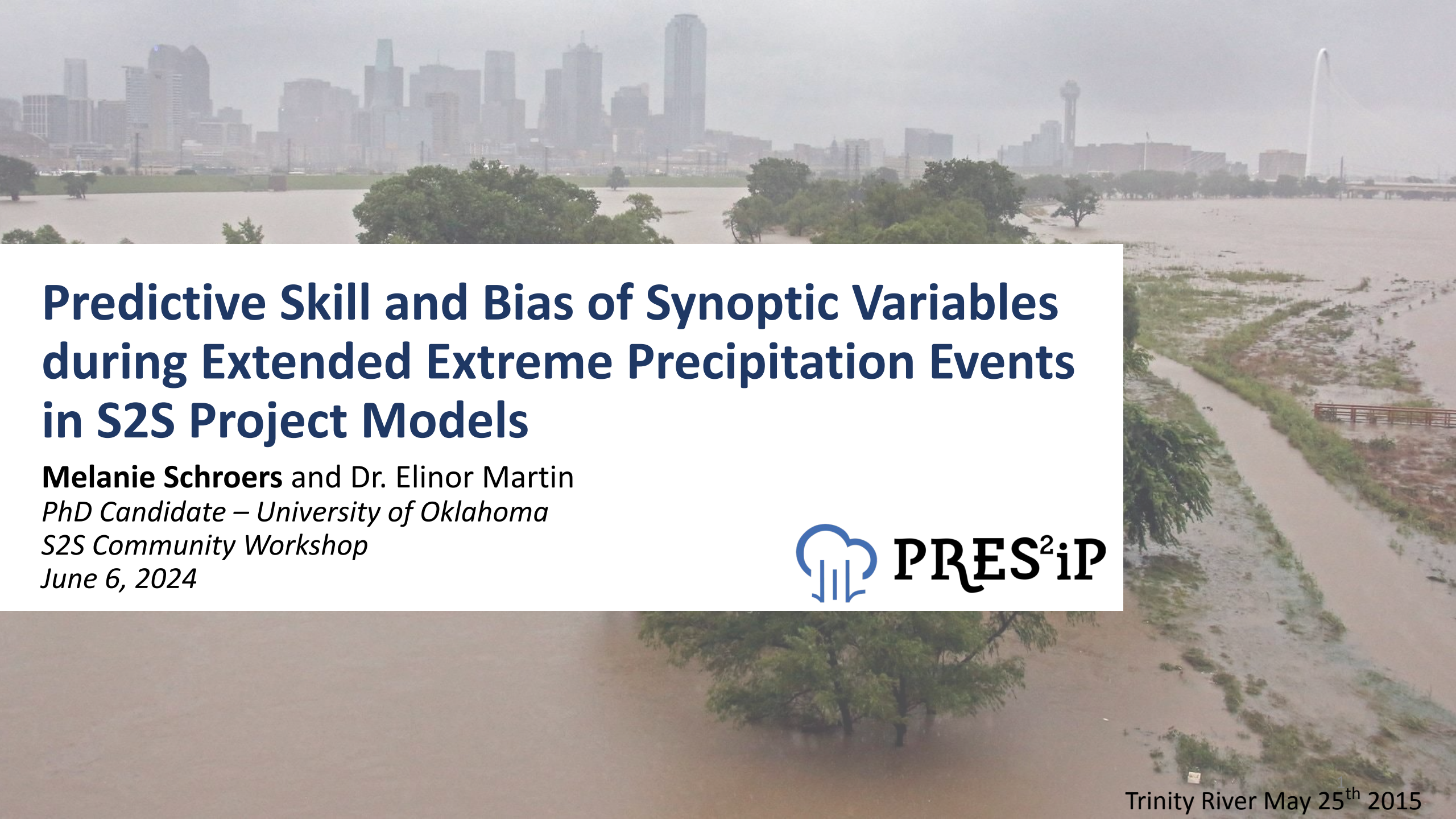

Predictive Skill and Bias of Synoptic Variables during Extended Extreme Precipitation Events in S2S Project Models

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PhD Candidate – University of Oklahoma
S2S Community Workshop
June 6, 2024

PRES²iP

Trinity River May 25th 2015

14-day Extreme Precipitation Period Database

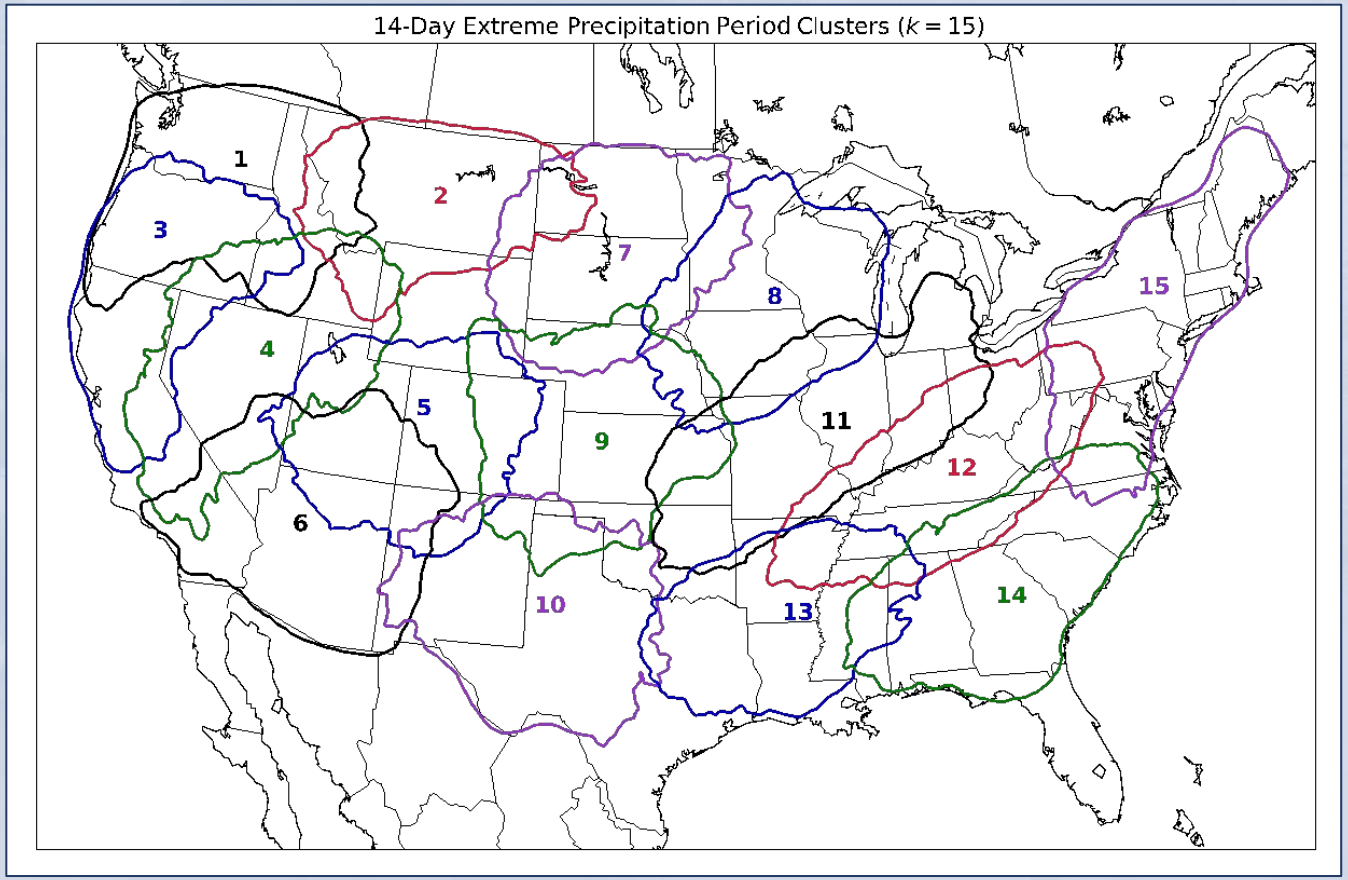
- 14-day extreme period database (Dickinson et al. 2021)
- January 1915 – December 2018
- 851 total events
- 15 clusters

Thresholds:

✔ Observed 14-day precip ≥ 14-day 99th percentile

✔ At least 7 days must receive precip ≥ long-term daily mean

✔ Area ≥ 200,000km^2



Verification of Synoptic Variables

Why Synoptic Variables?

