Subseasonal and Seasonal Tropical Pacific Precipitation Variability in Forecast Models

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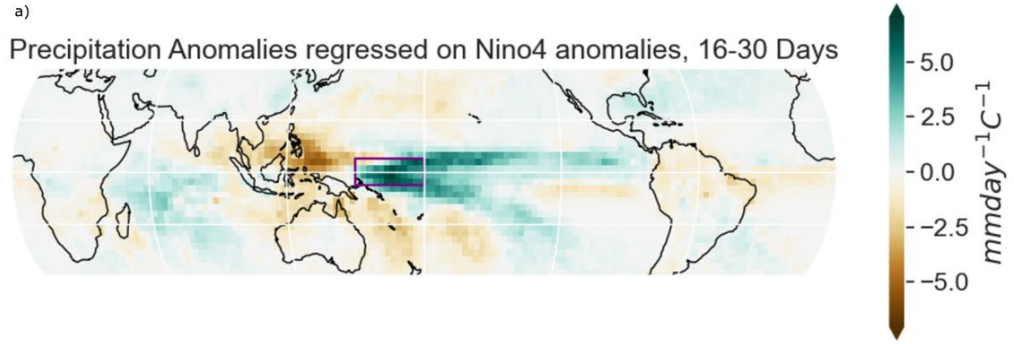
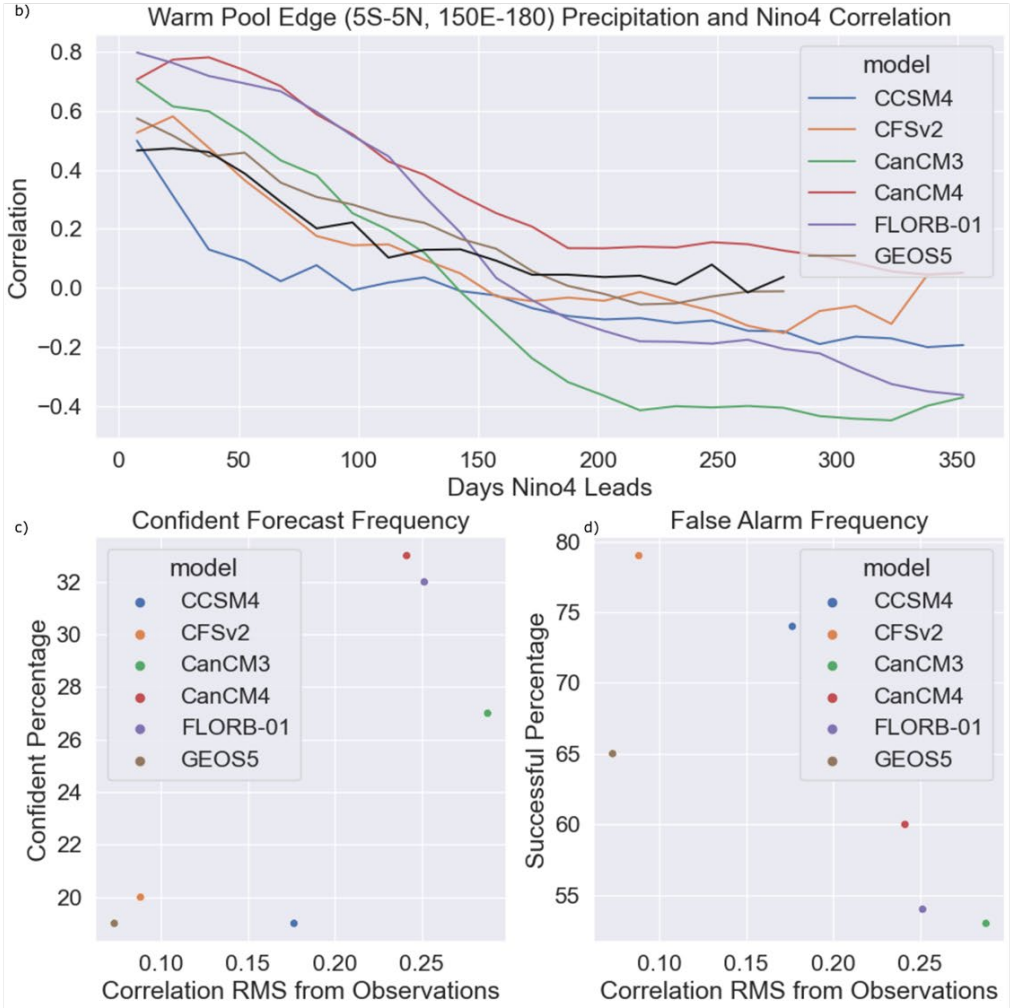
CICOES Symposium

June 2025





Motivation

- Previously Levine et al 2025 found that fewer false alarm El Niño forecasts was associated with less reliance of warm pool edge precipitation on initial Nino4 conditions
- How generalizable is this precipitation to forecasts versus role of initial Nino state?
- Are there differences in precipitation for forecast lead and eastern extent?

