

May 8th, 1:00 PM - 3:00 PM

# Extreme Precipitation Climatology of the Contiguous U.S.

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*Portland State University*

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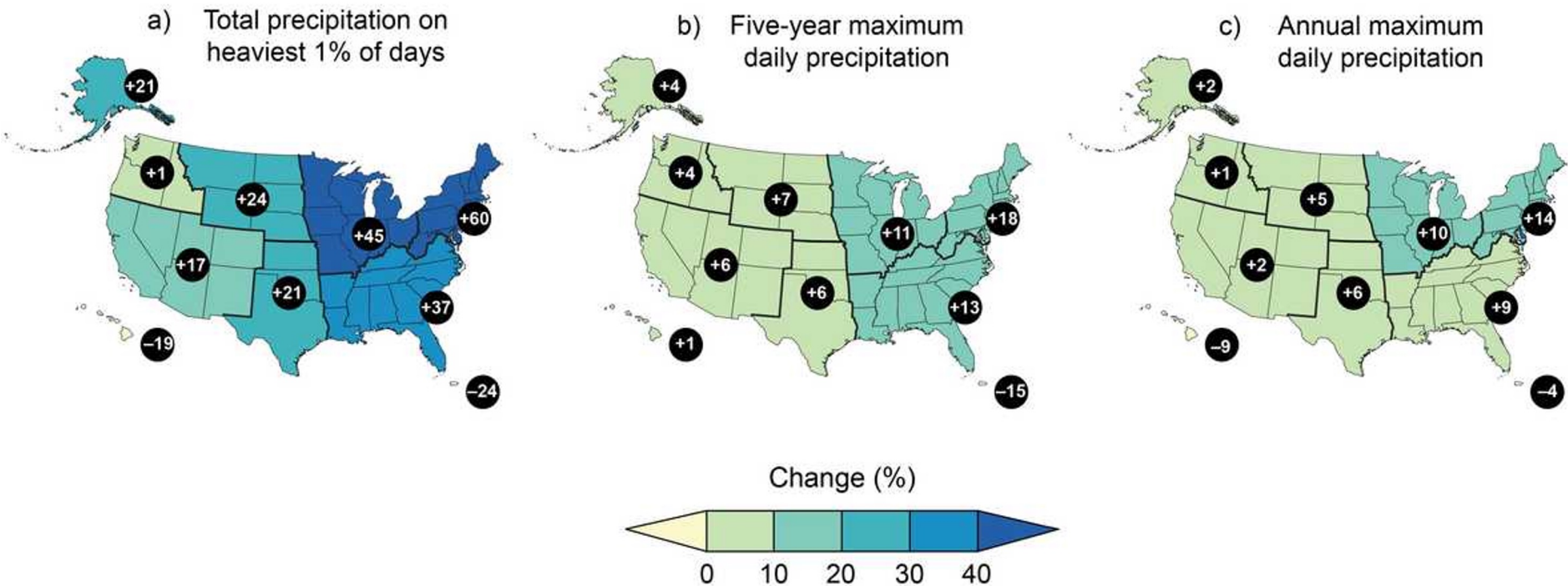
# Extreme Precipitation Climatology of the Contiguous US

Using Modern-Era Retrospective analysis for Research  
and Applications, Version 2 (MERRA-2)



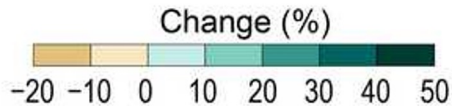
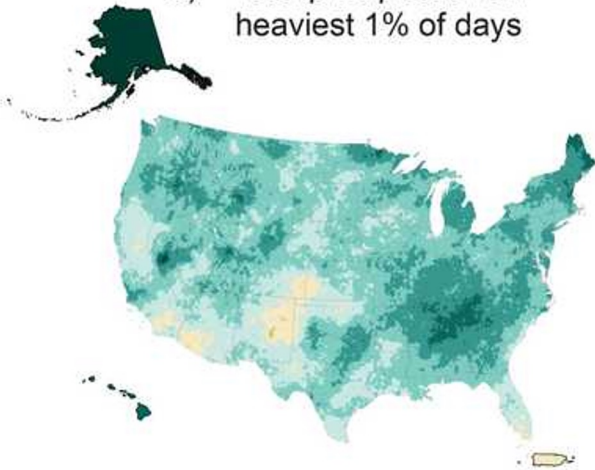
*Amy Johnson - Graduate Research Assistant*  
Portland State University Climate Science Lab  
Advisor: Dr. Paul Loikith  
Department: Geography  
May, 2024

# Observed Changes in the Frequency and Severity of Heavy Precipitation Events

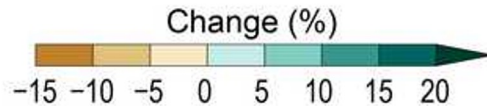
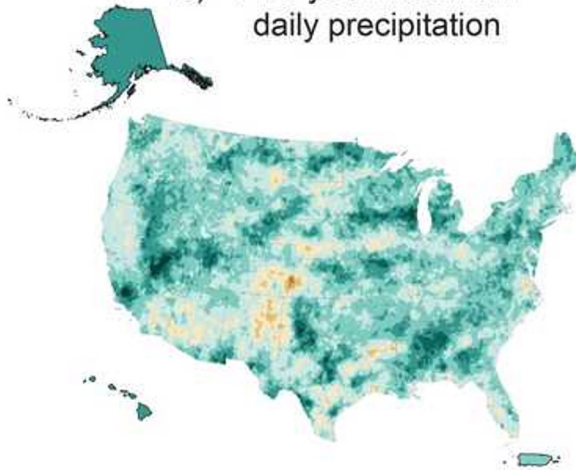