- Prediction skill of Precipitation in S2S models is low or near zero beyond Week 2 (Pan et al. 2019, Becker et al. 2020, McAfee et al. 2023)
- Geopotential Height and Specific Humidity together were shown to be a potentially skillful predictor (Schroers and Martin 2020)
- Statistically postprocessing model output has been shown to increase skill of precipitation process (Gagne et al. 2014, Hill and Schumacher 2021).

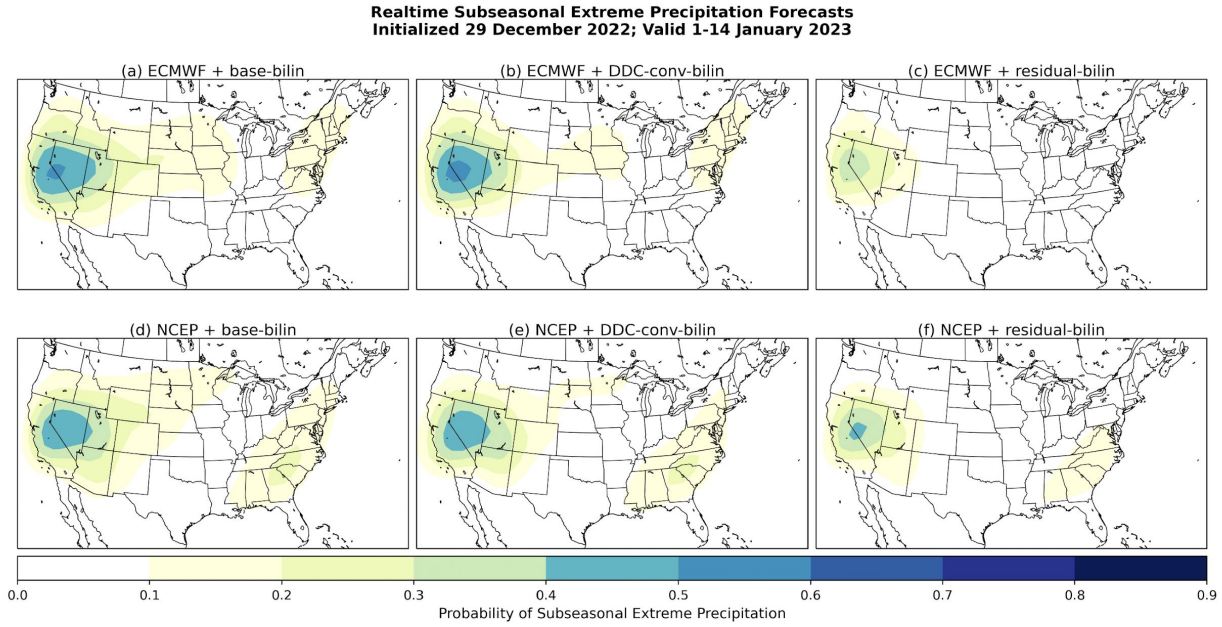


Figure 6.20: Realtime forecasts initialized on 29 December 2022 from (a-c) ECMWF and (d-f) NCEP subseasonal models valid for 1-14 January 2023. The dynamical forecasts were input into the (a,c) base-bilin, (b,d) DDC-conv-bilin, and (c,e) residual-bilin U-Nets.

Dickinson 2023

Verification

Verifying the ensemble averages of the extreme periods 14-day averaged forecasted anomalies against ERA5 observations.

Models used:

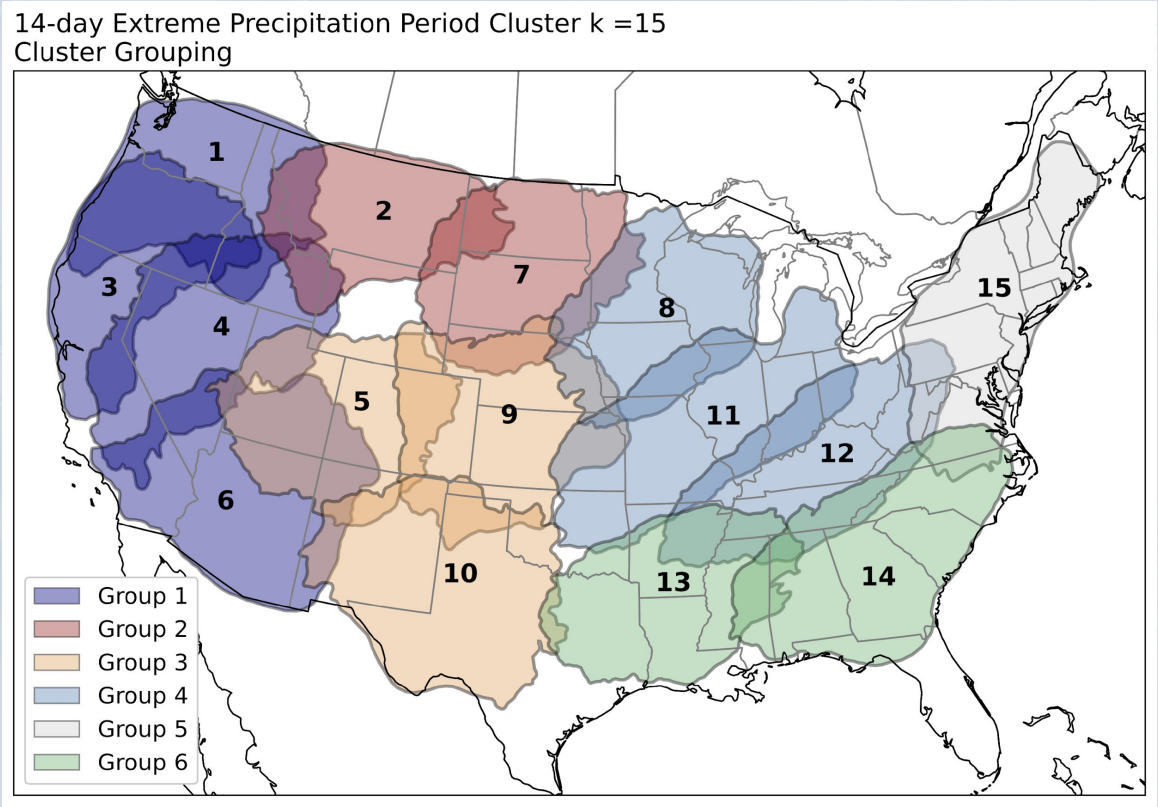
- ECMWF, UKMO, CNRM

Common Period:

