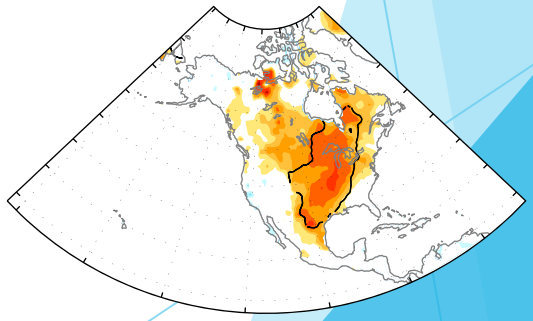
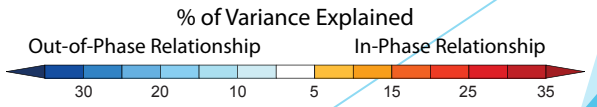




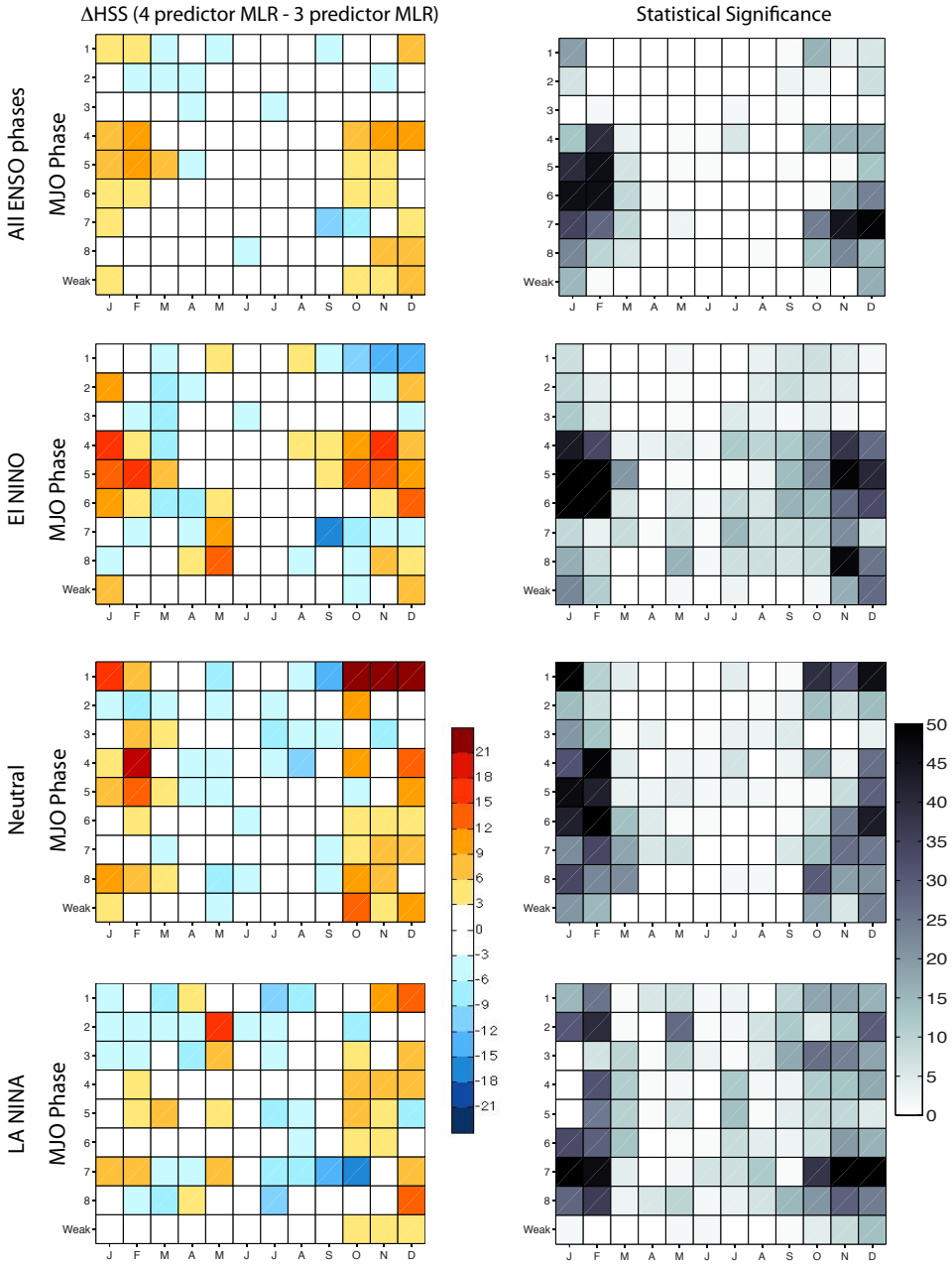
The 120-day oscillation predictor demonstrated forecast of opportunity, where periods of statistically significant enhancements to forecast skill can occur for the week 3-4 outlook.