# Projected Changes to Precipitation Extremes at 2°C of Global Warming

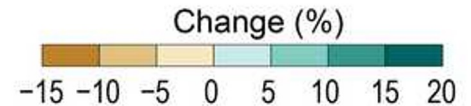
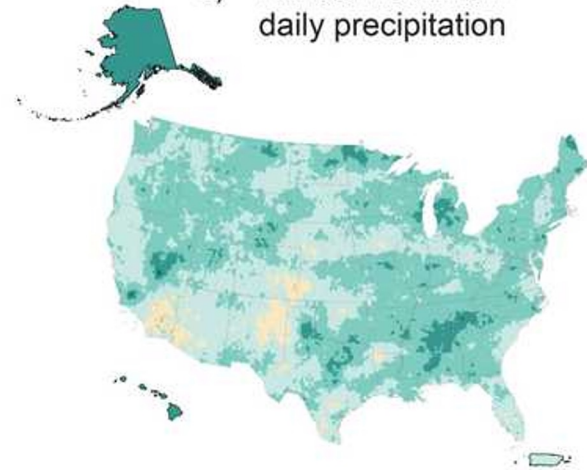
a) Total precipitation on heaviest 1% of days



b) Five-year maximum daily precipitation

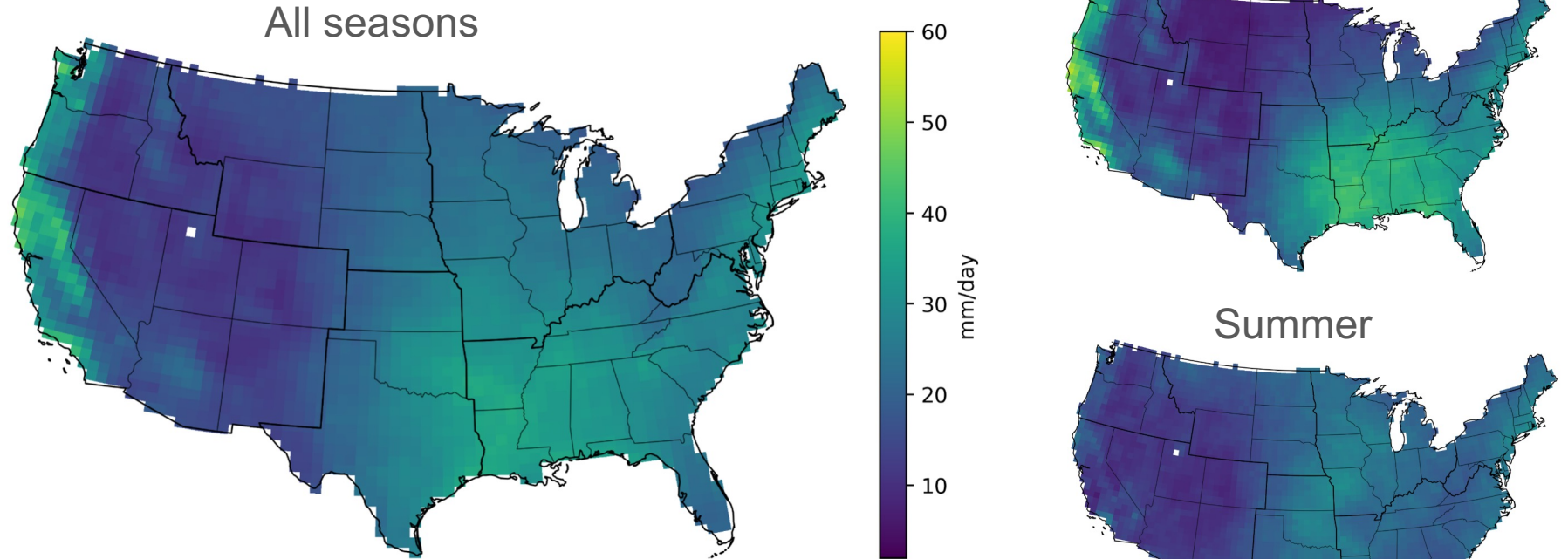


c) Annual maximum daily precipitation



# Extreme precipitation

95th percentile of daily precipitation (over 2mm)