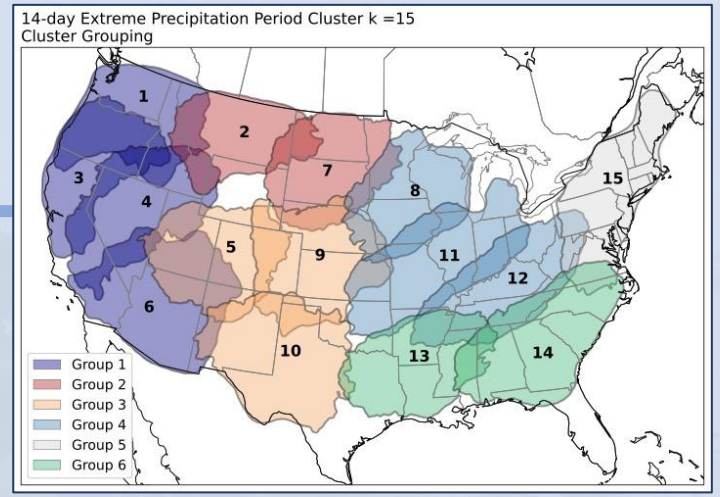
- 1996 – 2014

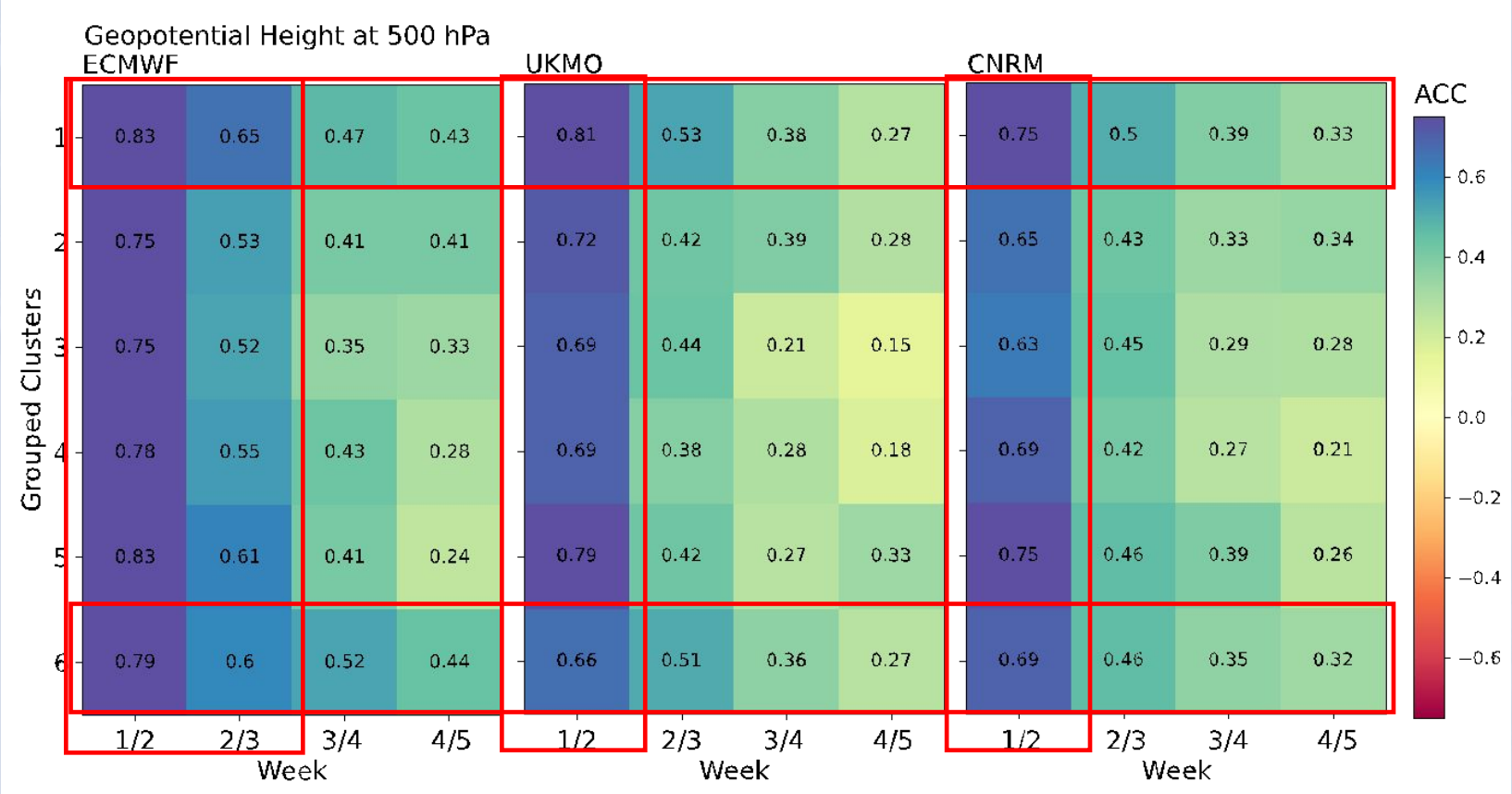
Variables verified:

- 500 hPa Geopotential Height (CONUS domain)
- 700 hPa Specific Humidity (group domain)
- 850 hPa Specific Humidity (group domain)

