

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

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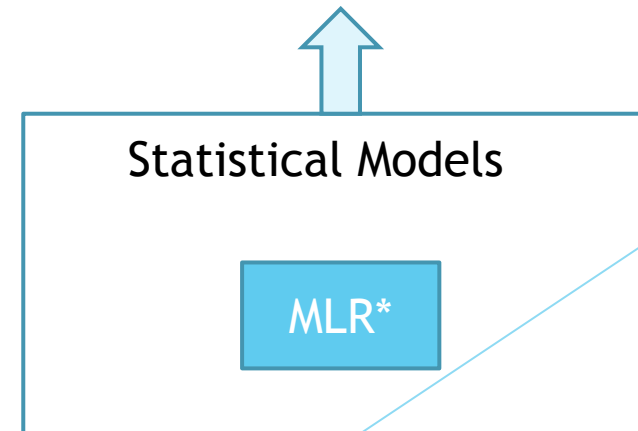
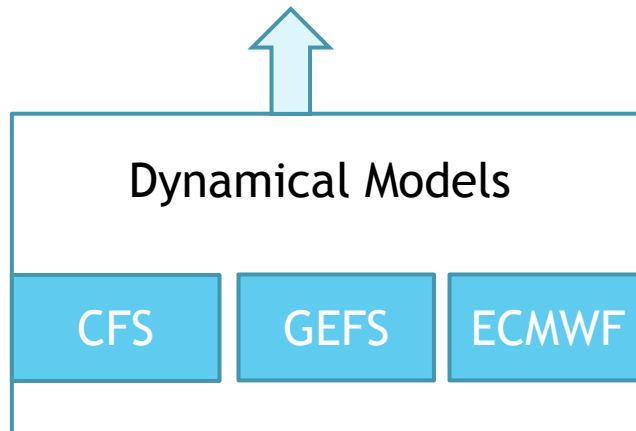
⁴ *Department of Atmospheric Science, Colorado State University, Fort Collins, CO*

Outline

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

Project Description

The screenshot shows the National Weather Service Climate Prediction Center website. The header includes the NOAA logo, the text "National Weather Service" and "Climate Prediction Center", and the URL "www.nws.noaa.gov". A navigation bar contains "Site Map", "News", "Organization", and a search box. The main content area displays "Week 3-4 Outlooks" with a validity period of "05 Aug 2017 to 18 Aug 2017" and an update date of "21 Jul 2017". A green banner prompts users to provide comments via an online survey. Below this, two sections are visible: "Temperature Probability" and "Precipitation Probability (Experimental)". A left sidebar contains search and general information options.