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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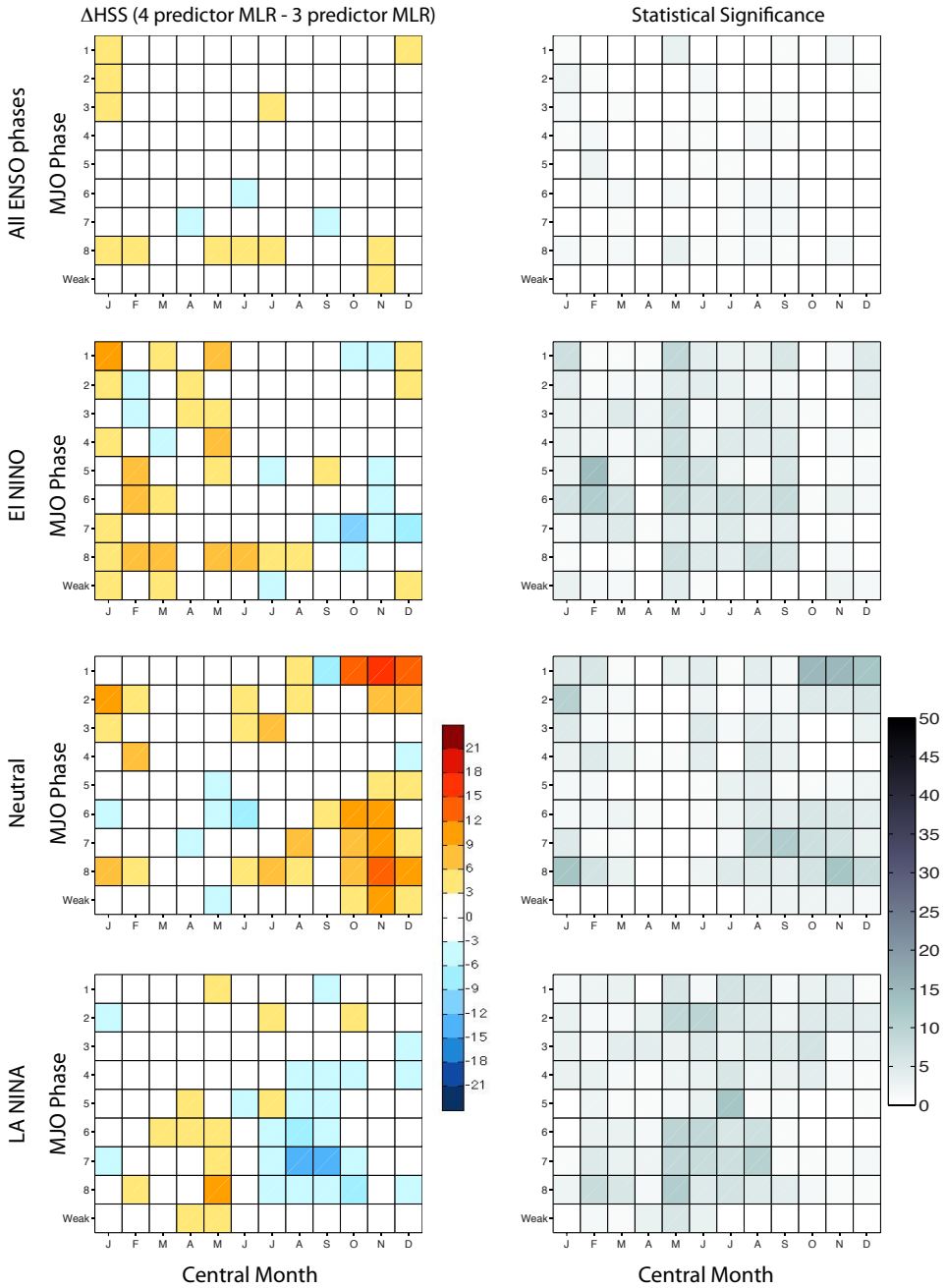

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