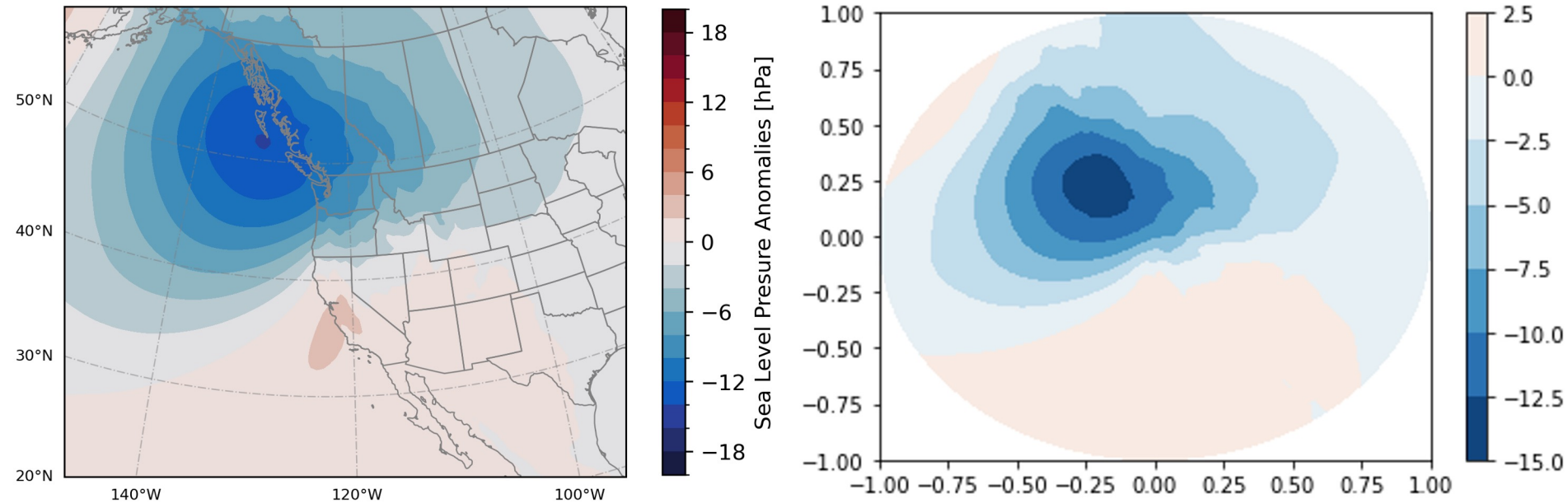


Meteorological seasons:

Winter is December, January and February (DJF); Summer is June, July and August (J

# Radial Composite Example - Portland Sea Level Pressure Anomalies

- Calculate Sea level pressure (SLP) anomalies for all days in study period
- Create composites: select days in the 95th percentile at each grid cell, average SLP anomaly values
- Interpolate values to a radial grid, a unit circle, the radius represents chosen radius (e.g. 1=4000km)
- Compute grand composite by averaging all radial composites in the CONUS
- Create regional composites
- Calculate summary statistics (repeat process for each season, and meteorological variable)