Objectives

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

Scientific Motivation

Northern Hemisphere Midlatitude Variability

Flow Regimes

PNA

Arctic High

Arctic Low

Alaska Blocking

Pacific Trough

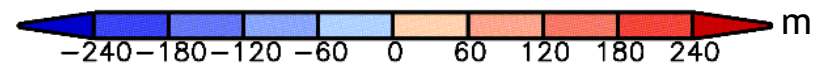
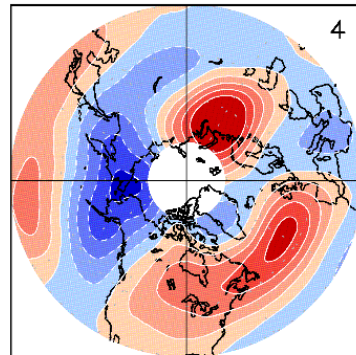
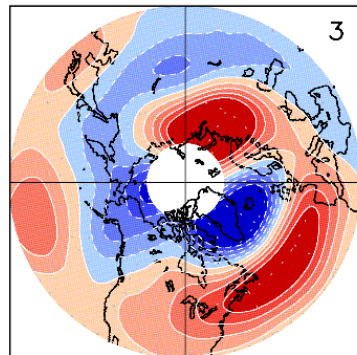
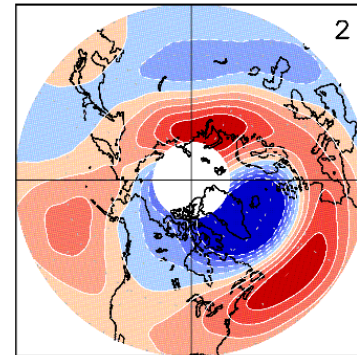
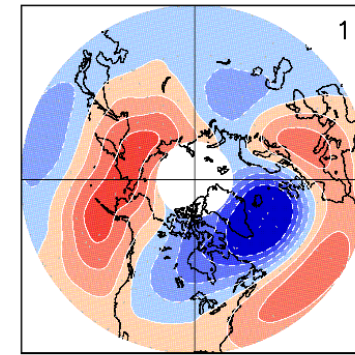
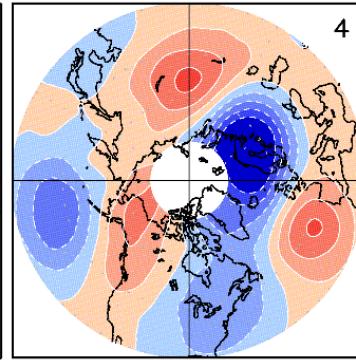
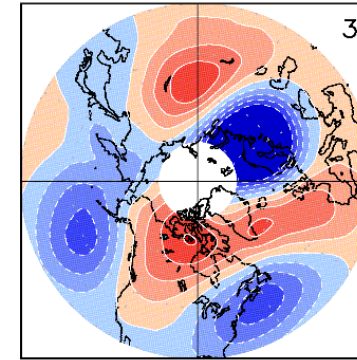
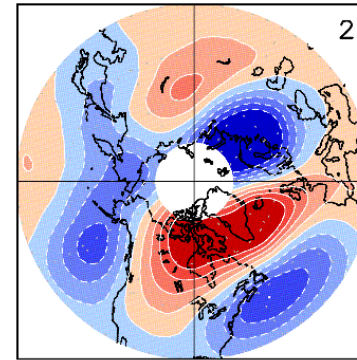
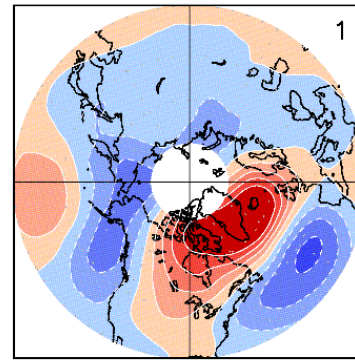
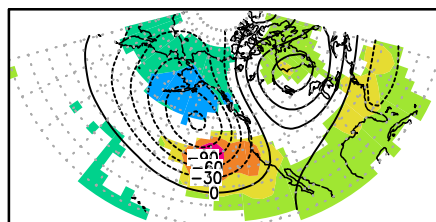
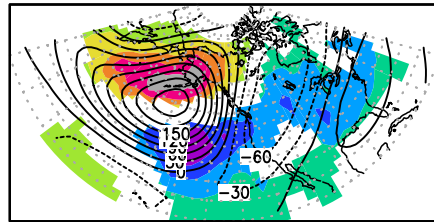
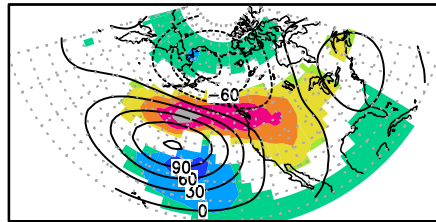
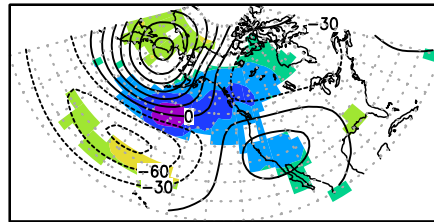
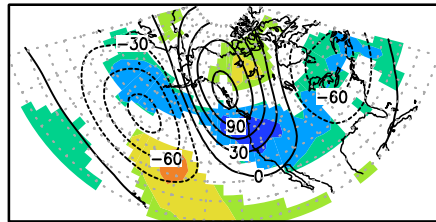
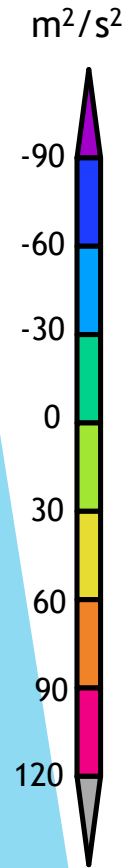
Contours: Cluster centroids based on 5-day running means of Z500 for DJF from reanalyses.

Shading: Shift in 300 hPa storm tracks (significant using bootstrap)

Intra-seasonal and Seasonal Oscillations

45-day Oscillation (PNA)

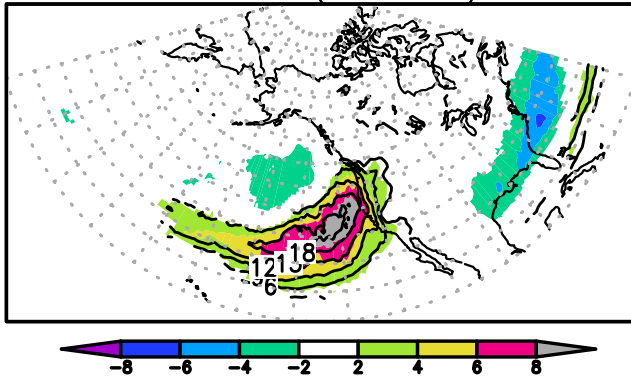
120-day Oscillation (NAO/AO)



How to use this potential source of predictability?

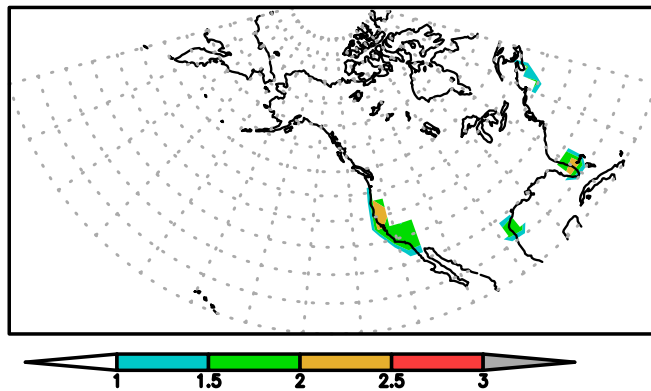
Atmospheric Rivers

AR: composite anomaly (shading) & total (contours)