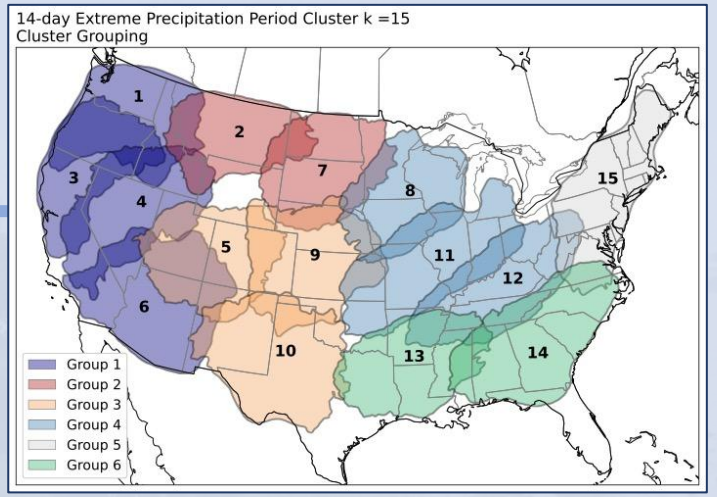


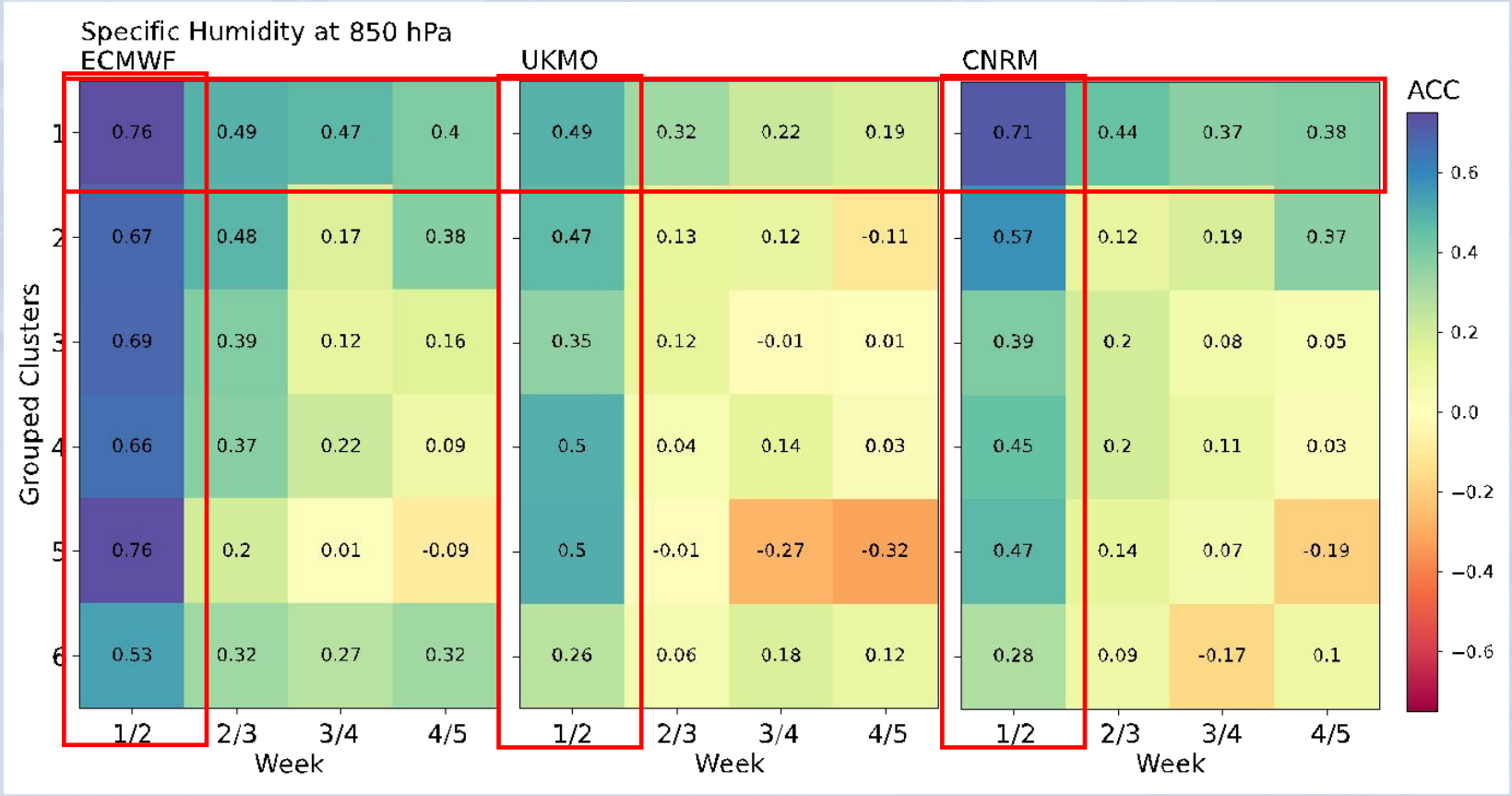
Verification – 500 hPa GPH



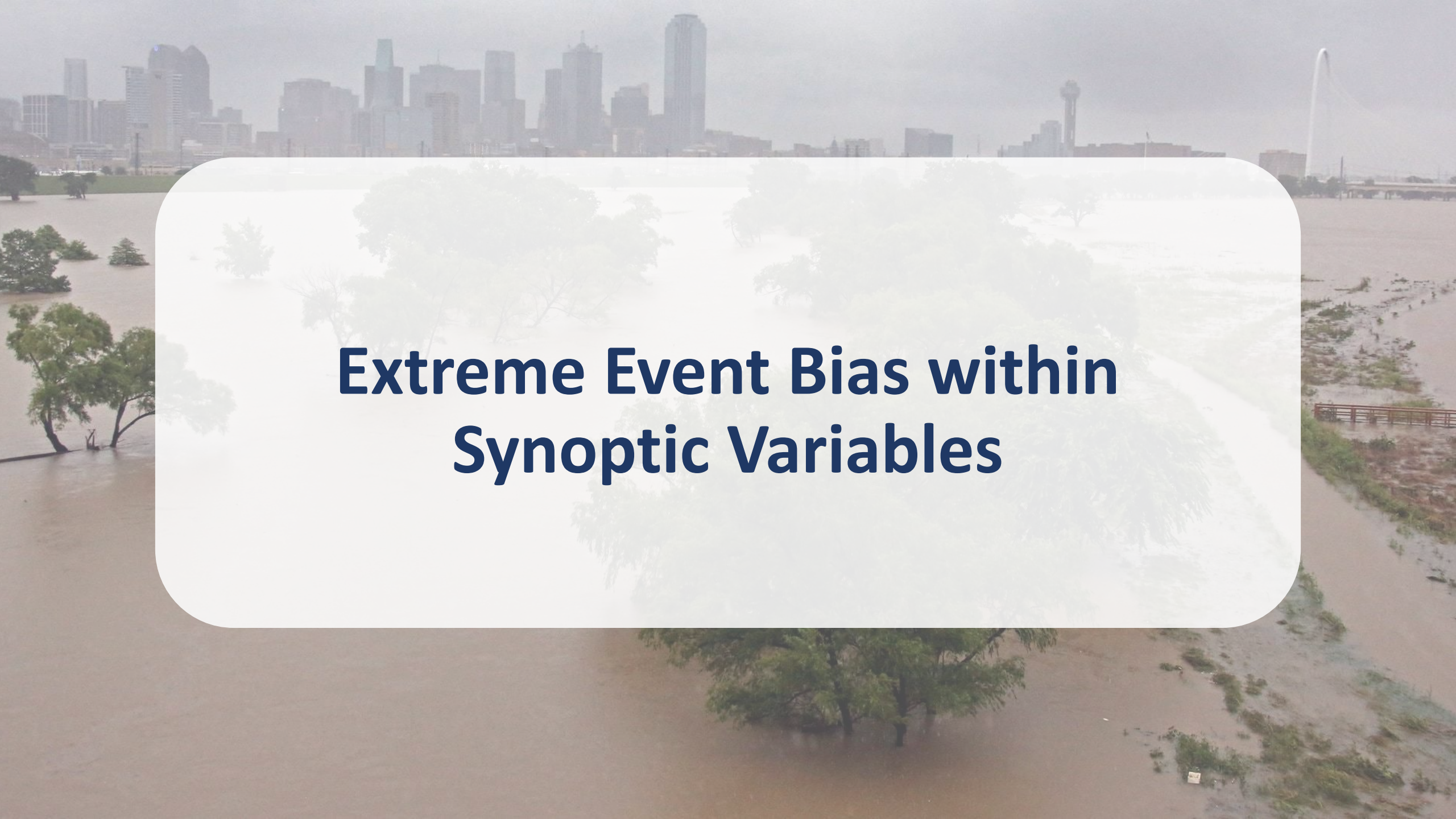


Verification – 850hPa Spechum





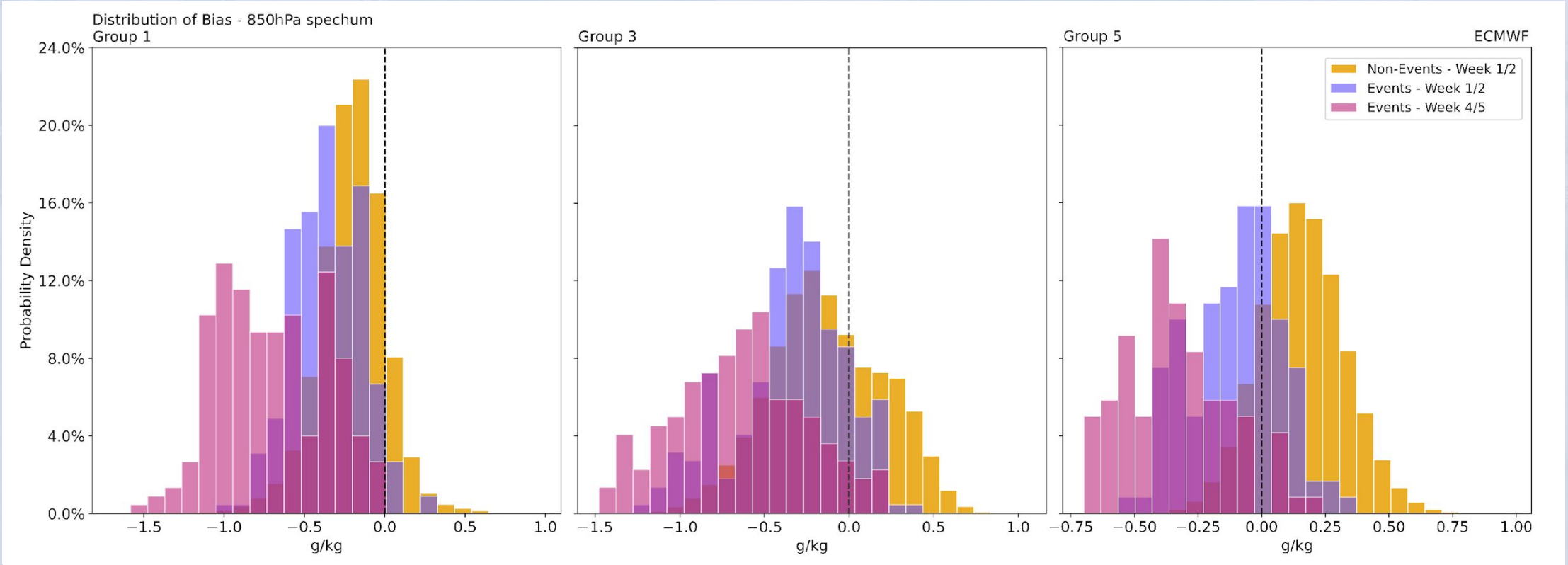
700hPa specific humidity has similar trends, with overall lower skill



