

S2S model biases can affect predictability of North American weather and climate

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Sources of Predictability for the North American weather and climate

ISV

Remote Source of predictability

- Atmospheric teleconnections on S2S time scales

L-A

Local Source of predictability

- Local land-atmosphere interaction processes

MLO
S

Regional Source of predictability

- Midlatitude oscillations

Tropical Biases

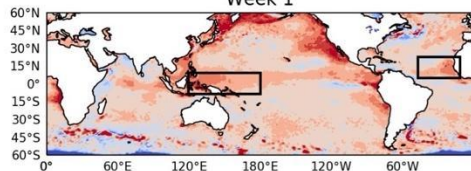
UFS 6

SS

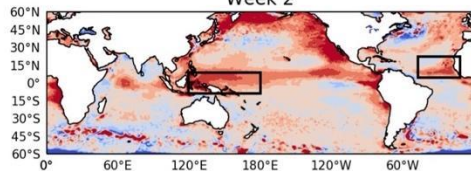
T

a) JJAS

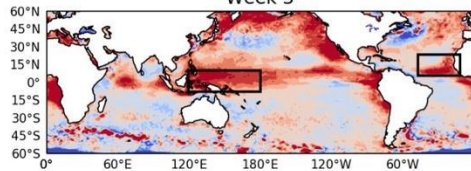
Week 1



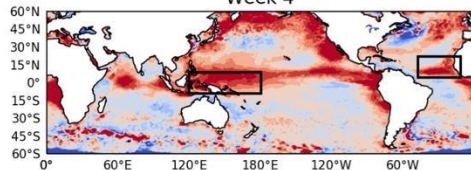
Week 2



Week 3

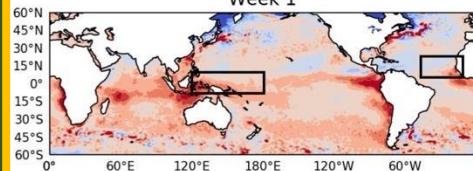


Week 4

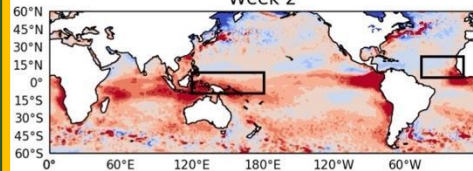


b) DJFM

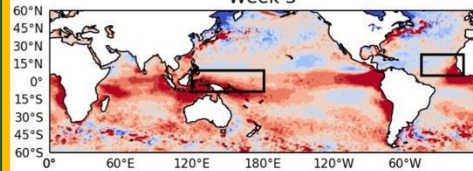
Week 1



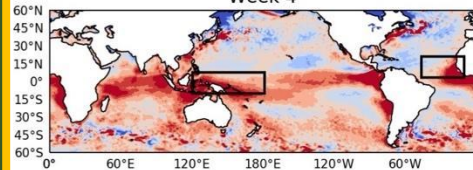
Week 2



Week 3



Week 4

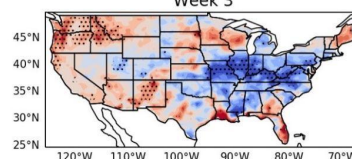


JJA

Rainfal

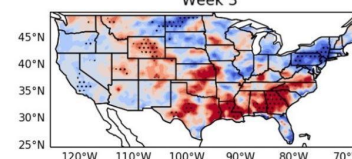
a) WP

Week 3



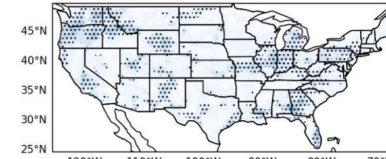
b) TNA

Week 3

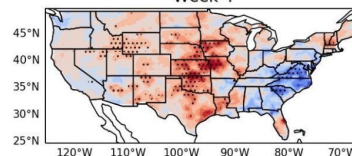


c) adj_R²

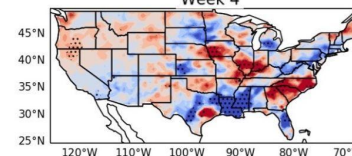
Week 3



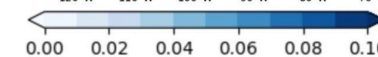
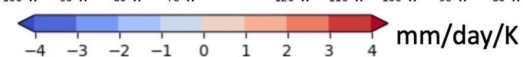
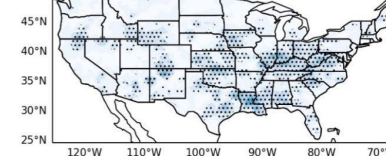
Week 4