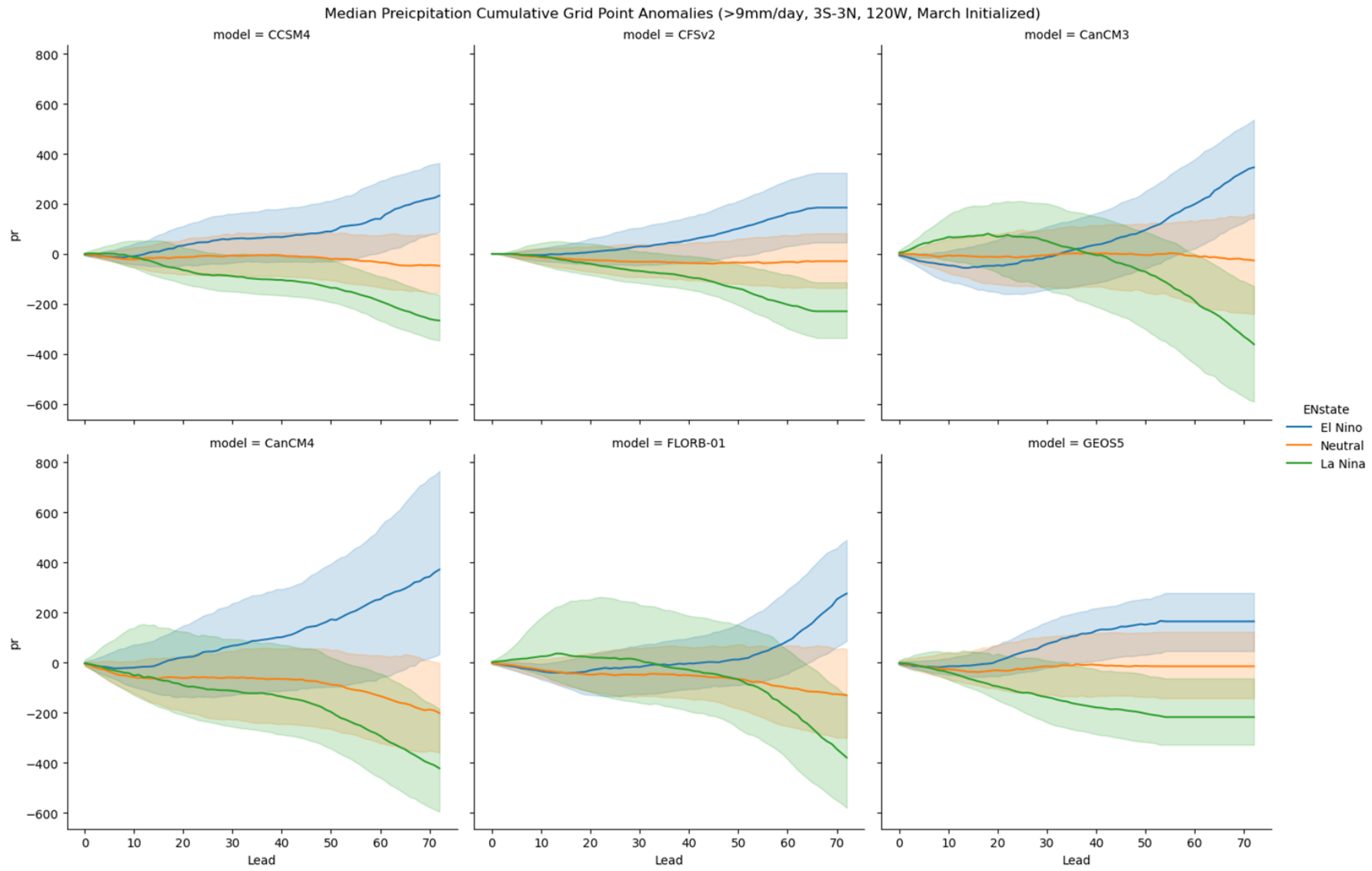
Levine, A.F., L'Heureux, M. and Wen, C., 2025. Understanding spring forecast El Niño false alarms in the North American Multi-Model Ensemble. *npj Climate and Atmospheric Science*, *8*(1), p.94.