Extreme Event Bias within Synoptic Variables

Bias of 850hPa Specific Humidity

Comparing distributions of event and non-event bias

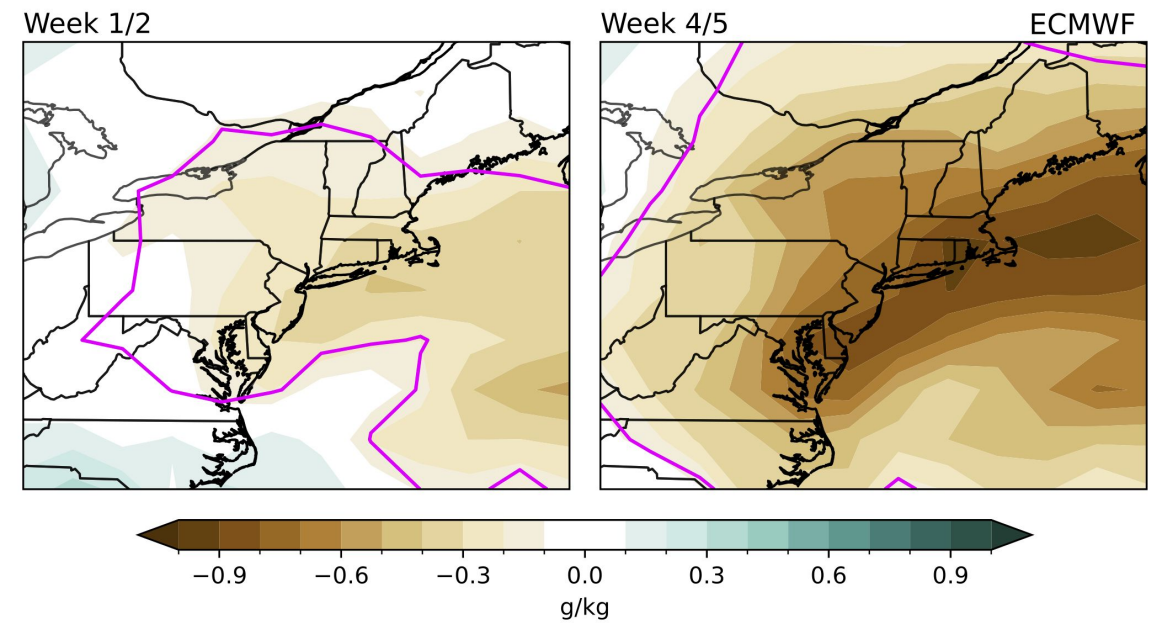


Bias of 850hPa Specific Humidity

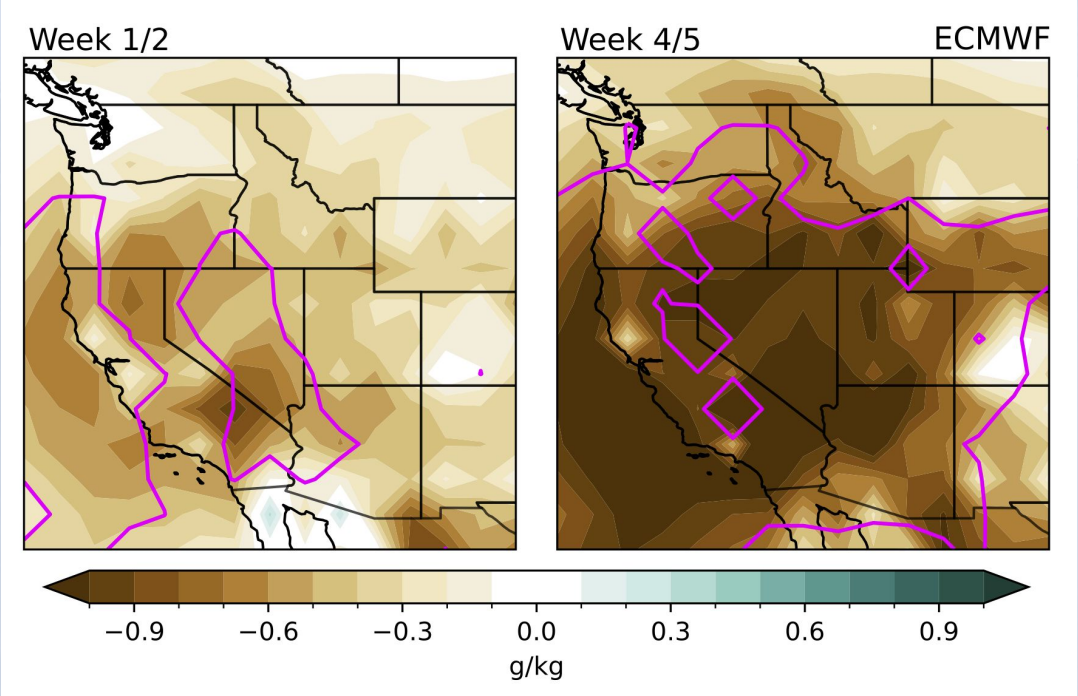
Geospatial distributions of Event Bias

P-value: 90% confidence interval compared to bootstrapped non-events (n = 2500)