Week 4



Week 4

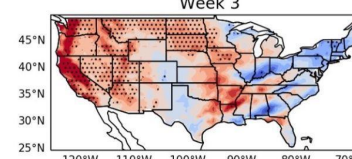


DJF

Rainfal

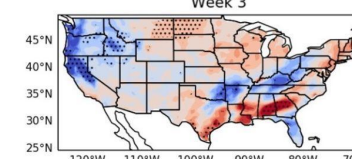
a) WP

Week 3



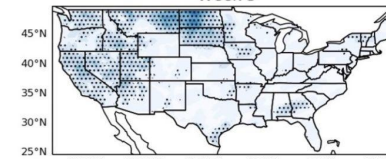
b) TNA

Week 3

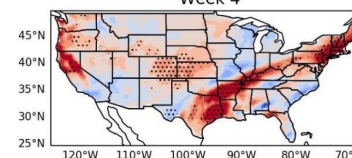


c) adj_R²

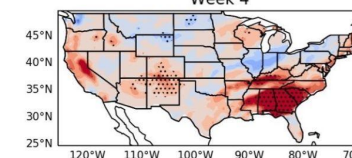
Week 3



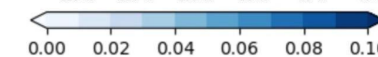
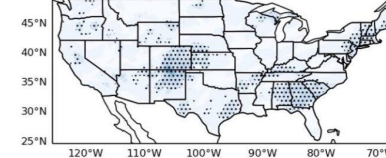
Week 4



Week 4



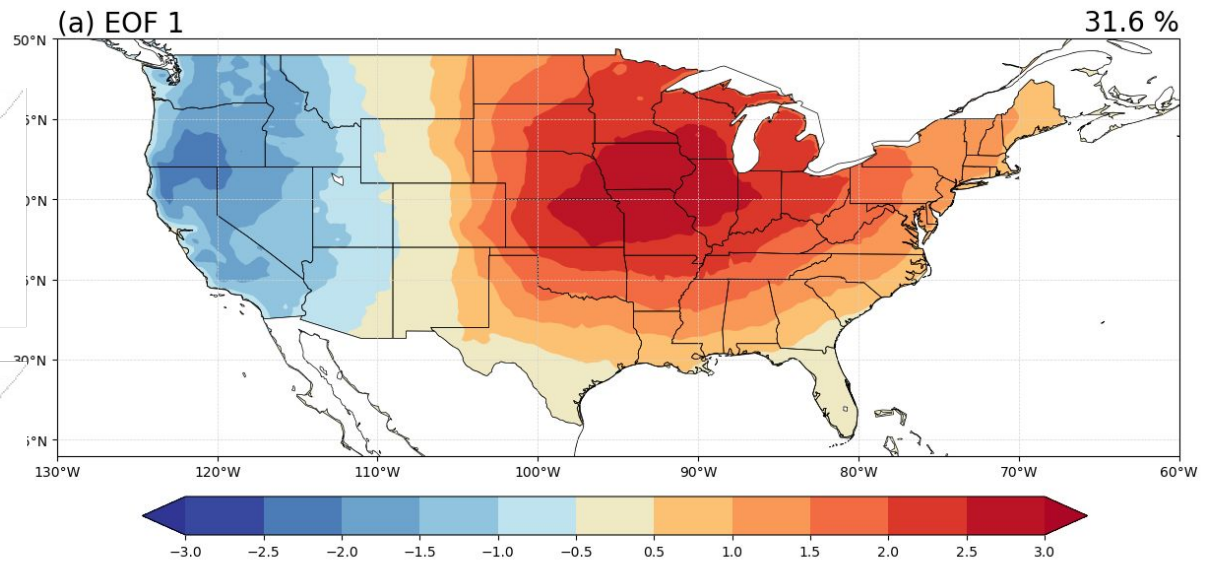
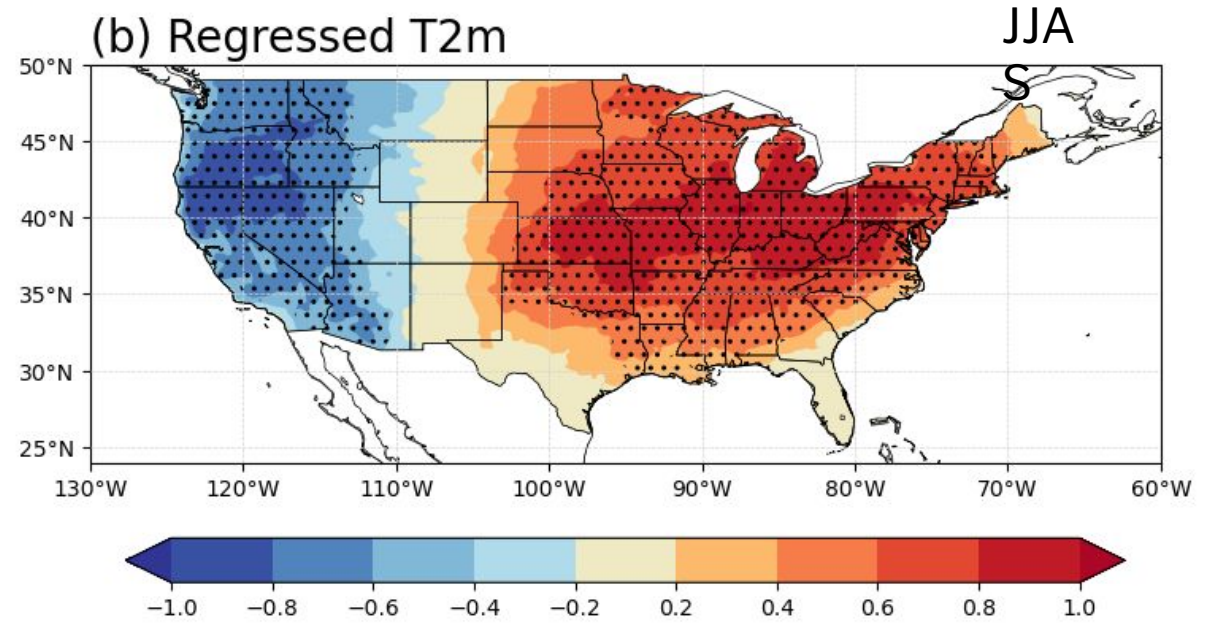
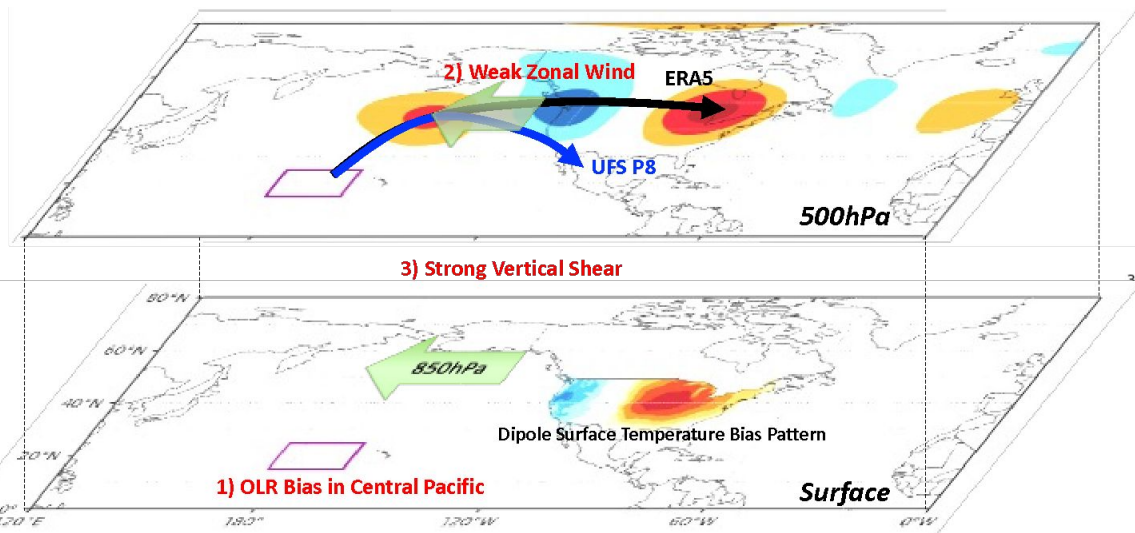
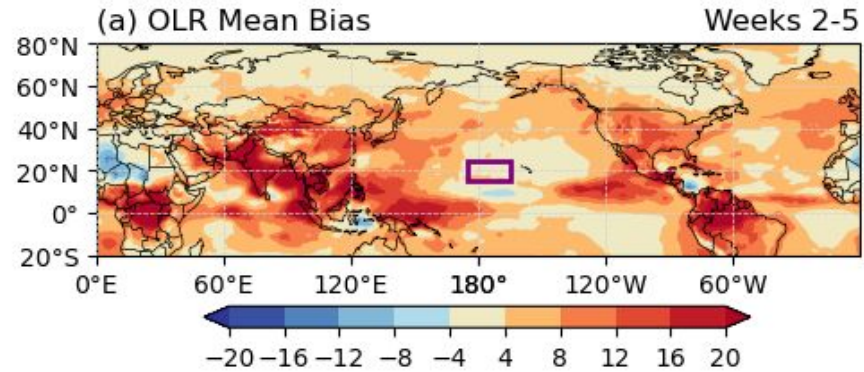
Week 4