Data Availability and Constraints

- NMME Phase II data contains daily precipitation forecasts
  - Hindcast period 1982-2012
  - 6 models (CanCM3, CanCM4, CCSM4, CFSv2, GEOS5, FLOR-B1)
- Highest resolution observational data over same period CMAP
  - Temporal resolution: 5 days
  - Spatial resolution 2.5 degrees
- Model data downsampled to match CMAP data
- Counting number of grid points exceeding specified average precipitation thresholds

NMME Precipitation timing by ENSO forecast

Median Cumulative Precipitation Anomalies from March Initializations



Forecast Lead (pentads)

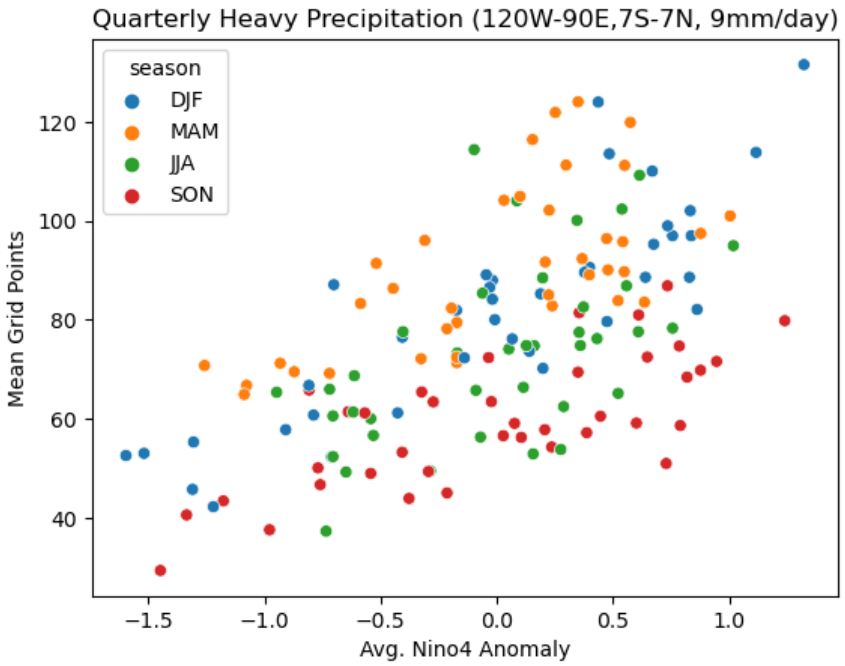
- Models with fewest false alarms (CFS, CCSM4, GEOS5) separate cumulative precipitation based on forecast outcome the slowest

Figure Info: Cumulative sum of anomalous heavy precipitation grids for all ensemble members, based on forecast DJF ENSO state
March Initializations