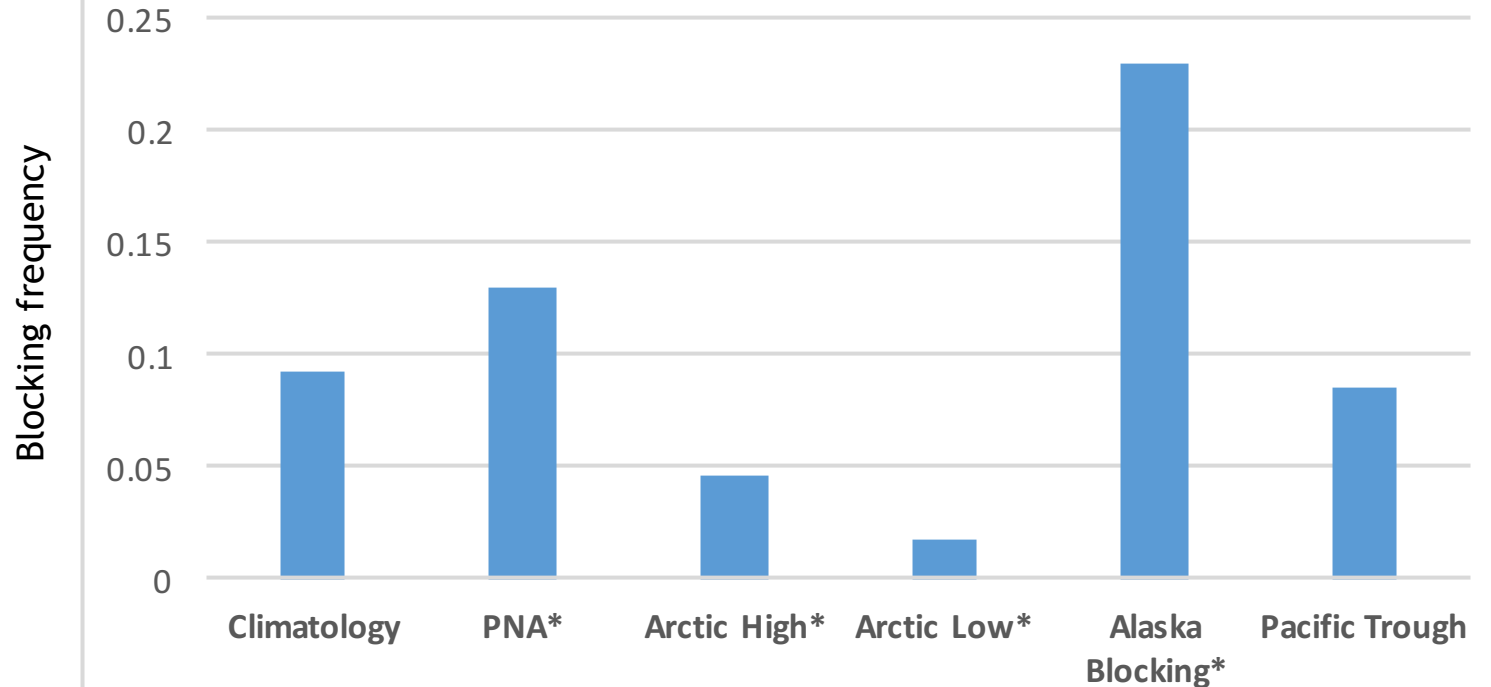
Precipitation

prec: Ratio (shading)