Bai et al.,
2023

Tropical Biases

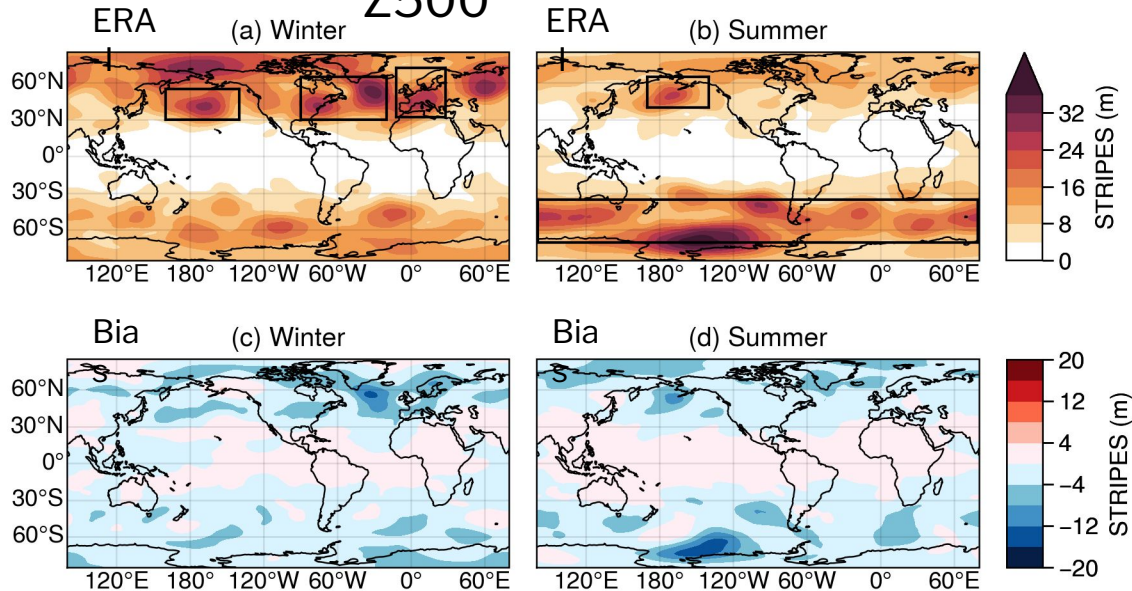
UFS



Choi and Stan,
2025

MJO Teleconnections: Tropospheric Pathway

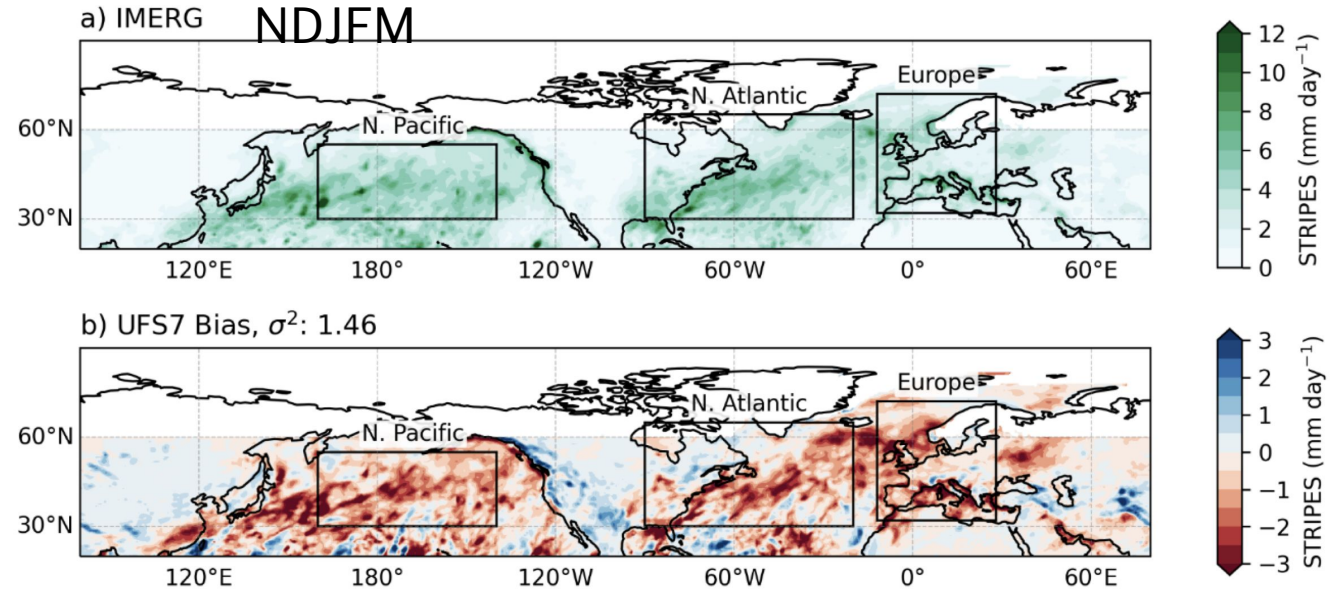
STRIPES Index for Z500



For both seasons, S2S models forecast weaker than observed teleconnection response in Z500.