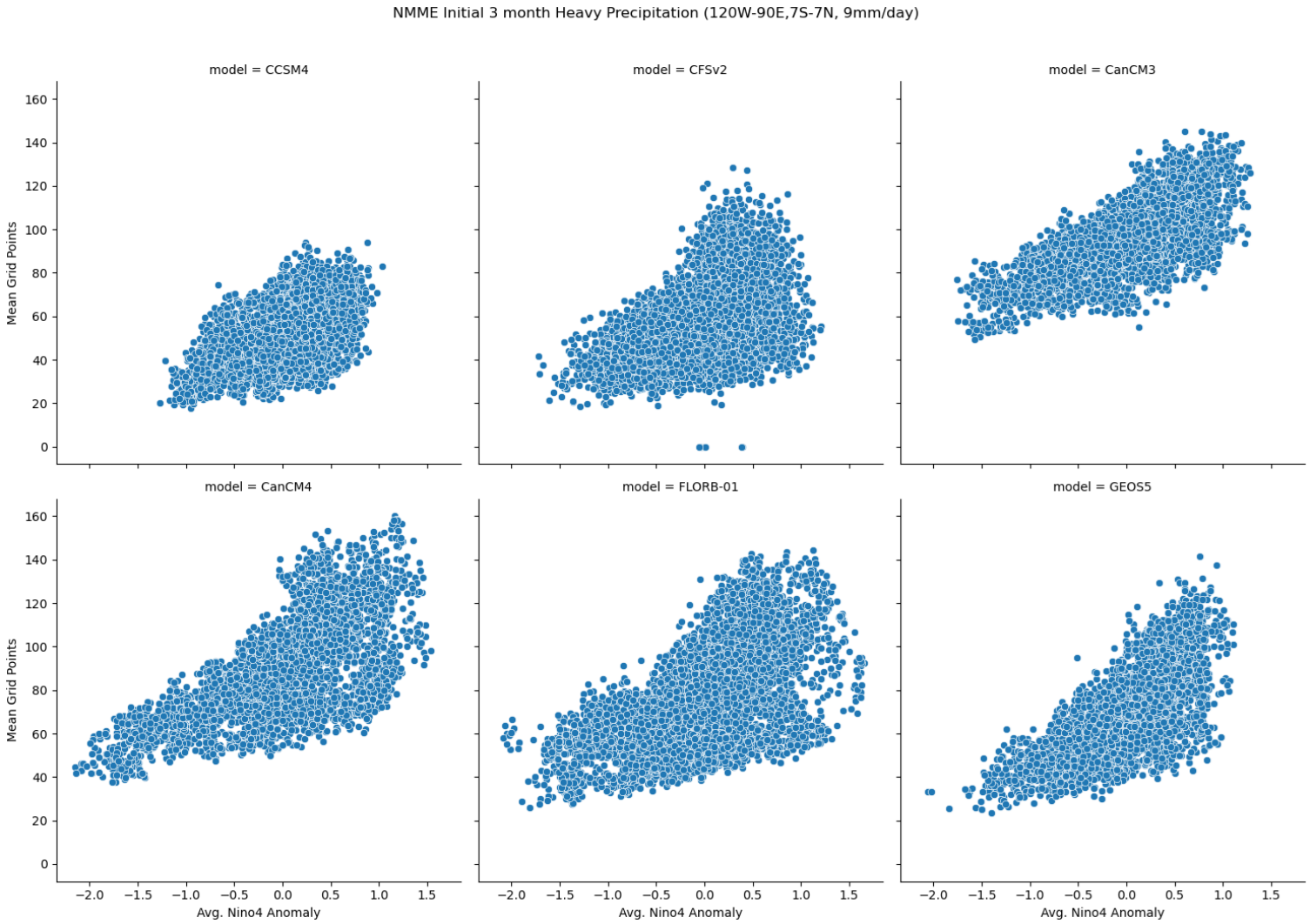
Line is median and shading is IQR

CMAP Heavy precipitation based on current Nino4

CMAP



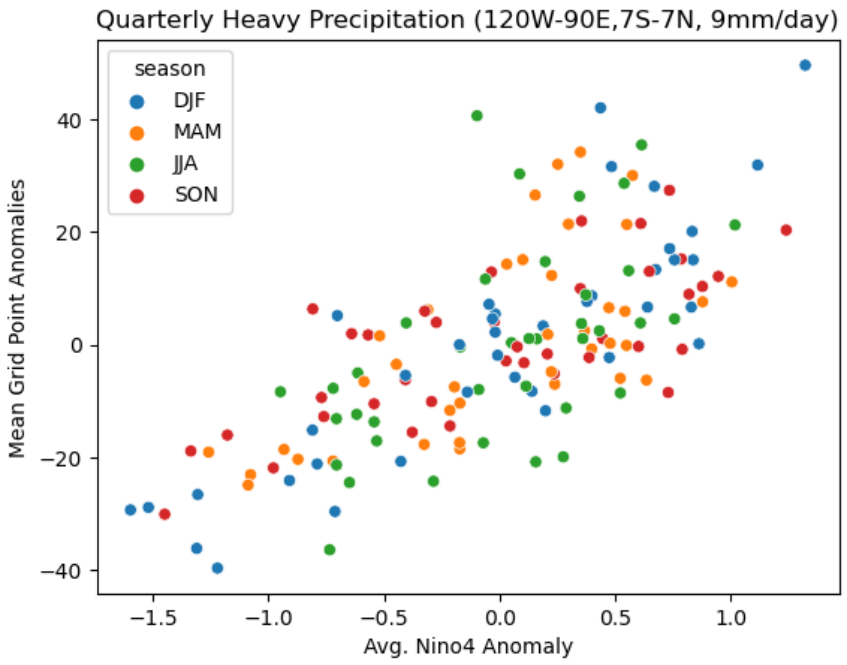
NMME Months 0-3



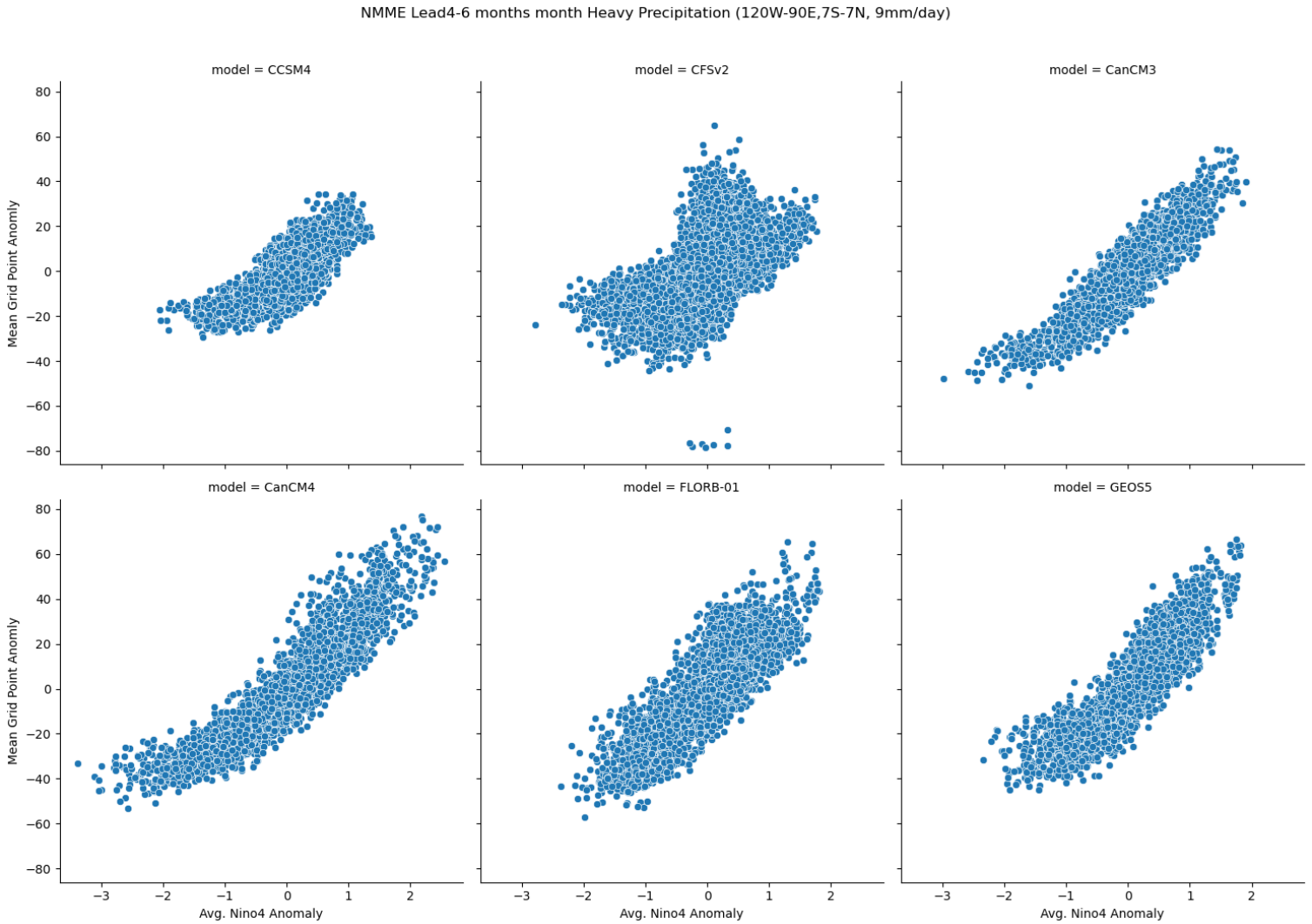
Contemporaneous Nino4