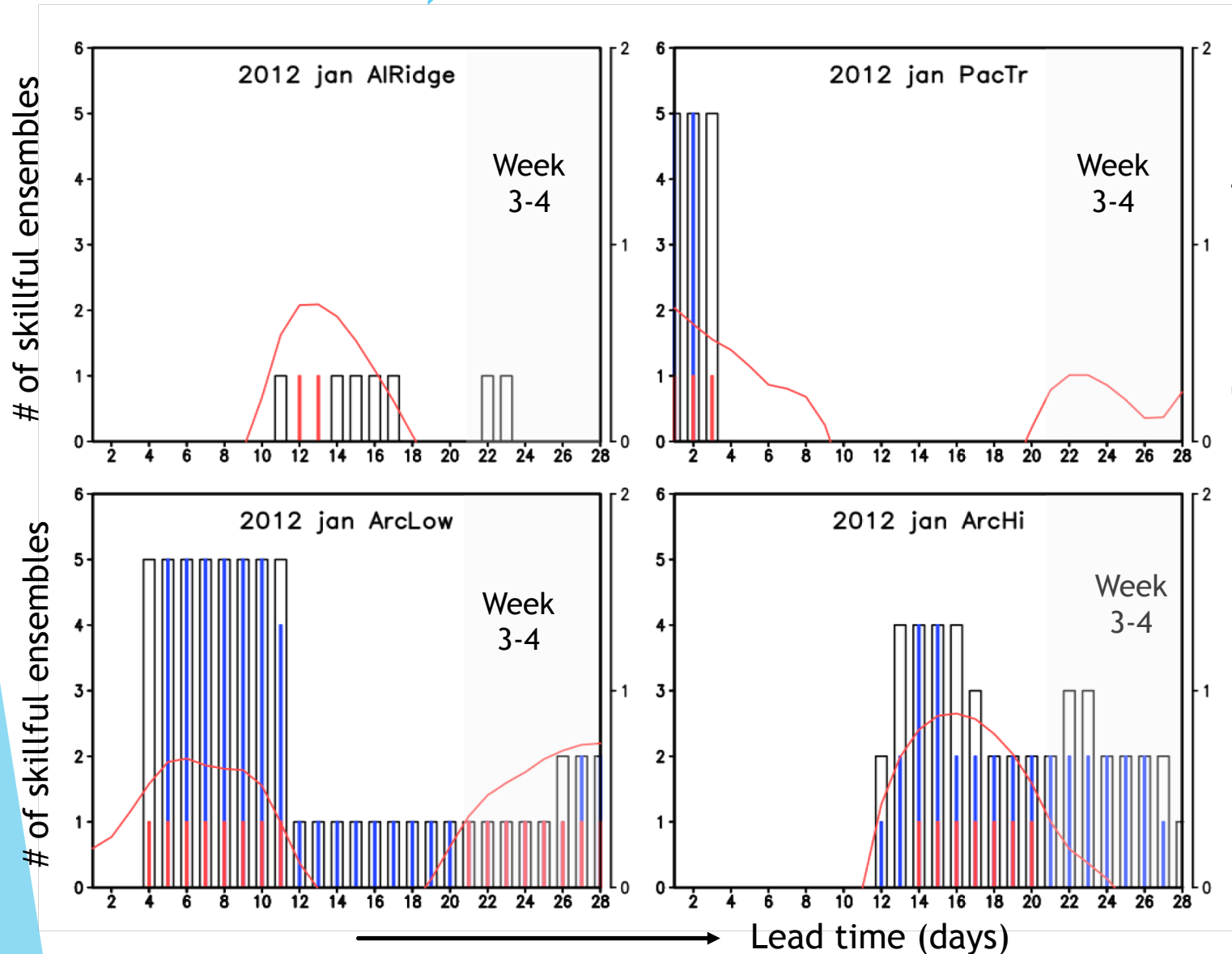


Pacific Trough

East Pacific Blocking by Regime



Dynamical Models (CFSv2 5-member Ensemble)



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

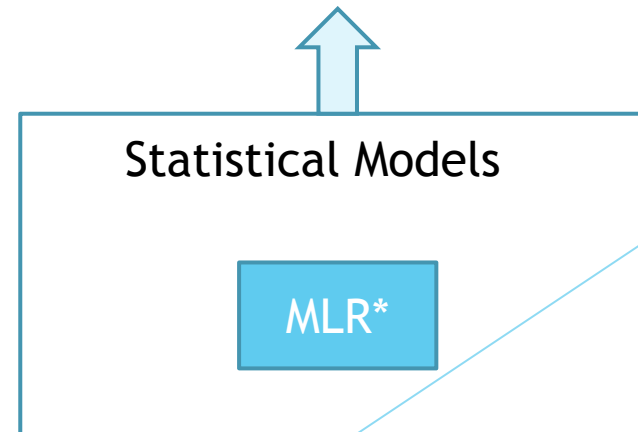
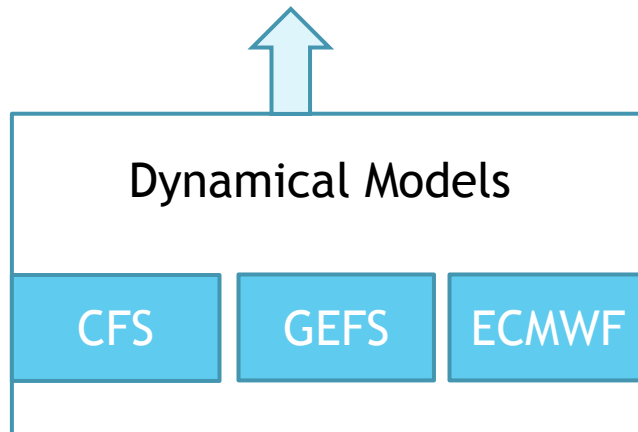
Red bar: Reanalysis flow regime

Blue bar: Ensembles with pattern correlation > 0.5

Black bar: Ensembles with pattern correlation > 0.4

Statistical Model

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Multi-linear Regression Model (MLR)