Stan et al.,
2022

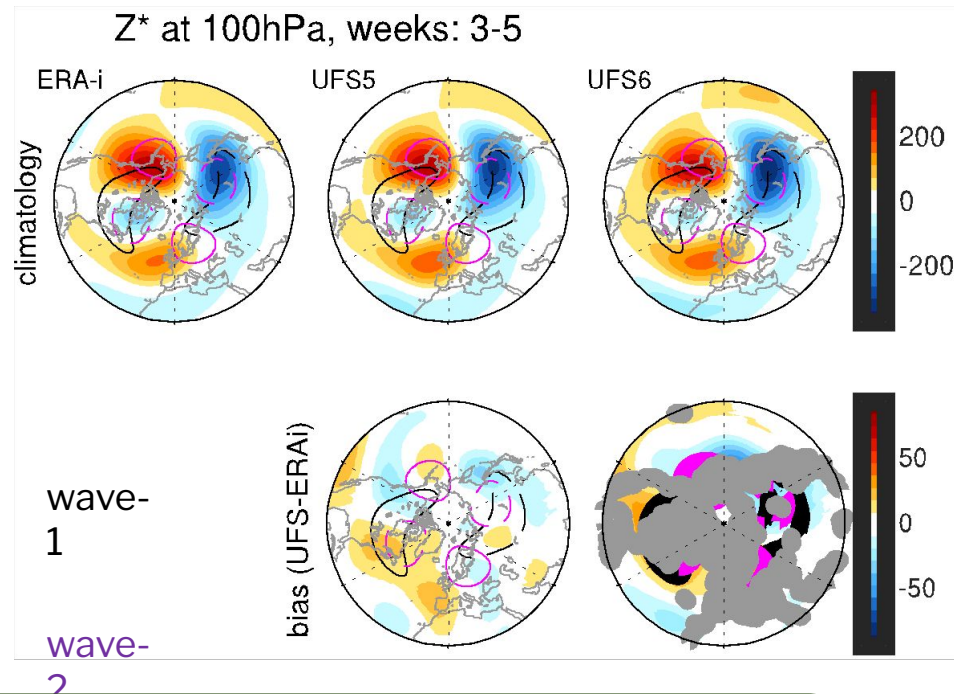
STRIPES Index for Precipitation, NDJFM



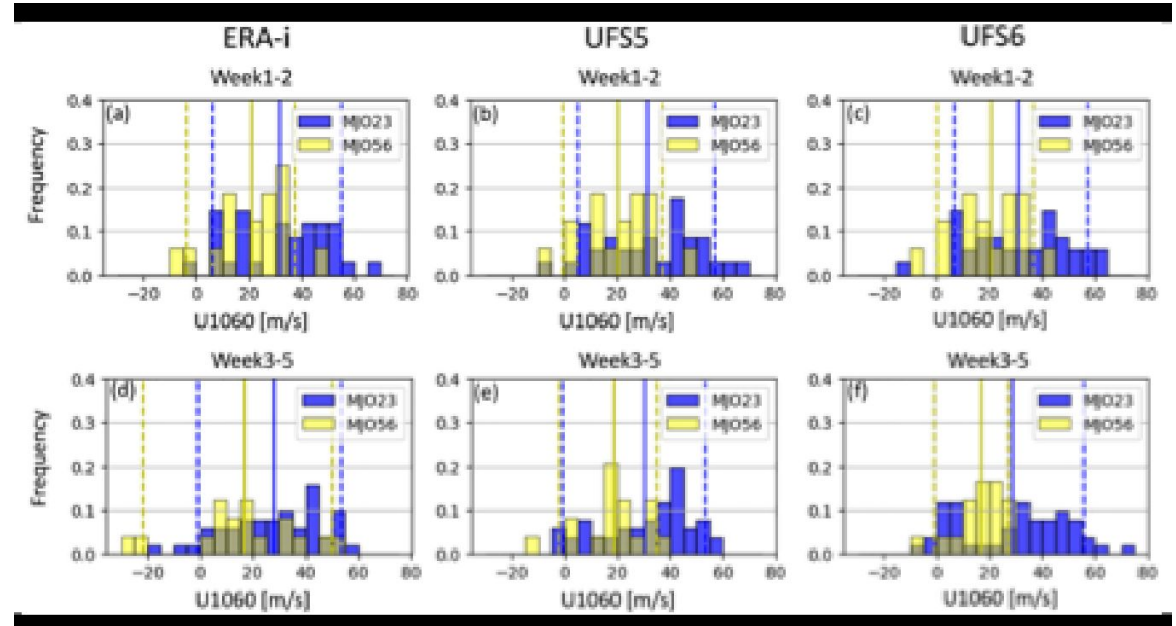
In boreal winter, the UFS model forecasts weaker than observed teleconnection response in rainfall.

Wang et al.,
2025

MJO Teleconnections: Stratospheric Pathway



UFS prototypes have biases in the stationary planetary waves in the lower stratosphere.



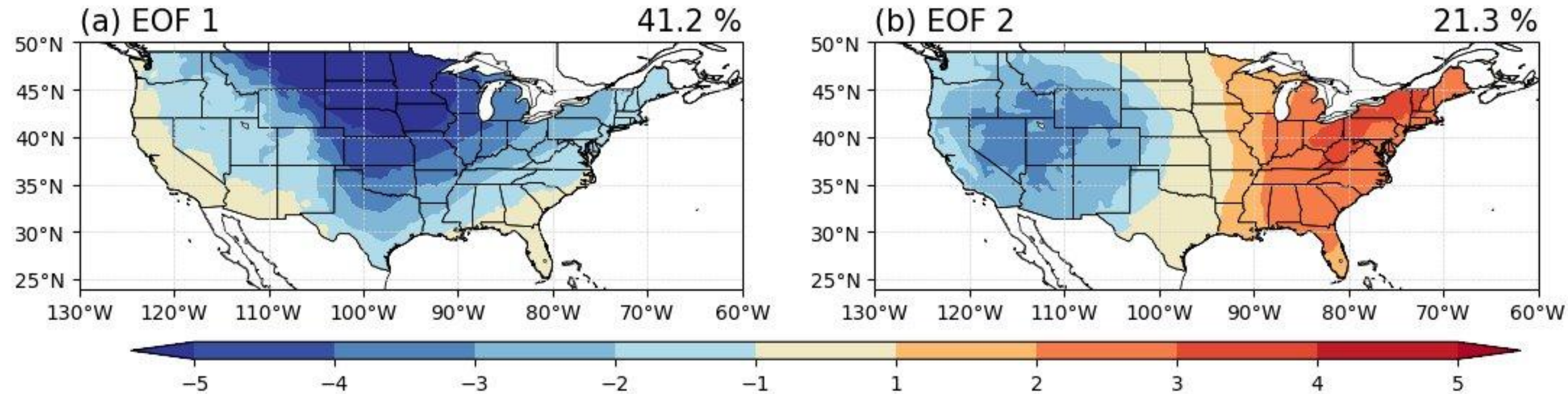
UFS prototypes predict a stronger polar vortex.