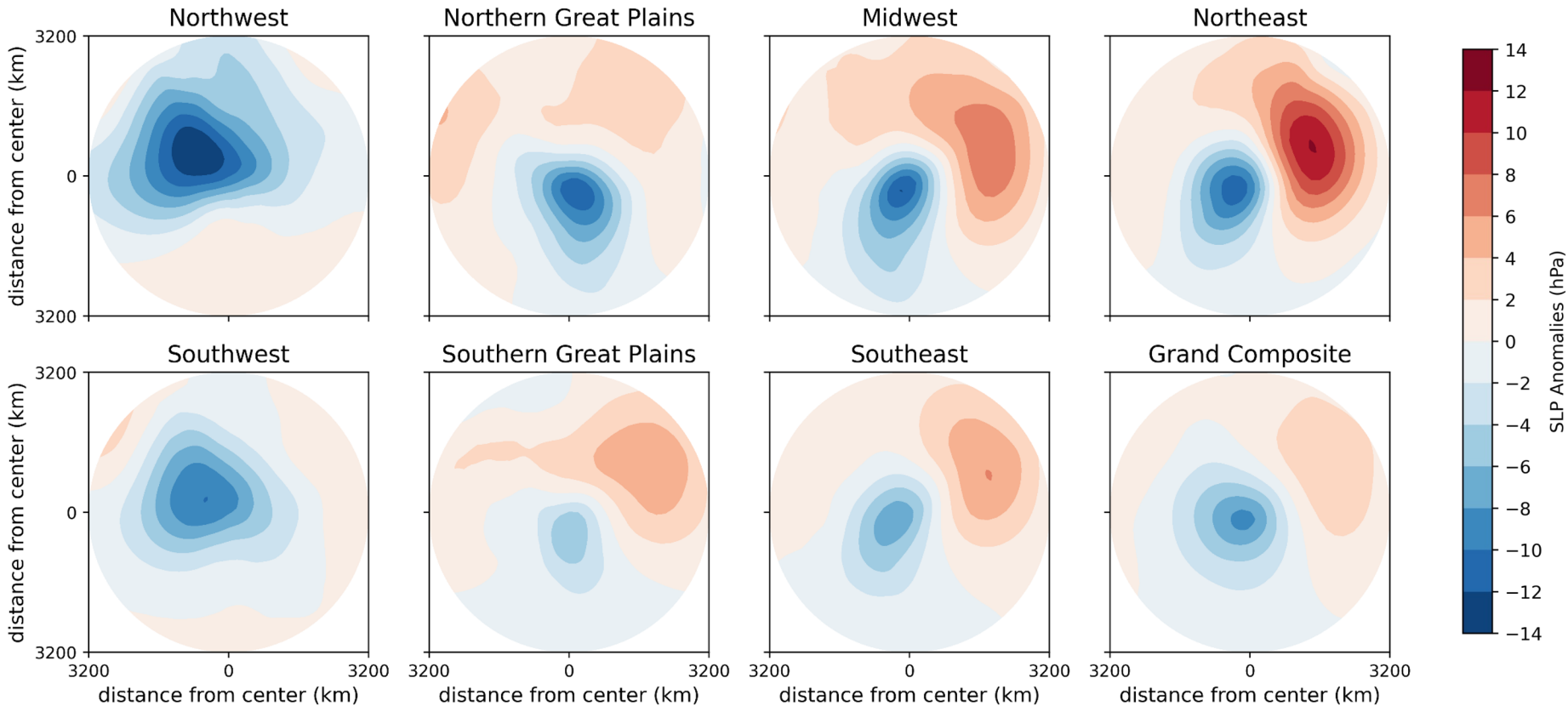




# Regional Radial Composites - SLP Anomalies

## Winter Extreme Precipitation days 1980-2023

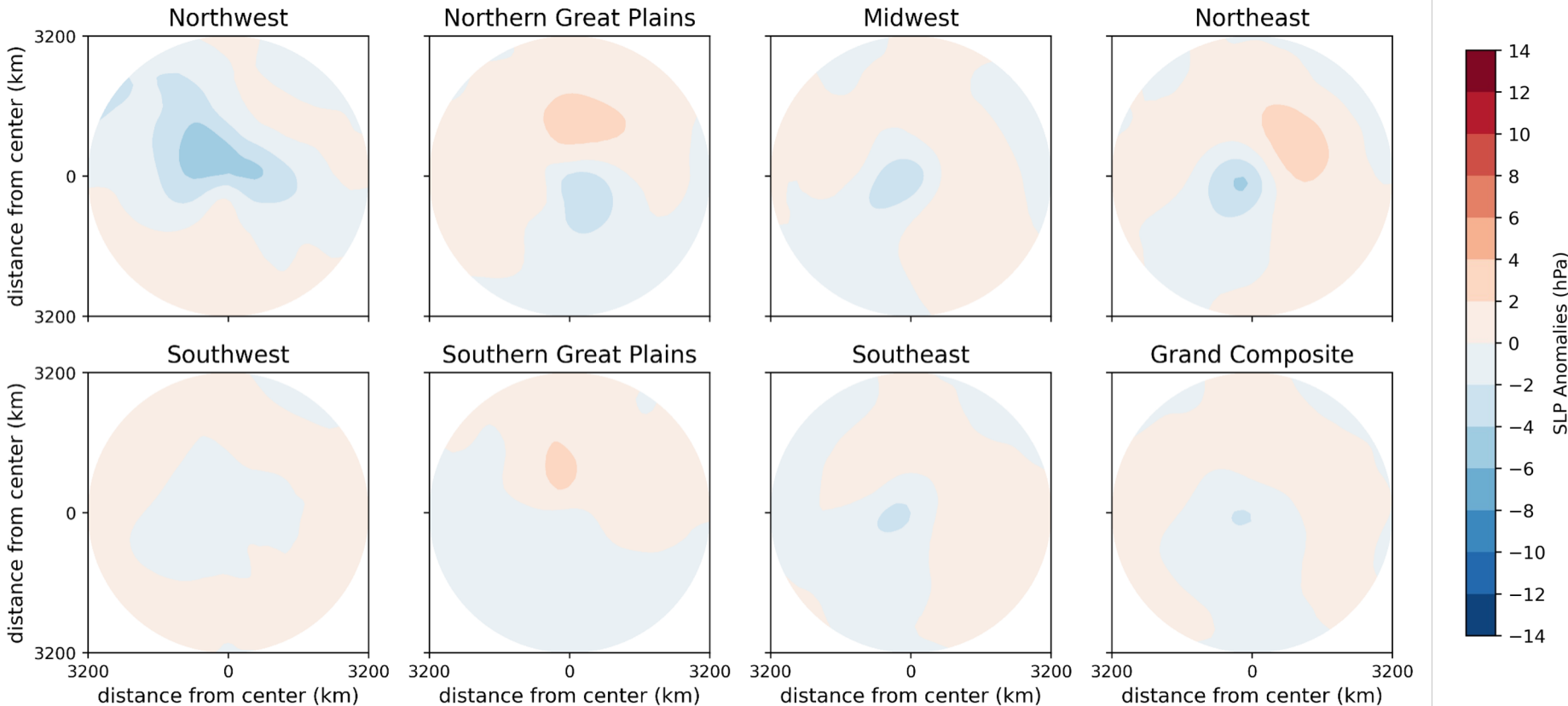
- Resemble patterns for all extreme days but intensified