Precipitation Anomalies, lead 4-6 months

CMAP



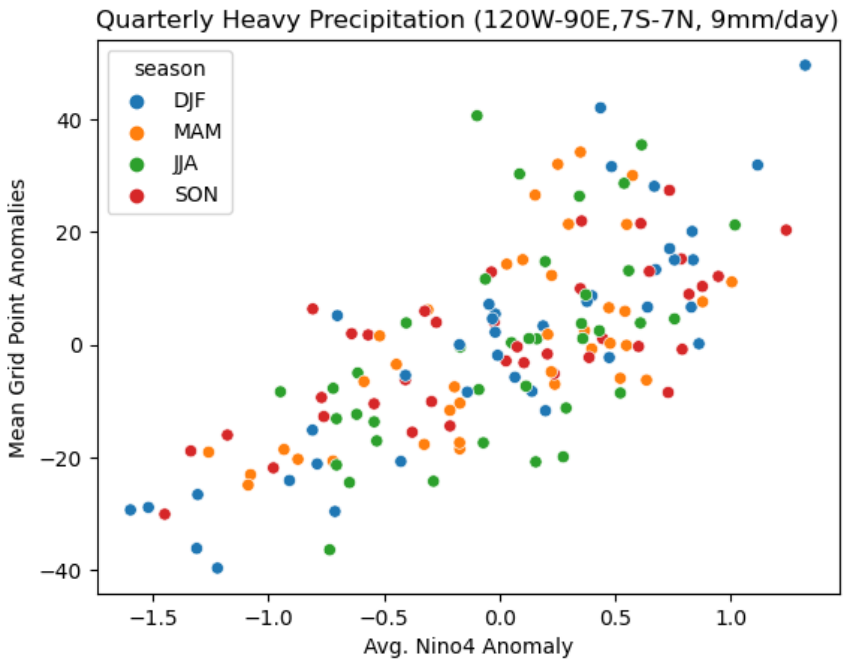
NMME Months 4-6



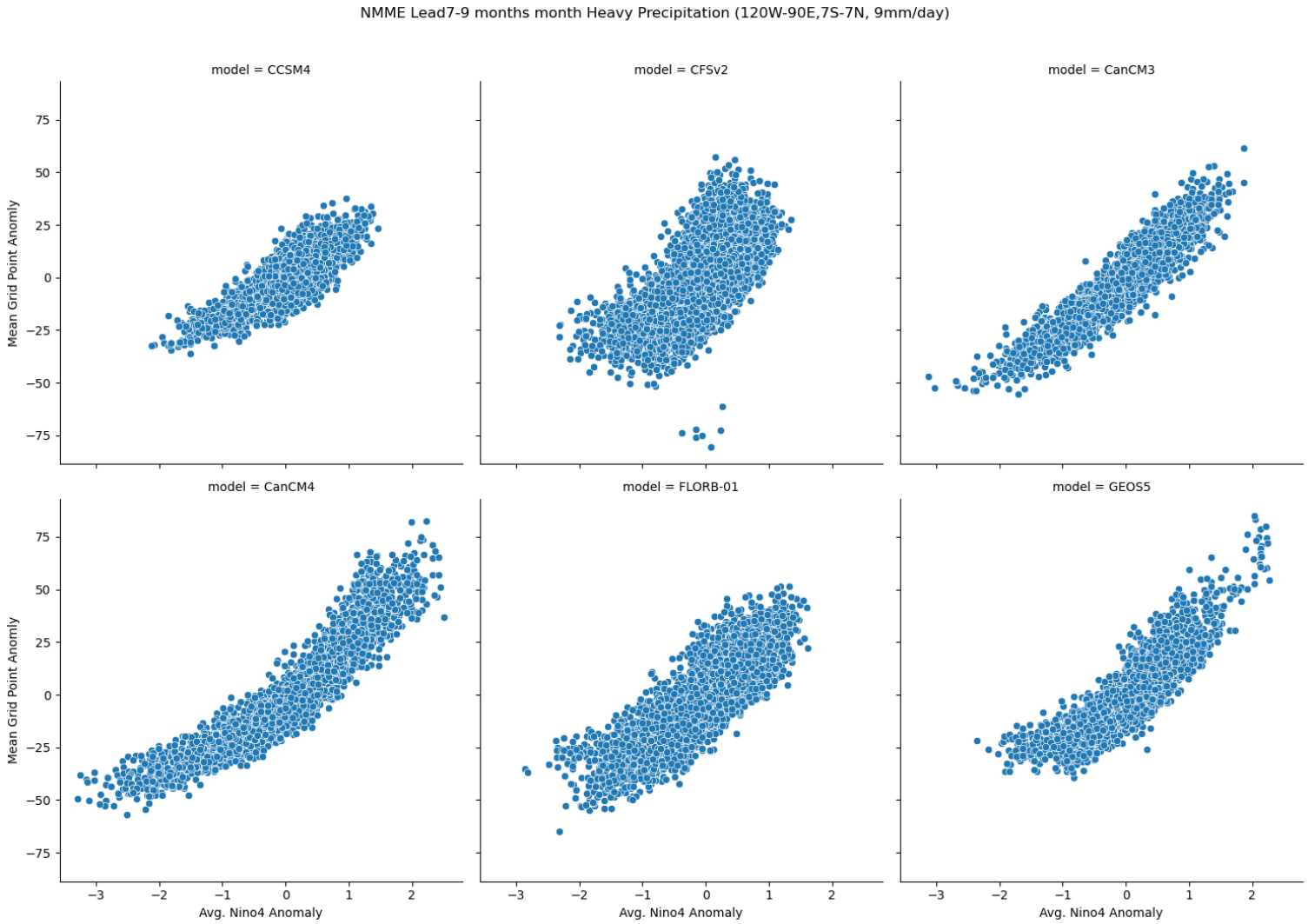
Contemporaneous Nino4

Precipitation Anomalies, lead 7-9 months

CMAP