Garfinkel et al.,
2024

2025 US CLIVAR Summit
July 22, 2025

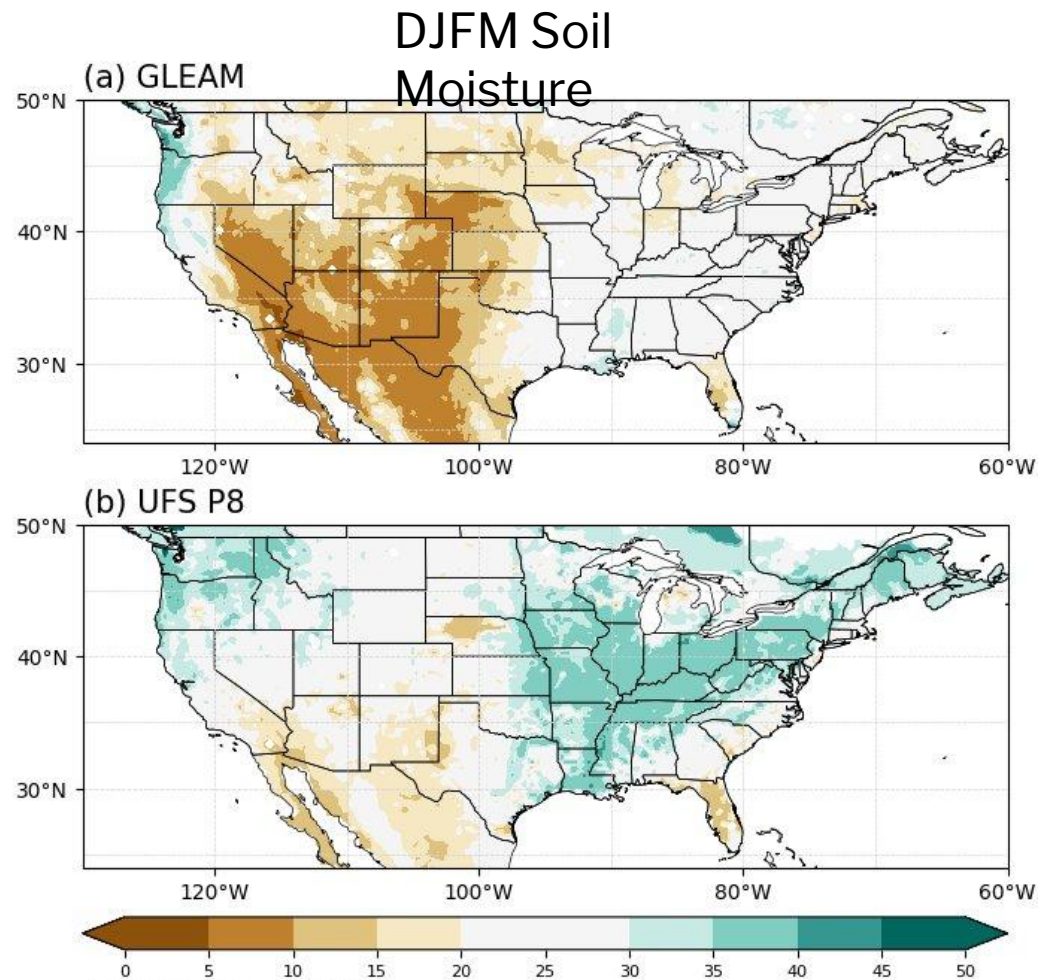
Local Land-Atmosphere Interactions

DJFM T2m
bias

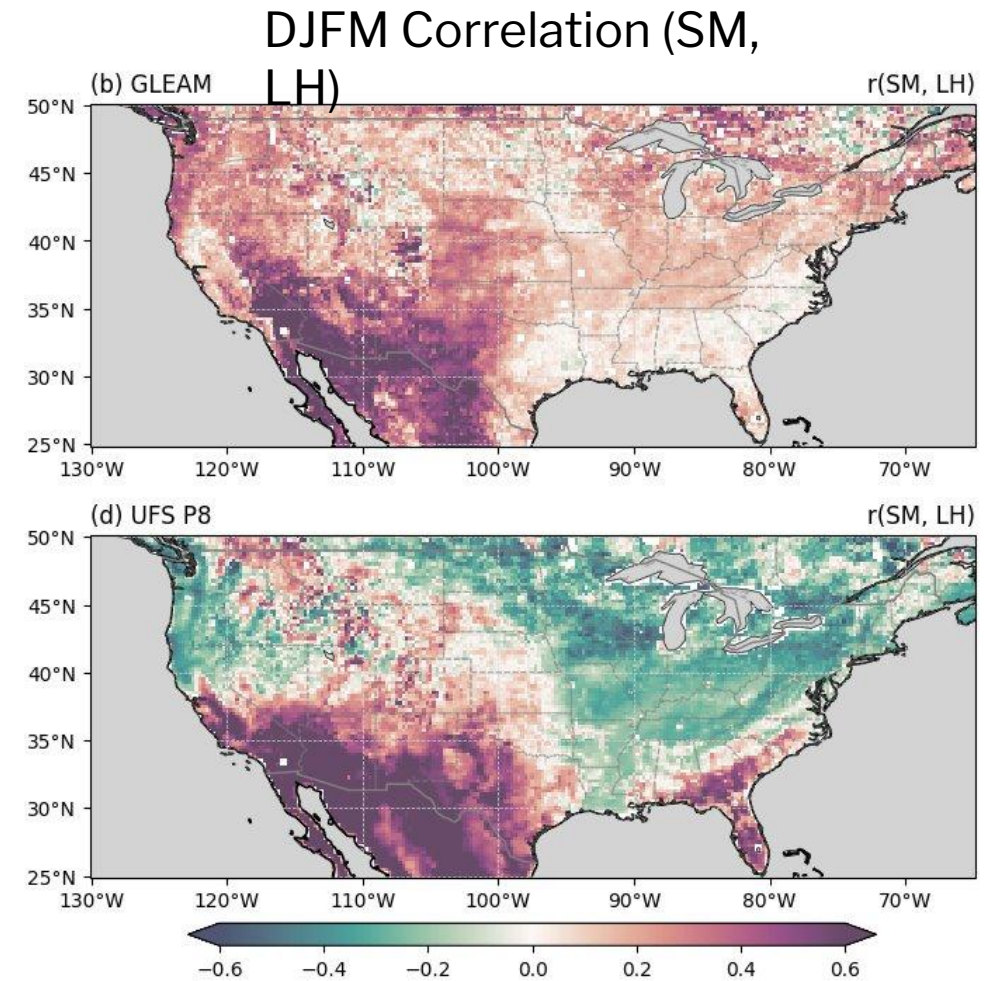