# Regional Radial Composites - SLP Anomalies

## Summer Extreme Precipitation days 1980-2023

- Patterns altered and weaker





# Seasonal Grand Composites SLP Anomalies

# Root Mean Square Difference Grid cell pattern similarity to grand composite

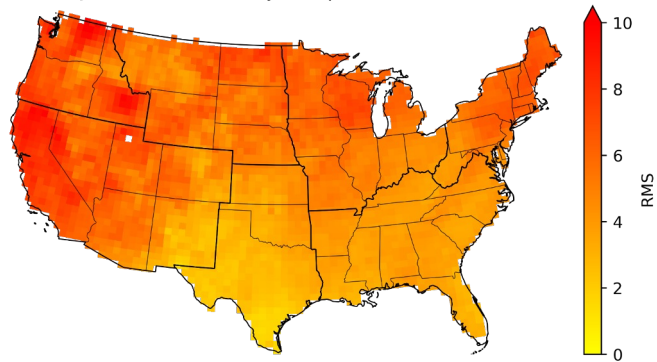
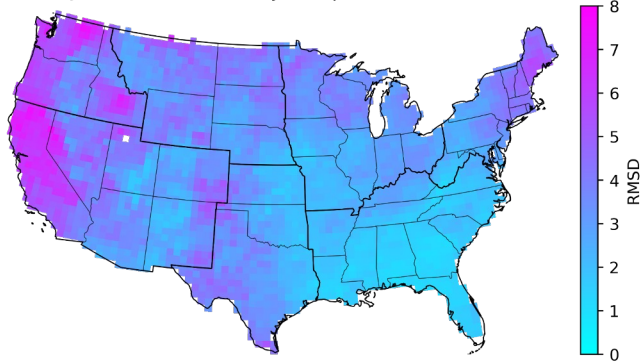
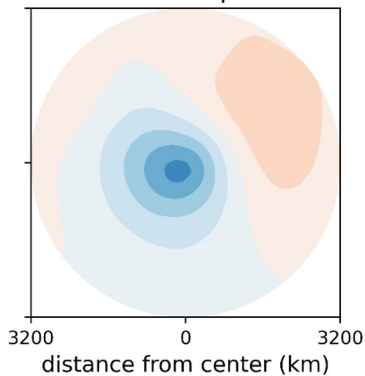
# Root Mean Square Grid cell pattern strength

Grand Composite

DJF RMSD SLP Anomaly Composites 1980-2023

DJF RMS SLP Anomaly Composites 1980-2023

Winter

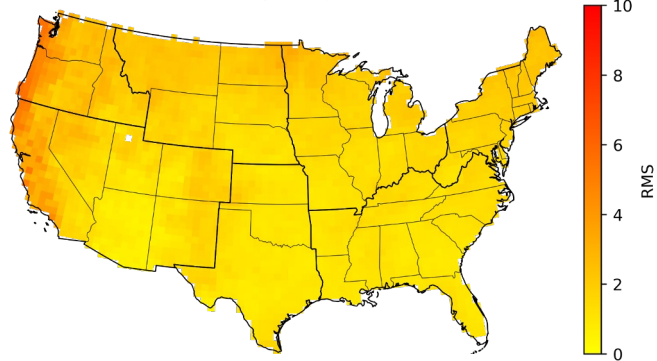
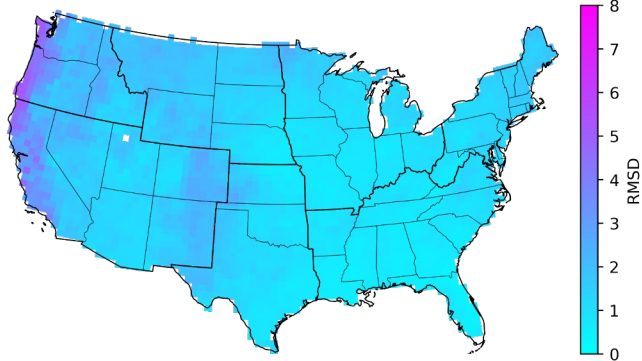
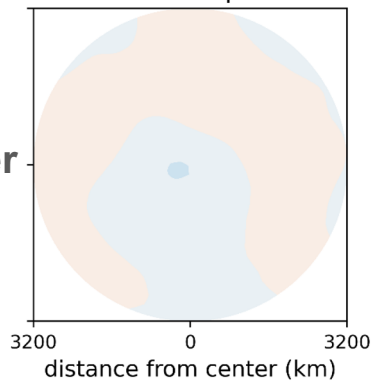


Grand Composite

JJA RMSD SLP Anomaly Composites 1980-2023

JJA RMS SLP Anomaly Composites 1980-2023

Summer



# Summary Conclusions

- Study will compute synoptic scale extreme precipitation climatology for 1980-2023 using MERRA-2 data, including key diagnostic meteorological variables to study the weather that drives extreme precipitation
- Regional and seasonal patterns exist, for sea level pressure anomalies winter patterns are intensified summer patterns are weaker and altered
- Results could be used to examine how well climate models simulate the weather that drives extreme precipitation in historic runs and examine changes to patterns or pattern frequency in model projections

# Acknowledgements



Support for this work was provided by the National Aeronautics and Space Administration (NASA) Modeling Analysis and Prediction Program award 80NSSC21K1501

Thank you to my advisor Dr. Paul Loikith and my lab mates in the Climate Science Lab

Thank you to Dmitri Kalashnikov PhD, UC Merced, NSF postdoc fellow and former Climate Science Lab member for radial interpolation code

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Portland State University Climate Science Lab - Geography Department