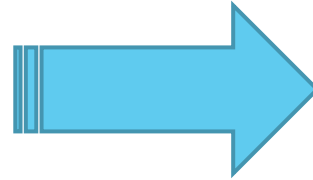
▶ *Predictors:*

- ▶ 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

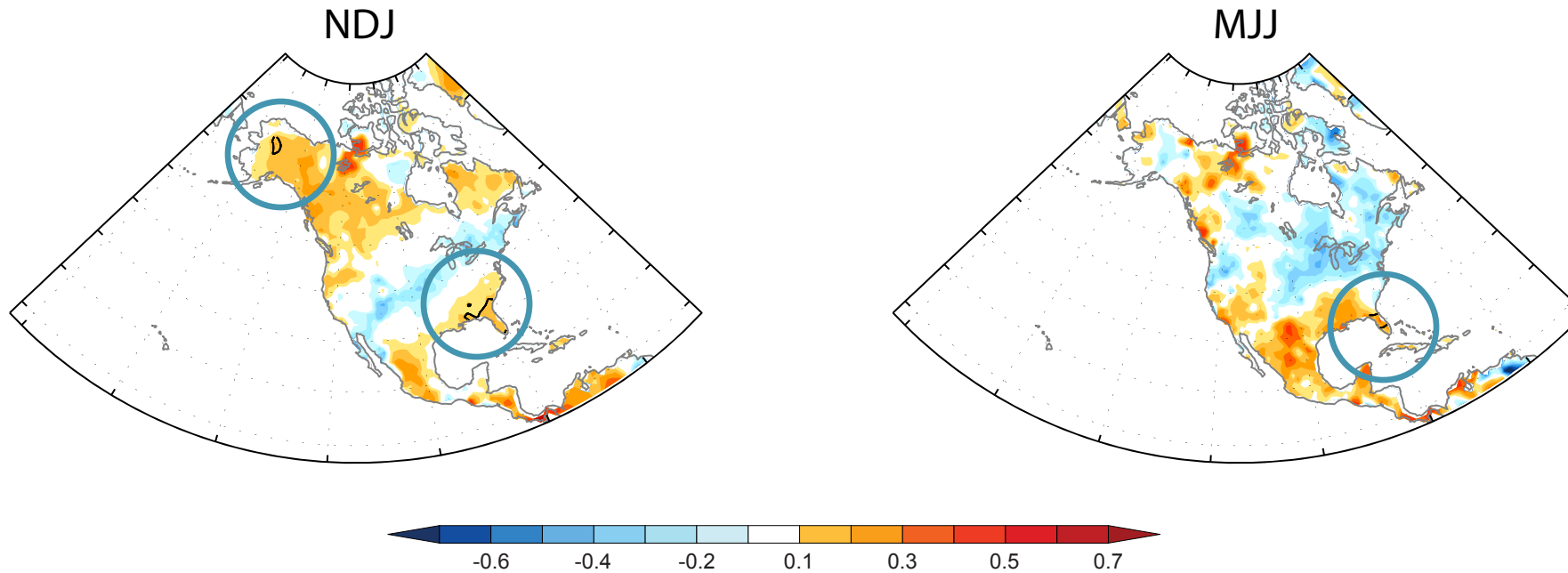
▶ *Predictands:*

- ▶ 2-meter Temperature anomalies
- ▶ Precipitation anomalies

Off-line

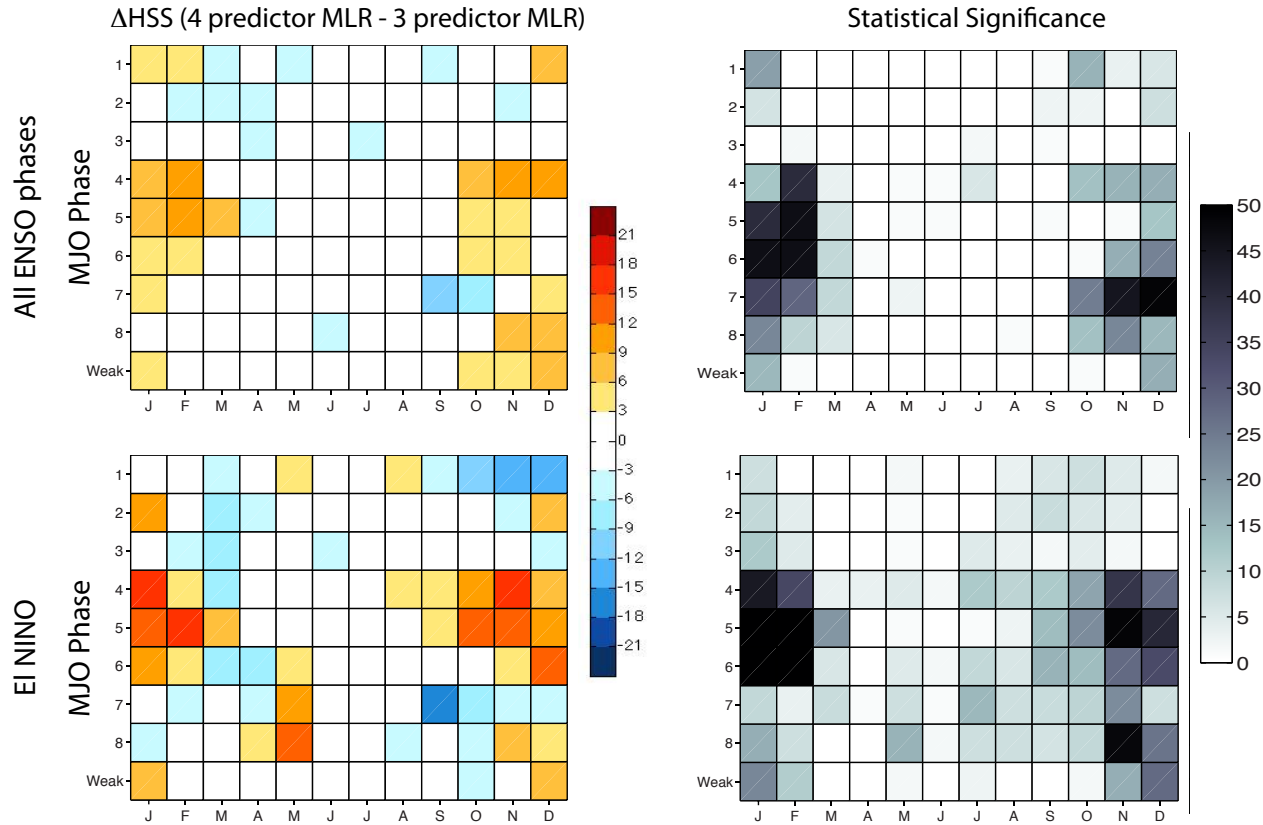
The impact of the 45-day oscillation predictor on 2m temperature