Group 5 - Northeast



Group 1 – West Coast



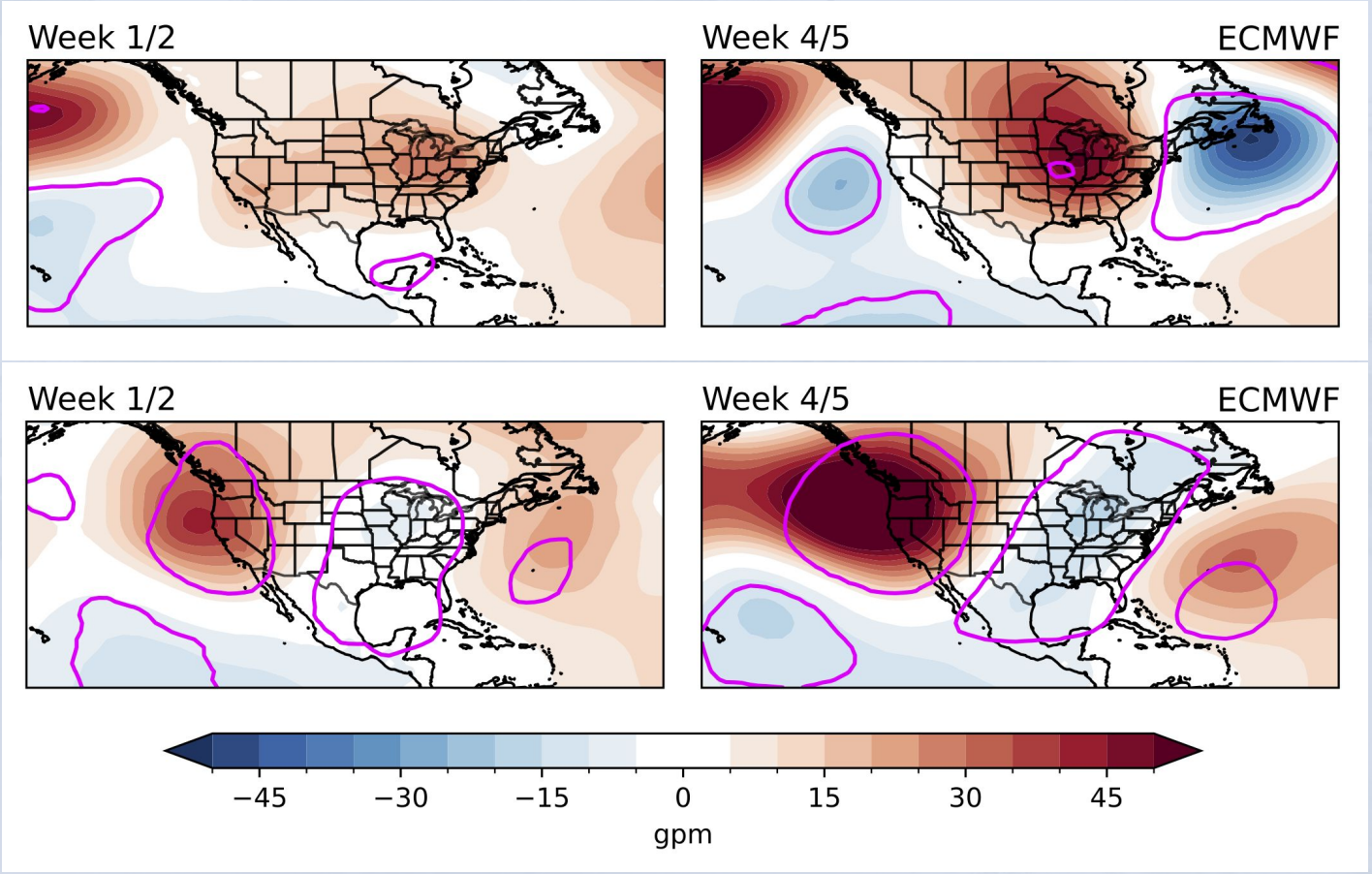
Bias of 500hPa Geopotential Height

Geospatial distributions of Bias

P-value: 90% confidence interval compared to bootstrapped non-events (n = 2500)

Group 5 – Northeast

Group 1 – West Coast



Conclusions

- Skill of synoptic variables is low past Week 2/3, with more skill seen on the West Coast. Similar to S2S model precipitation skill of these events.
- There is a dry bias in low level specific humidity that increases with lead time.
- Models have an inability to produce 500hPa dipoles that are common to most extreme events cases past Week 1/2.
- There are cases where the synoptic variables are well forecasted with better precipitation forecasts. Primarily on the West Coast of the CONUS.

Next Steps:
What does the extra-tropical cyclone activity look like during these extreme events? Do the S2S models properly represent ETC activity during events?

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Information regarding climatology, typical storm reports, and seasonality of the extreme precipitation events is now accessible to all at pres2ip.com.

SCAN ME

Contact:
maschroers@ou.edu

About PRES^{2}iP

Prediction of Rainfall Extremes at Subseasonal to Seasonal Periods

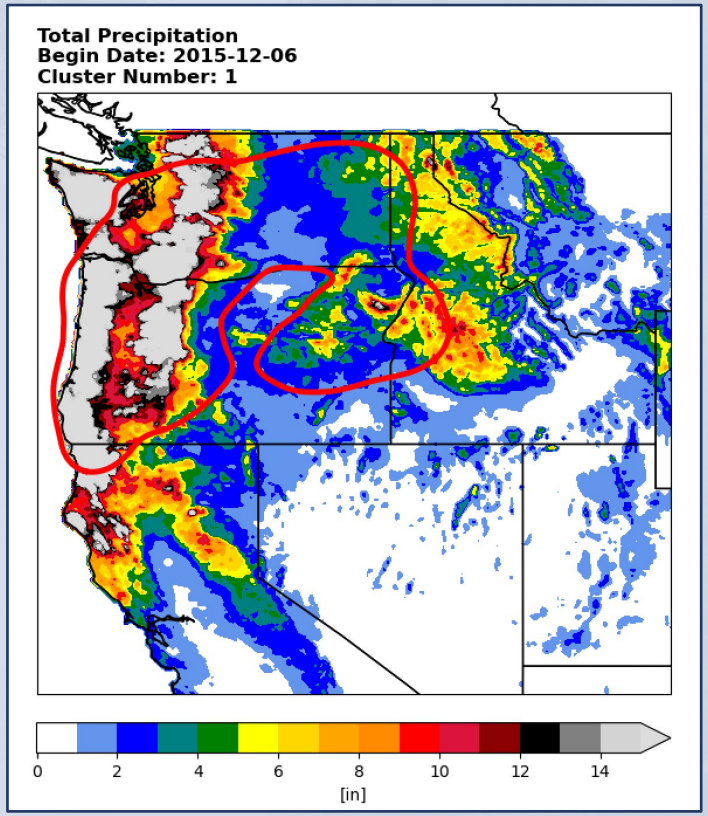
The goal of this project is to enhance the physical understanding of the large-scale dynamics and forcing of S2S extreme precipitation events, improve our capability to predict these events, and increase communication between research and stakeholder communities with regard to extreme precipitation.

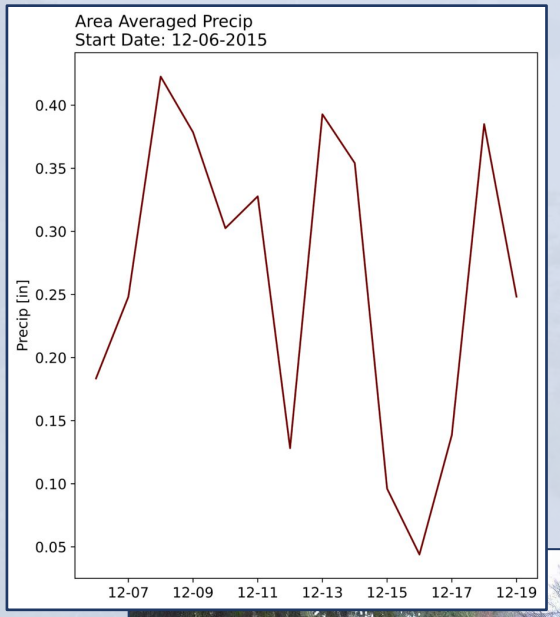
PRES^{2}iP

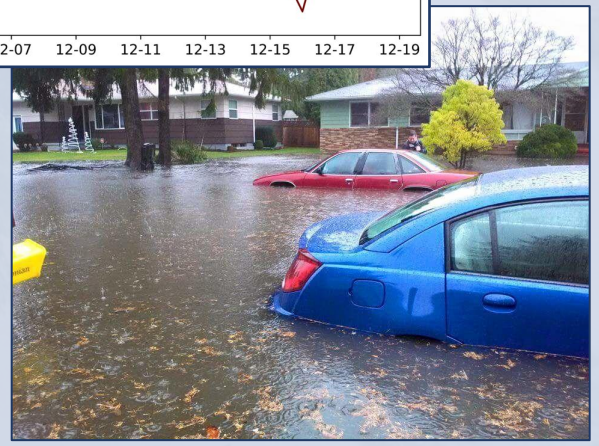
What do these extreme periods look like?

West Coast Extreme Period in December 2015

- $35 Million of Property Damage
- Occurred after regional drought.
- Typically made up of multiple systems passing over the same area.