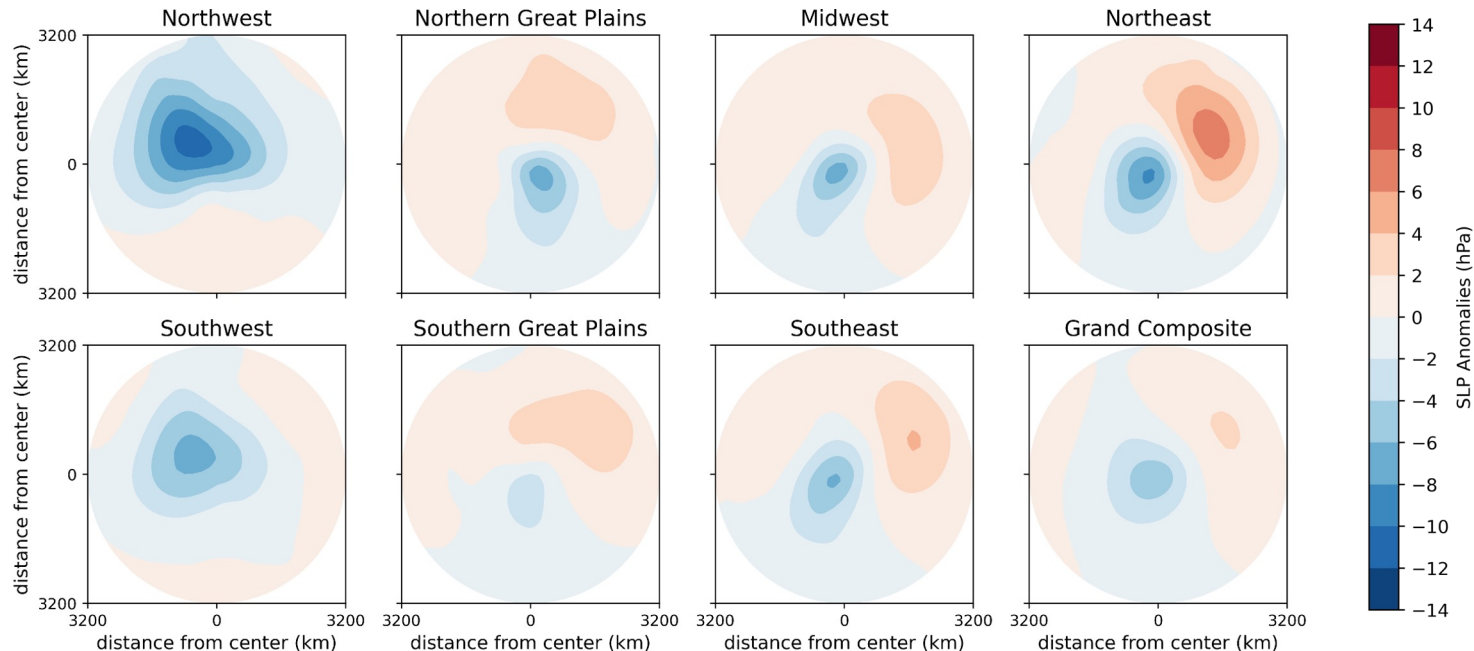
# Regional Radial Composites

Extreme Precipitation days

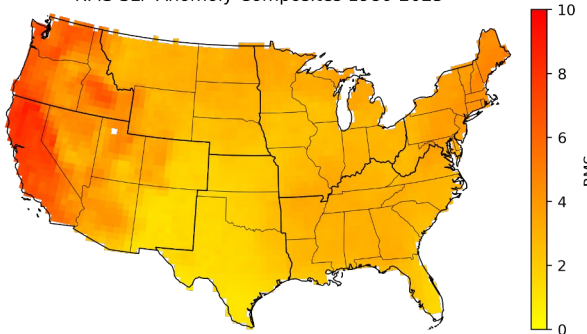
1980-2023

## SLP Anomalies

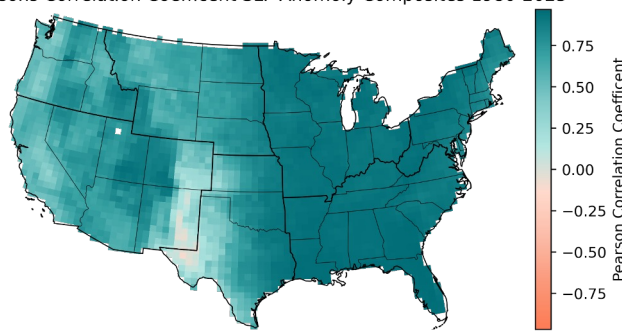
Regional composites 1980-2023



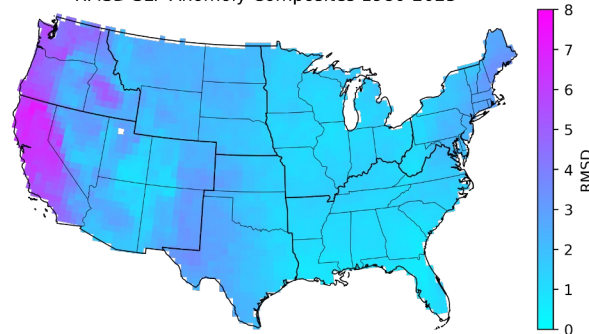
RMS SLP Anomaly Composites 1980-2023



Pearsons Correlation Coefficient SLP Anomaly Composites 1980-2023