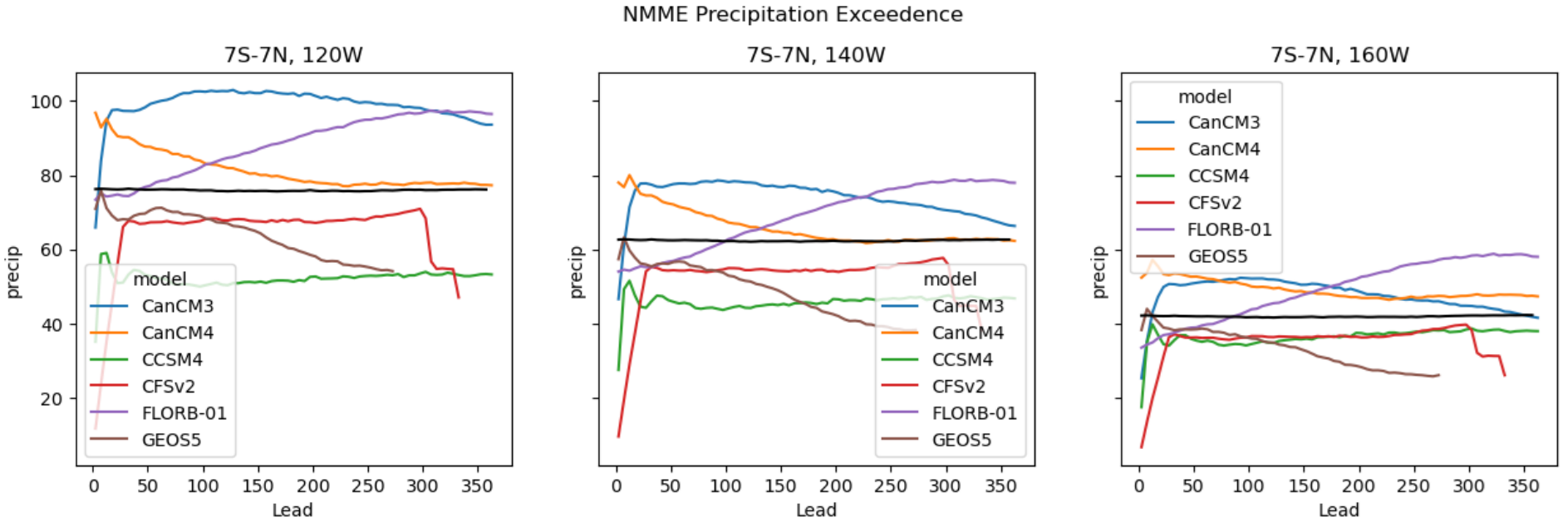
NMME Months 7-9



Correlation increases as function of lead

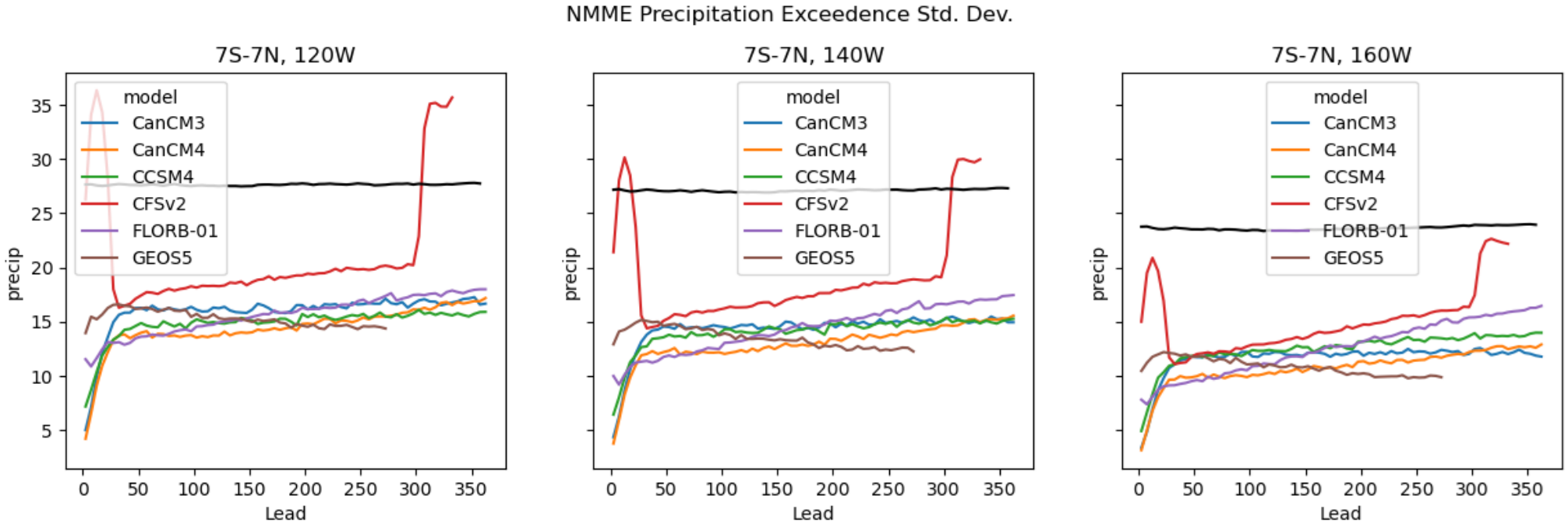
Contemporaneous Nino4

NMME models vastly different at lead



- Since models have a decent seasonal cycle at all forecast leads, model drift important
- Black line is CMAP value
- Box size important for total number, but not for model differences
- Models do not have coherent drift across models
  - 2 decrease for the whole period, 1 increases, 2 constant