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

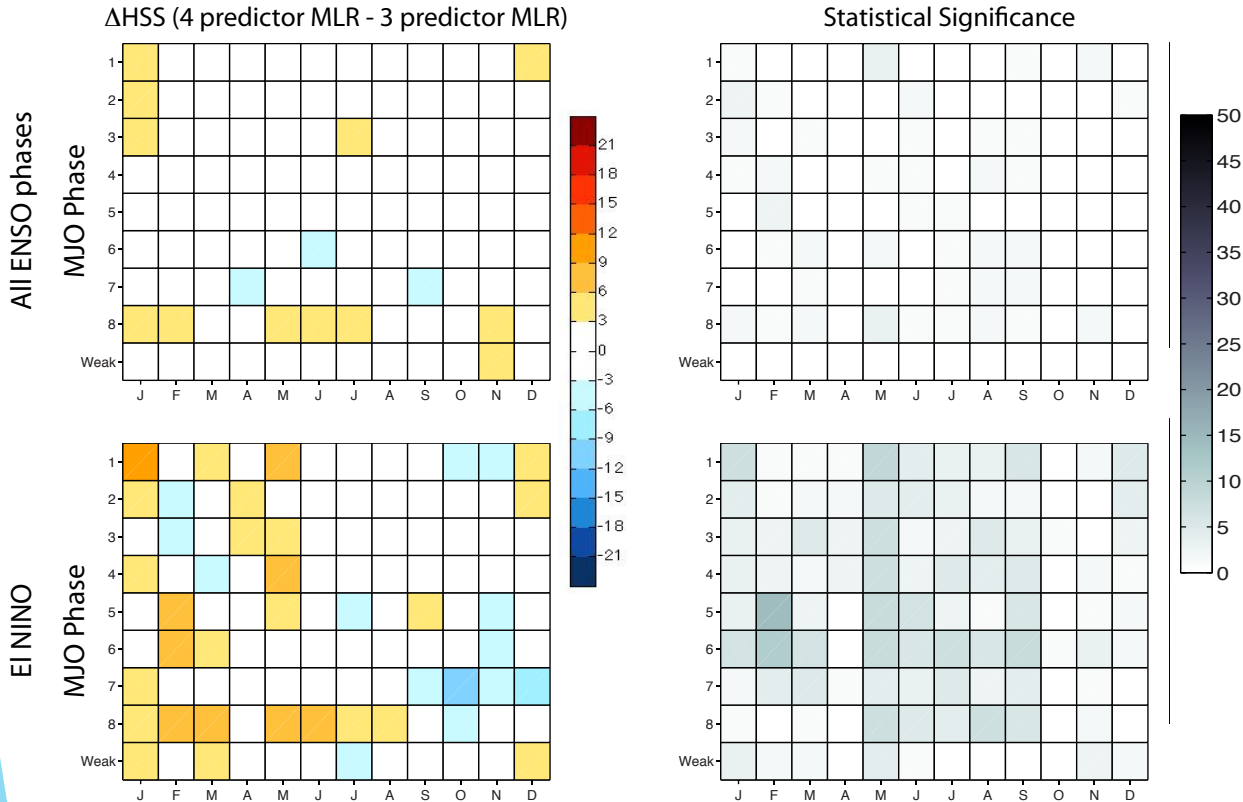


□ Heidke Skill Score aggregated over US (including Alaska) grid points

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

Statistical significance: percentage of grid points across the US that exceed the 95% significance test based on the F-stat

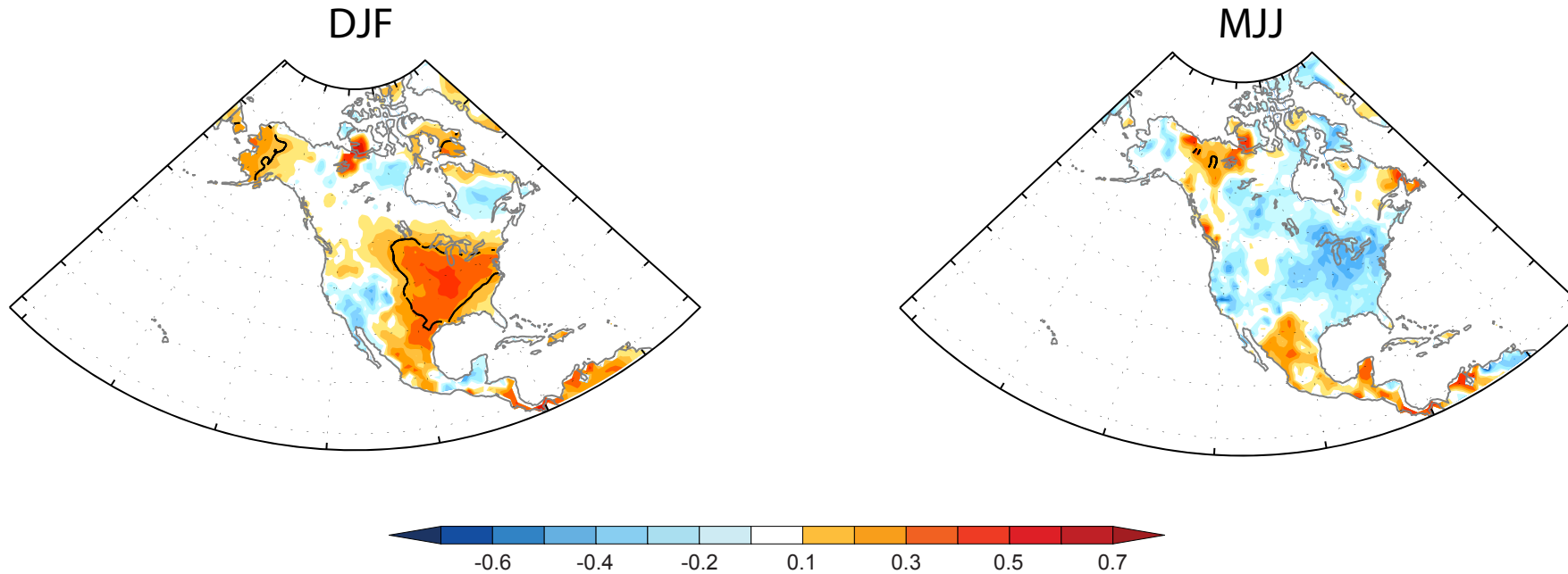
The impact of 120-day oscillation predictor on precipitation