Choi et al.,
2025

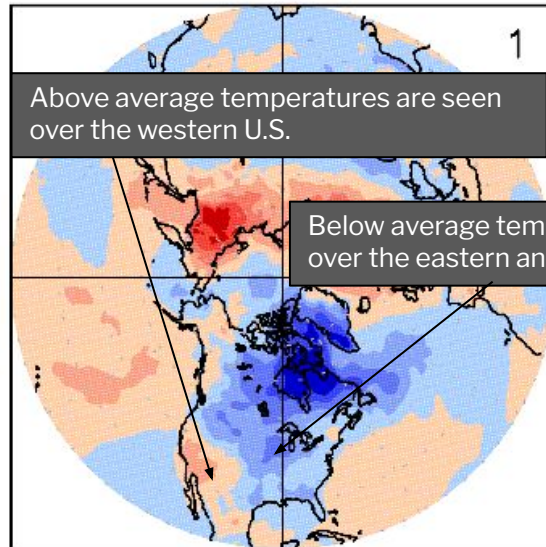
Local Land-Atmosphere Interactions



Choi et al.,
2025

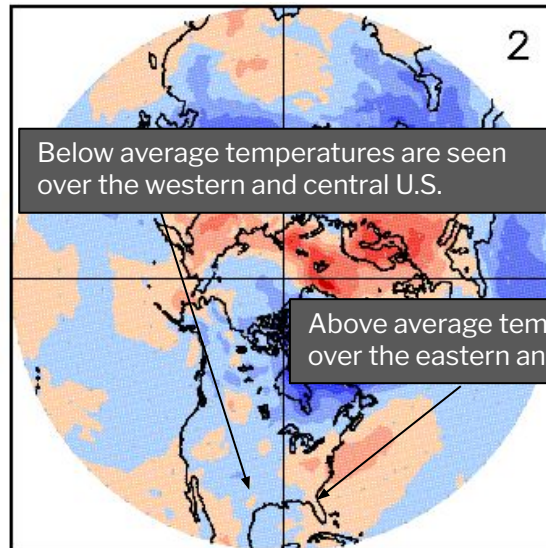
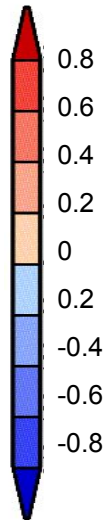