RMSD SLP Anomaly Composites 1980-2023



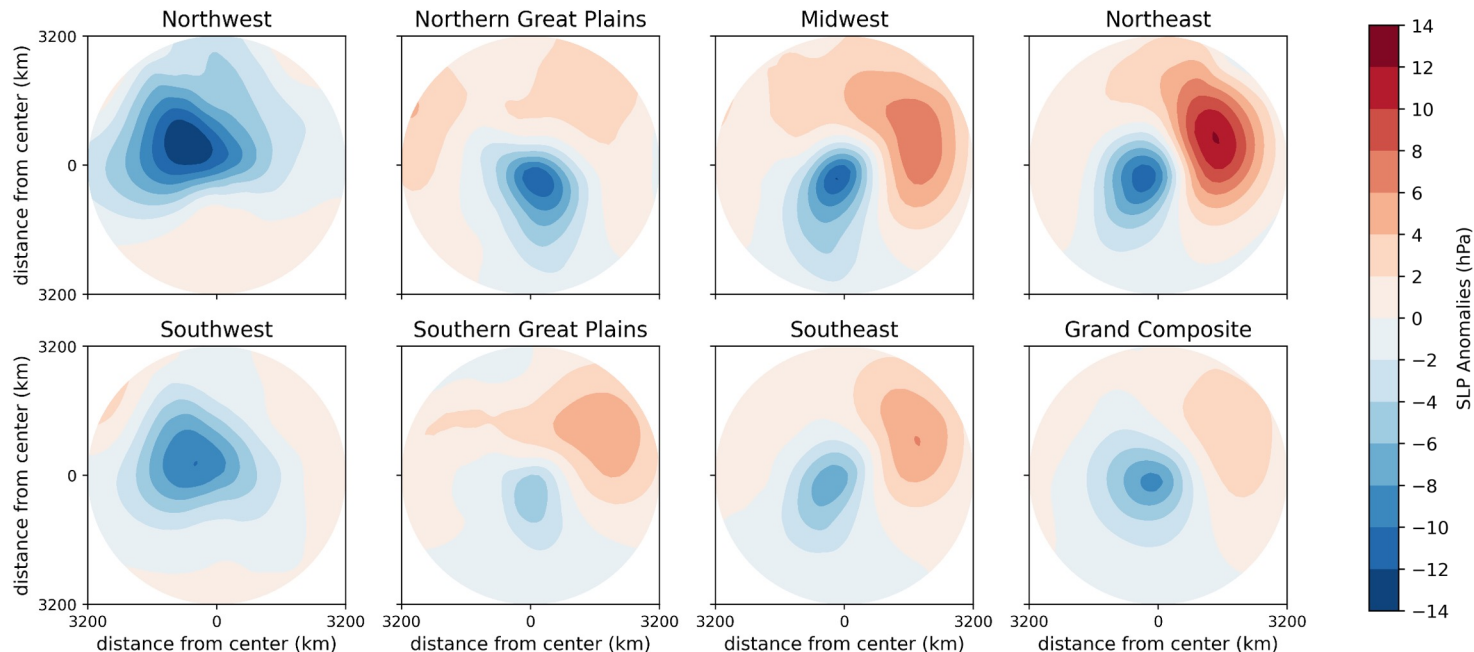
# Regional Radial Composites

Winter Extreme Precipitation days

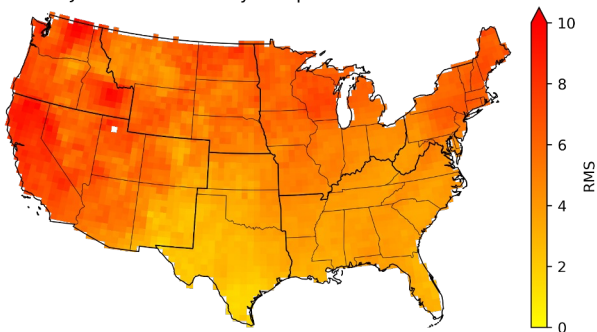
1980-2023

# SLP Anomalies

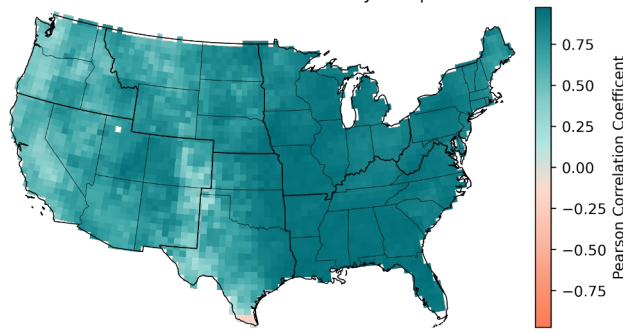
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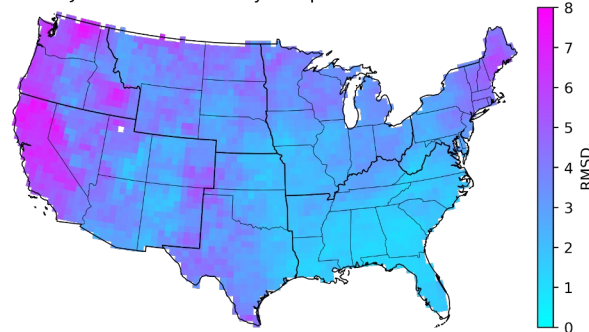
### DJF RMS SLP Anomaly Composites 1980-2023