- 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

All Phases of ENSO and Phase 6 of MJO



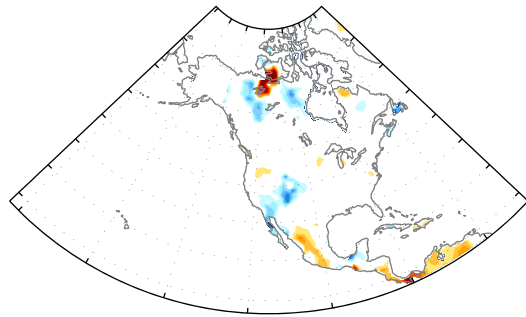
Correlation between the observed and predicted 2m temperature anomalies

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

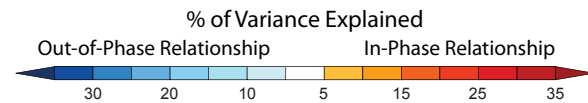
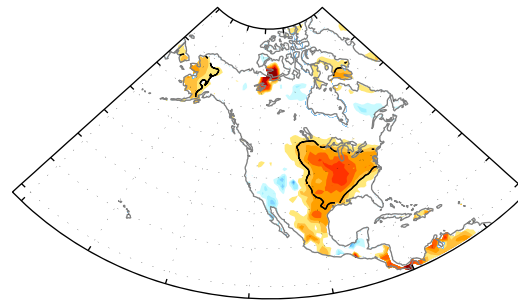
All ENSO Phases and MJO Phase 6

DJF

3 Predictor MLR
(ENSO, MJO, Trend)



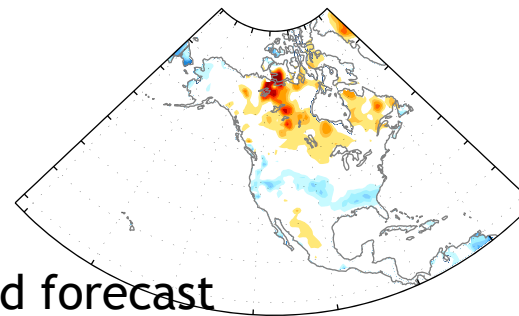
4 Predictor MLR
(ENSO, MJO, Trend, NAO)



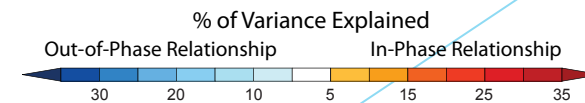
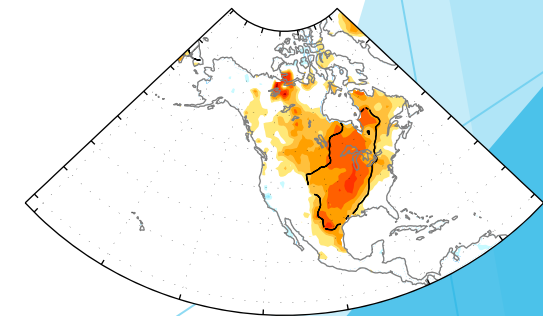
All ENSO Phases and MJO Phase 7

OND

3 Predictor MLR
(ENSO, MJO, Trend)



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



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.