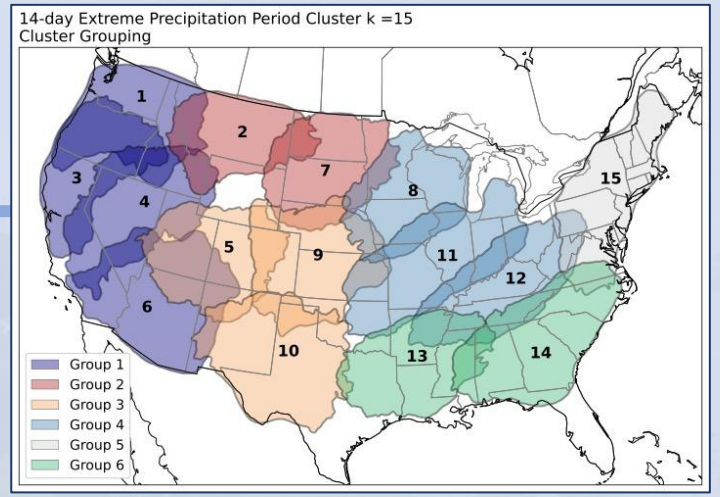


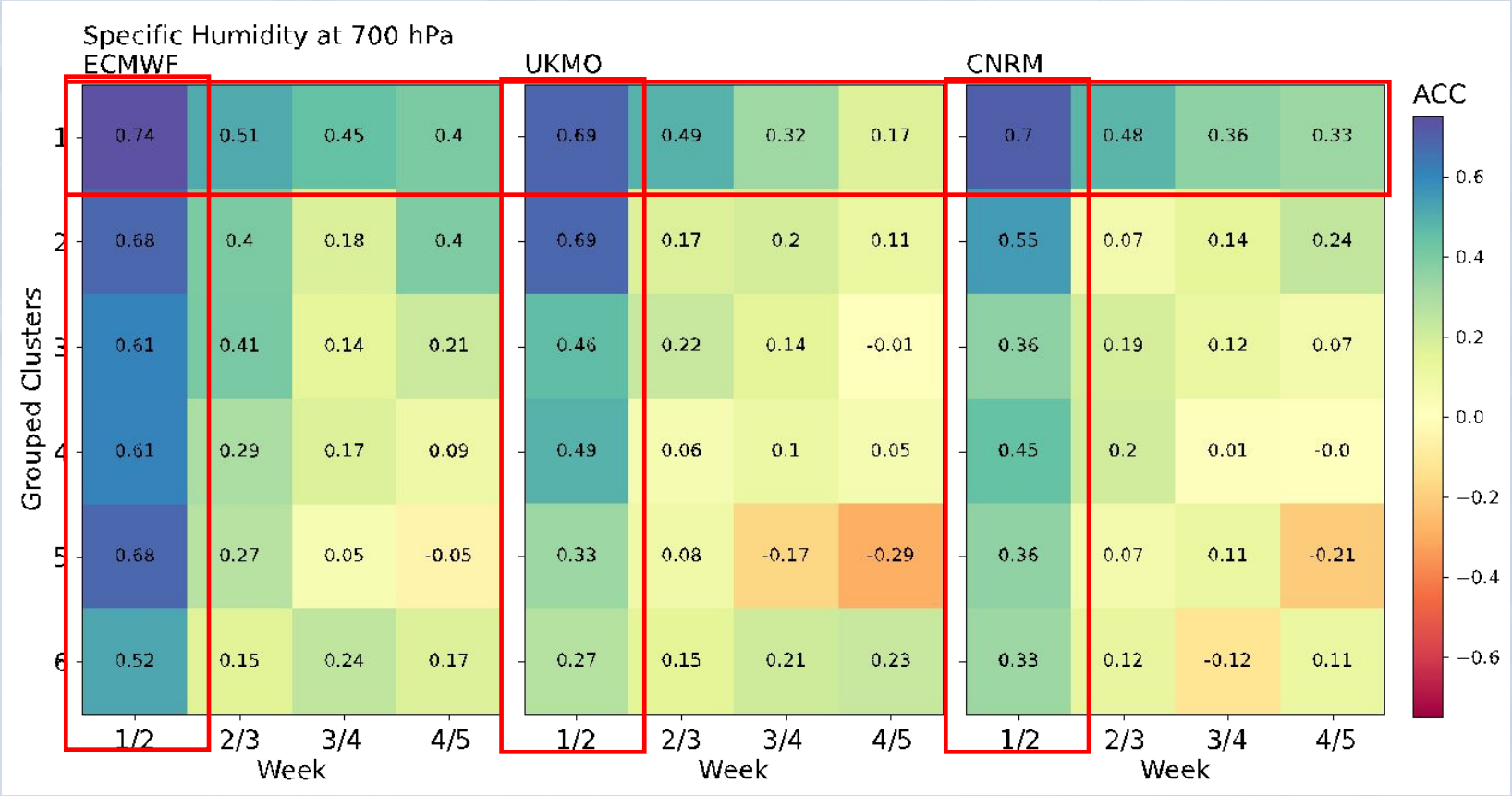
S2S Model Descriptions

Verifying the ensemble averages of the extreme periods 14-day averaged forecasted anomalies against ERA5 observations.

S2S Model	Time Range	Hindcast Freq	Hindcast Period	Ensemble Size	Ocean Coupled	Sea-Ice Coupled	Extreme Periods Covered
ECMWF	46	2/week	1996-2014	11	Yes	No	171
UKMO	60	4/month	1996-2014	2	Yes	Yes	171
Meteo-France	61	1/week	1996-2014	15	Yes	Yes	171