Mid-latitude Oscillations



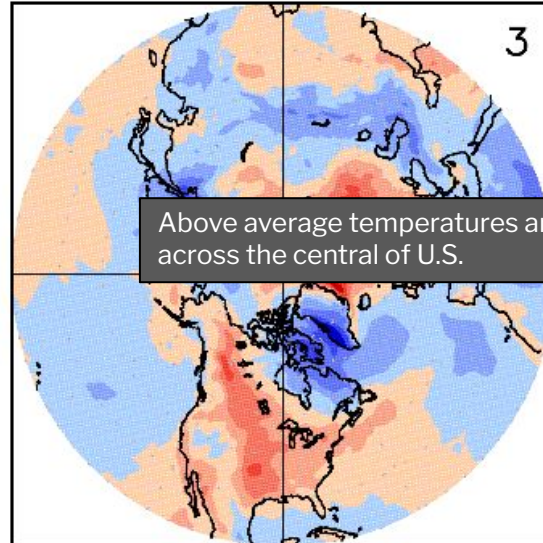
Above average temperatures are seen over the western U.S.

Below average temperatures are seen over the eastern and central U.S.

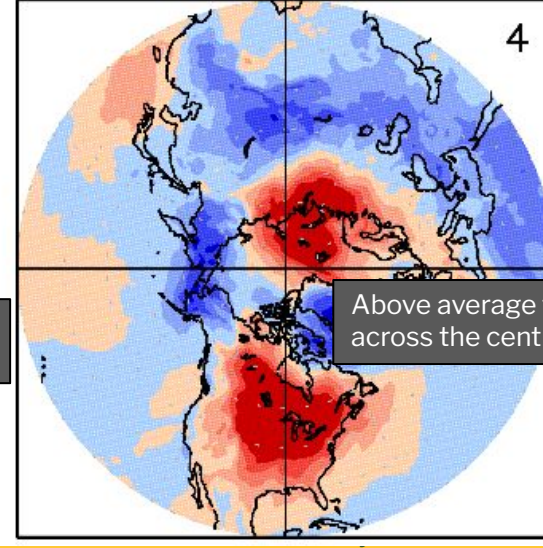
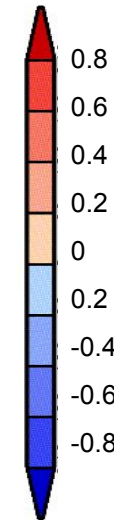


Below average temperatures are seen over the western and central U.S.

Above average temperatures are seen over the eastern and southeastern U.S.

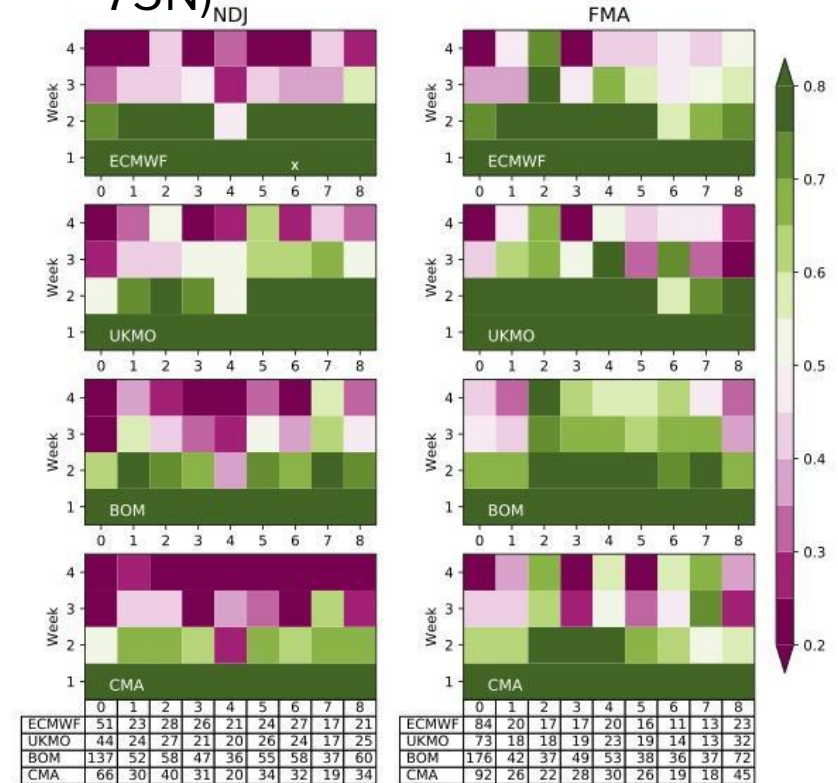


Above average temperatures are seen across the central of U.S.



Above average temperatures are seen across the central and eastern U.S.

ACC T2m averaged over (30°N-75°N)



Stan,
2022

GEORGE MA

S2S model biases affecting predictability of North American weather and climate

- Tropical SST biases (WP and NA); summer and winter precipitation
- Central Pacific OLR: summer T2m
- Upper tropospheric zonal wind: summer T2m
- Vertical wind shear: summer T2m
- MJO Teleconnections: large-scale circulation, precipitation, and T2m
- Stratospheric polar vortex and stratosphere-troposphere coupling: T2m
- Local land-atmosphere coupling: winter T2m
- Mid-latitude oscillations