### DJF Pearson's Correlation Coefficient SLP Anomaly Composites 1980-2023



### DJF RMSD SLP Anomaly Composites 1980-2023



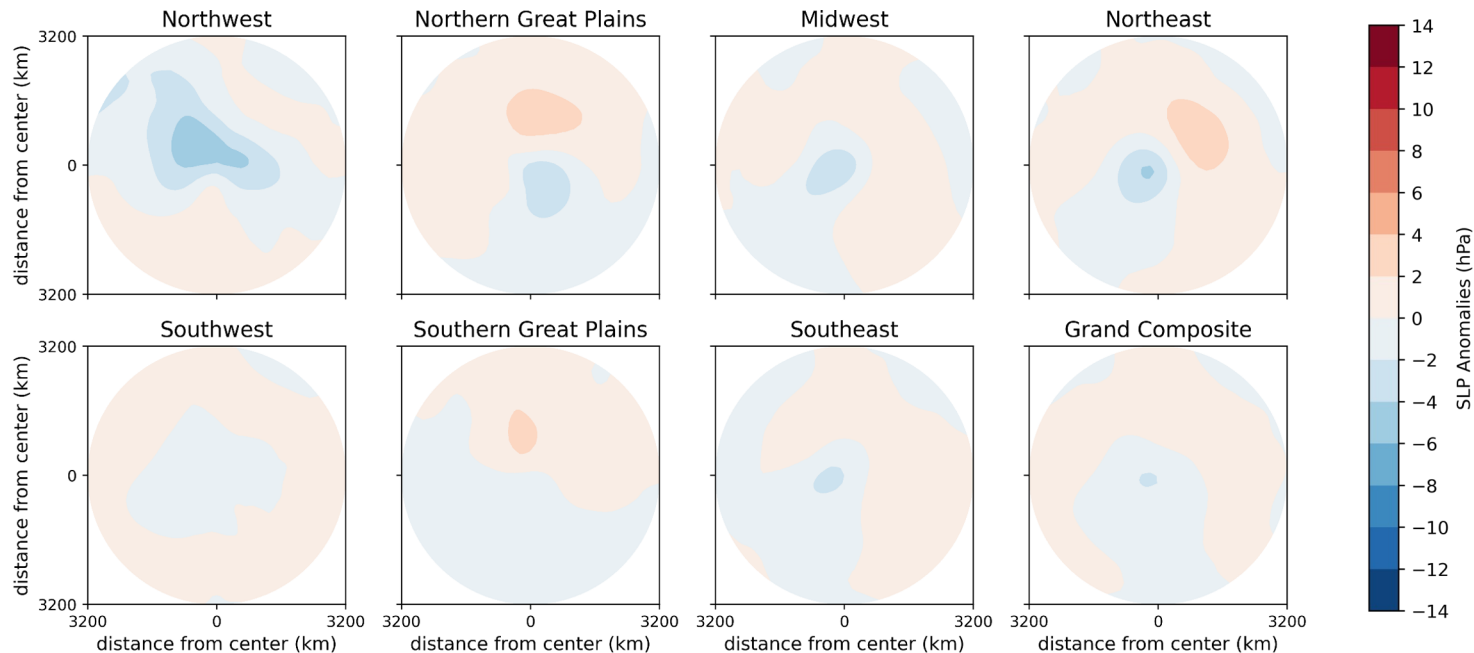
# Regional Radial Composites

Summer Extreme Precipitation days

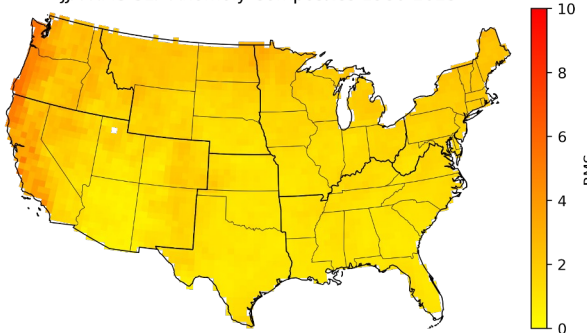
1980-2023

## SLP Anomalies

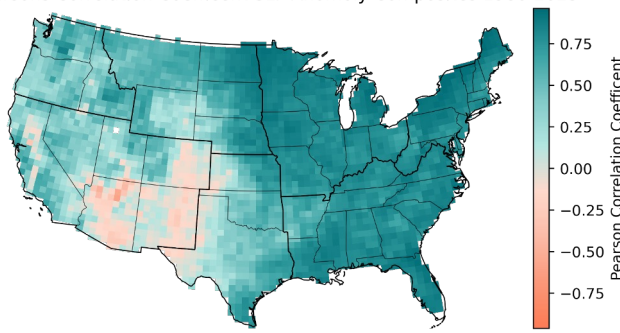
### JJA Regional composites 1980-2023



### JJA RMS SLP Anomaly Composites 1980-2023



### JJA Pearson's Correlation Coefficient SLP Anomaly Composites 1980-2023



### JJA RMSD SLP Anomaly Composites 1980-2023