Verification – 700hPa Spechum

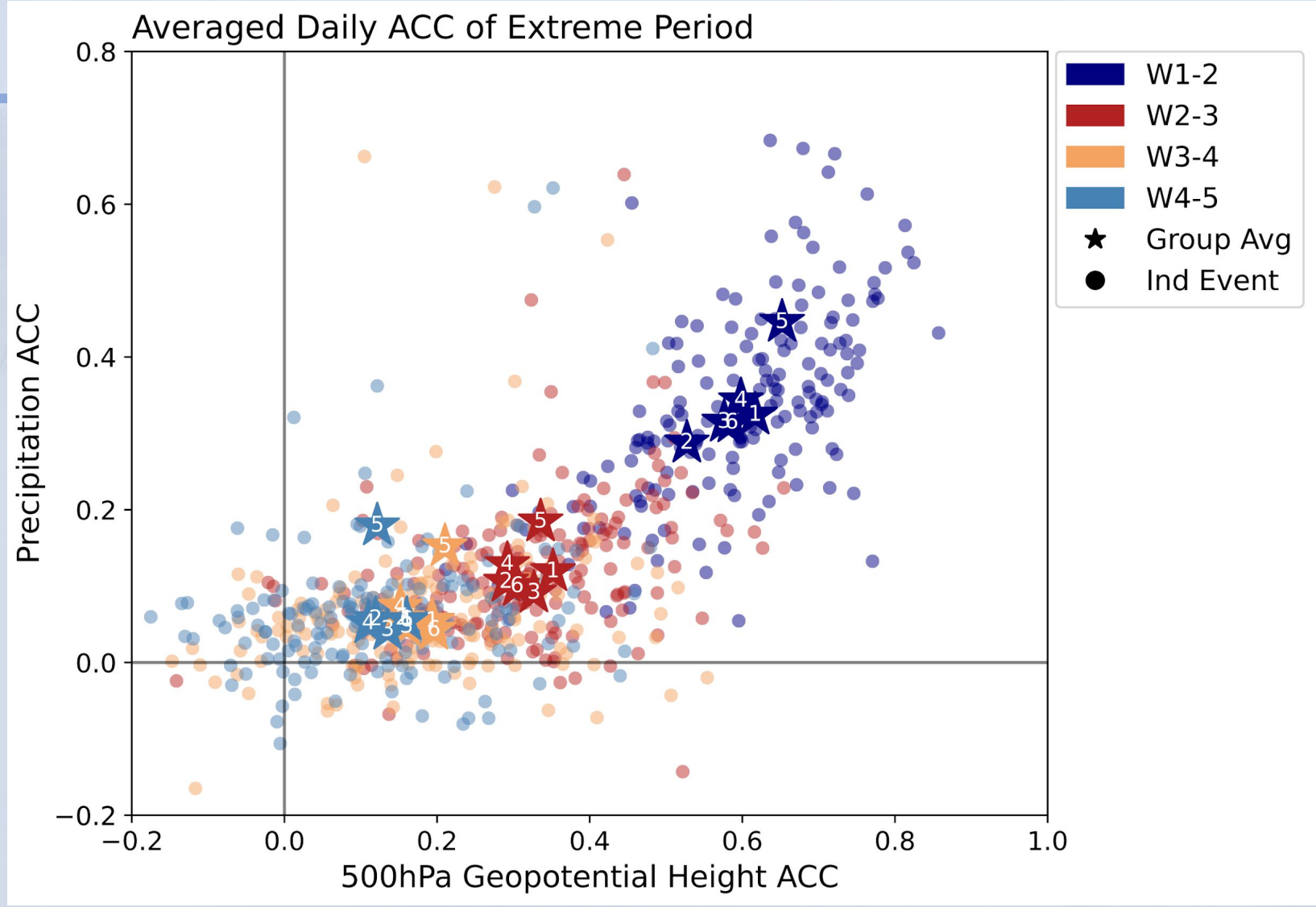




Comparison to Precipitation Skill

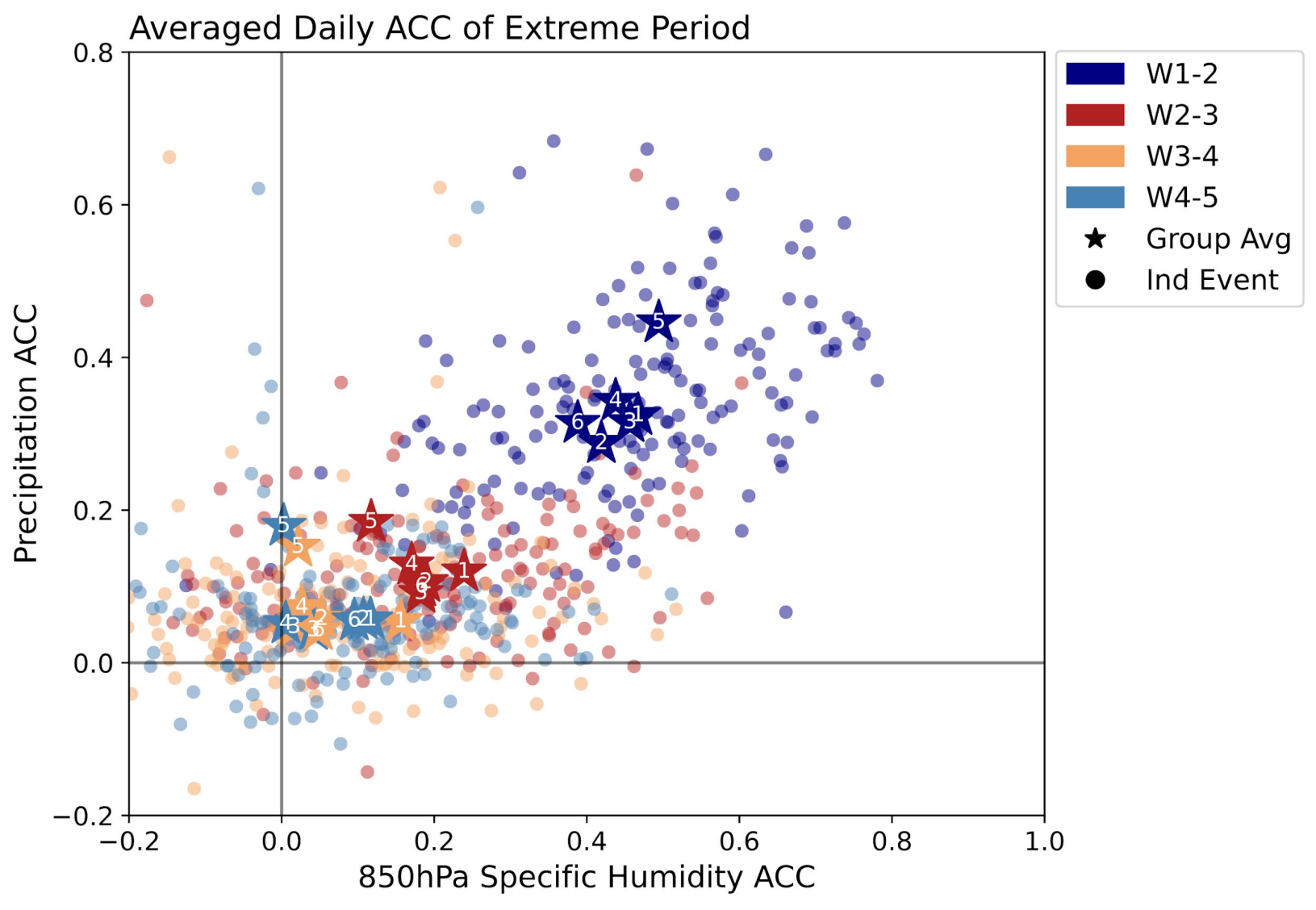
Precipitation ACC (y) vs.
500hPa geopotential ACC (x)

- Positive correlation at Week 1/2
- Less to no correlation seen past Week 1/2
- Group Averages are similar



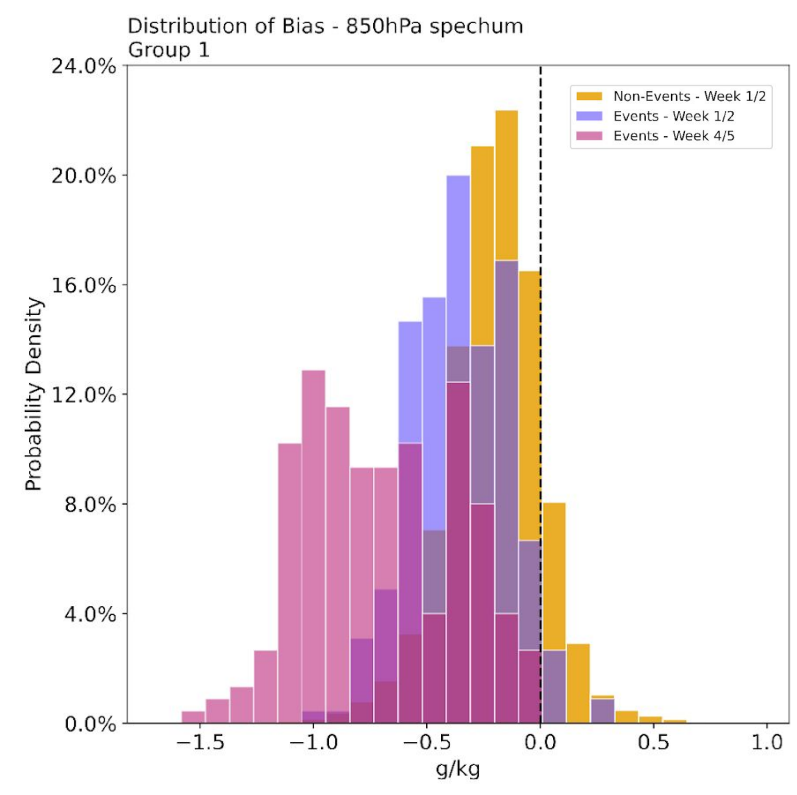
Comparison to Precipitation Skill

Precipitation ACC (y) vs.
850hPa spec humidity ACC (x)



Bias of 850hPa Specific Humidity

Comparing distributions of event and non-event bias



Group	Period	Lead [Weeks]	Mean	Variance
1	Non-Event	1	-0.202	0.044
		4	-0.299	0.060
	Event	1	-0.356	0.046
		4	-0.704	0.109