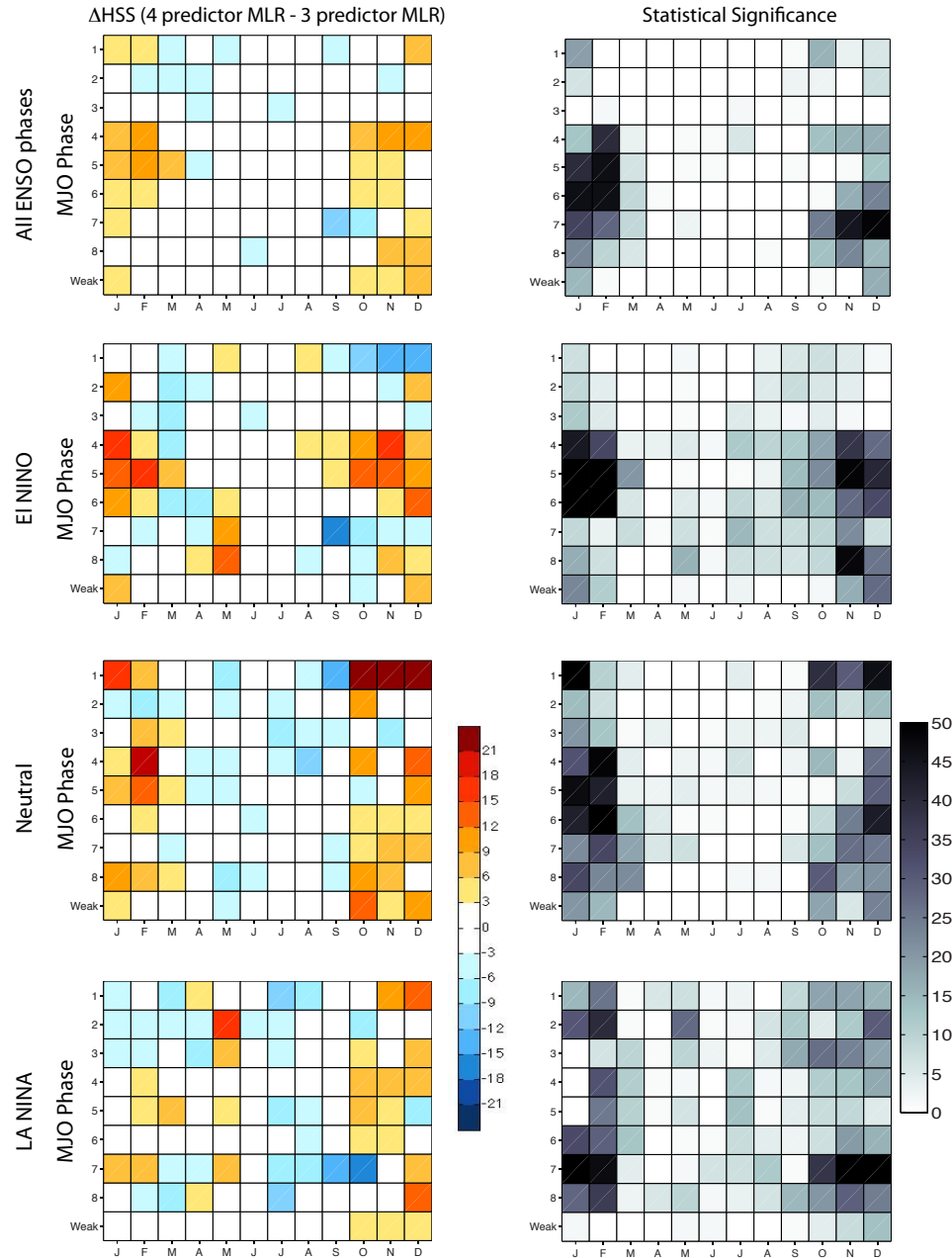
The Next Steps

- ▶ Explore various options for expanding 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 background features abstract, overlapping geometric shapes in various shades of blue, ranging from light sky blue to deep navy blue. These shapes are primarily located on the right side of the frame, creating a modern, layered effect against the white background.

The impact of 120-day oscillation predictor on 2m temperature

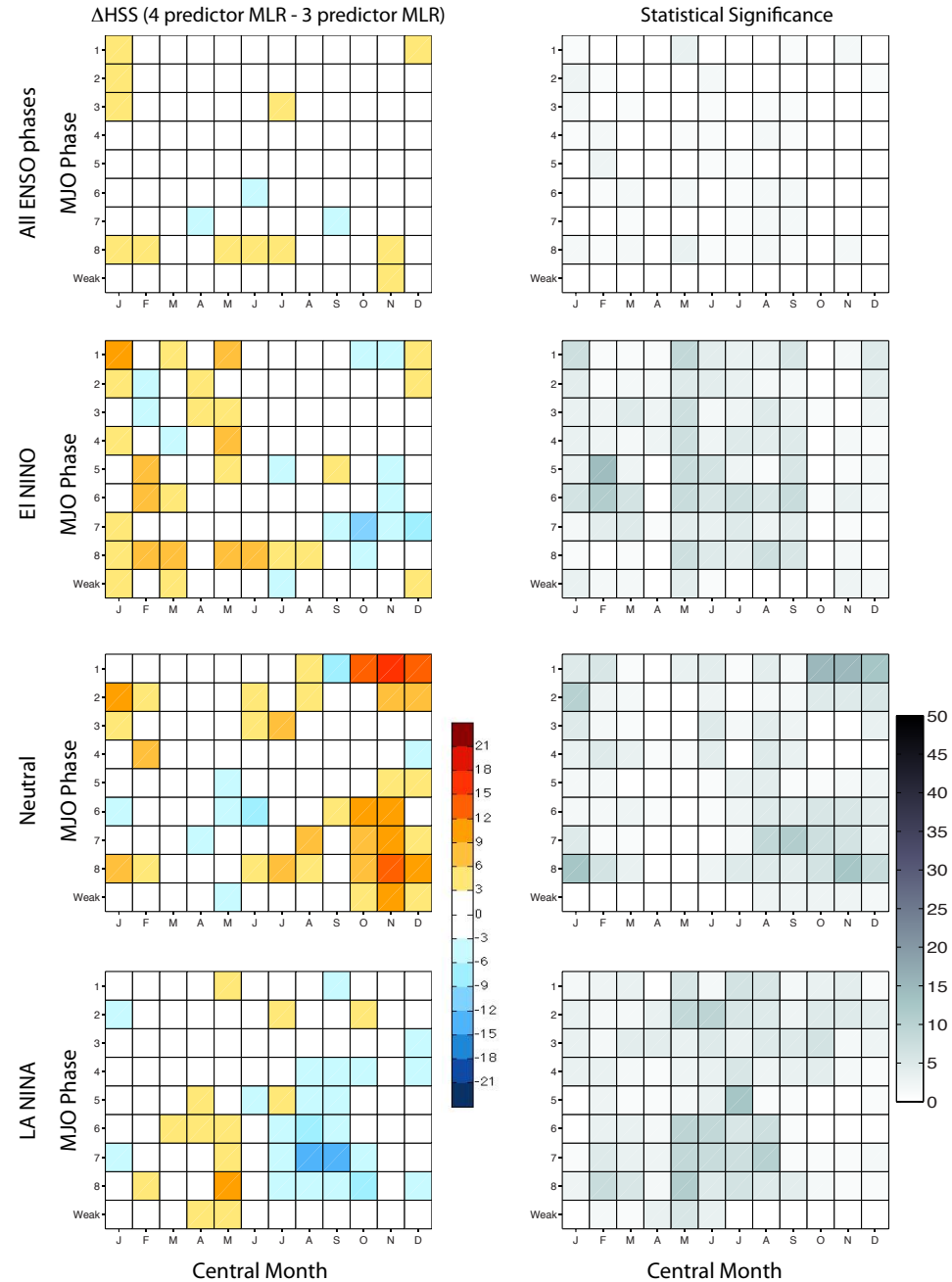


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