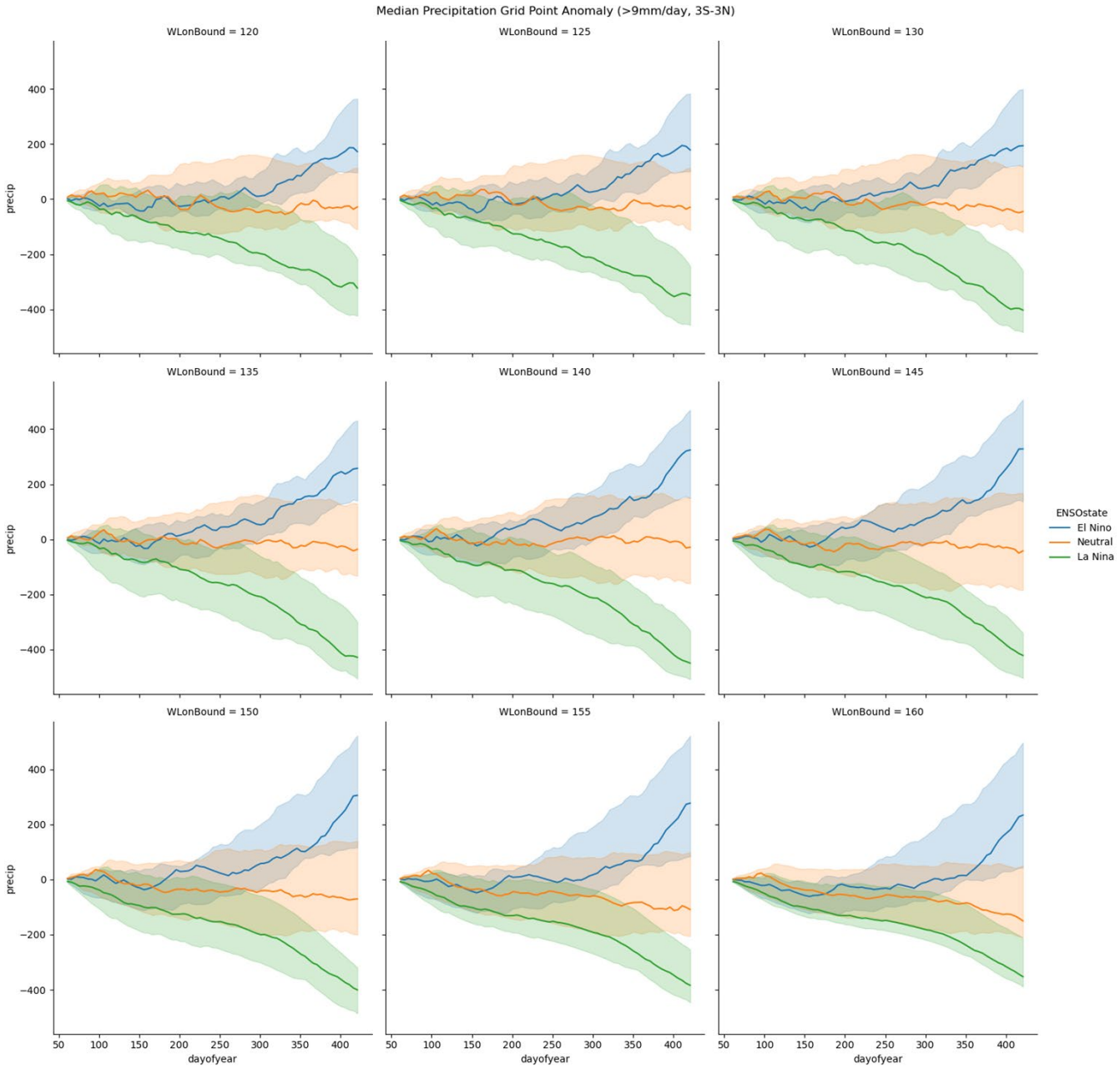
…and vastly under dispersive



- Black line is CMAP value
- Initial quick increase in spread corresponds with timescales of deterministic skill
- Models' asymptote does not approach observed value

Conclusions and Future Work

- Western Pacific precipitation strongly tied to current Nino4 temperature anomalies
  - Leads to very deterministic ENSO forecasts from spring
- Western Pacific precipitation mean close to observations at most leads, but under dispersive
- Work continuing on understanding precipitation under dispersion
  - Organized precipitation?
  - Precipitation tracking?

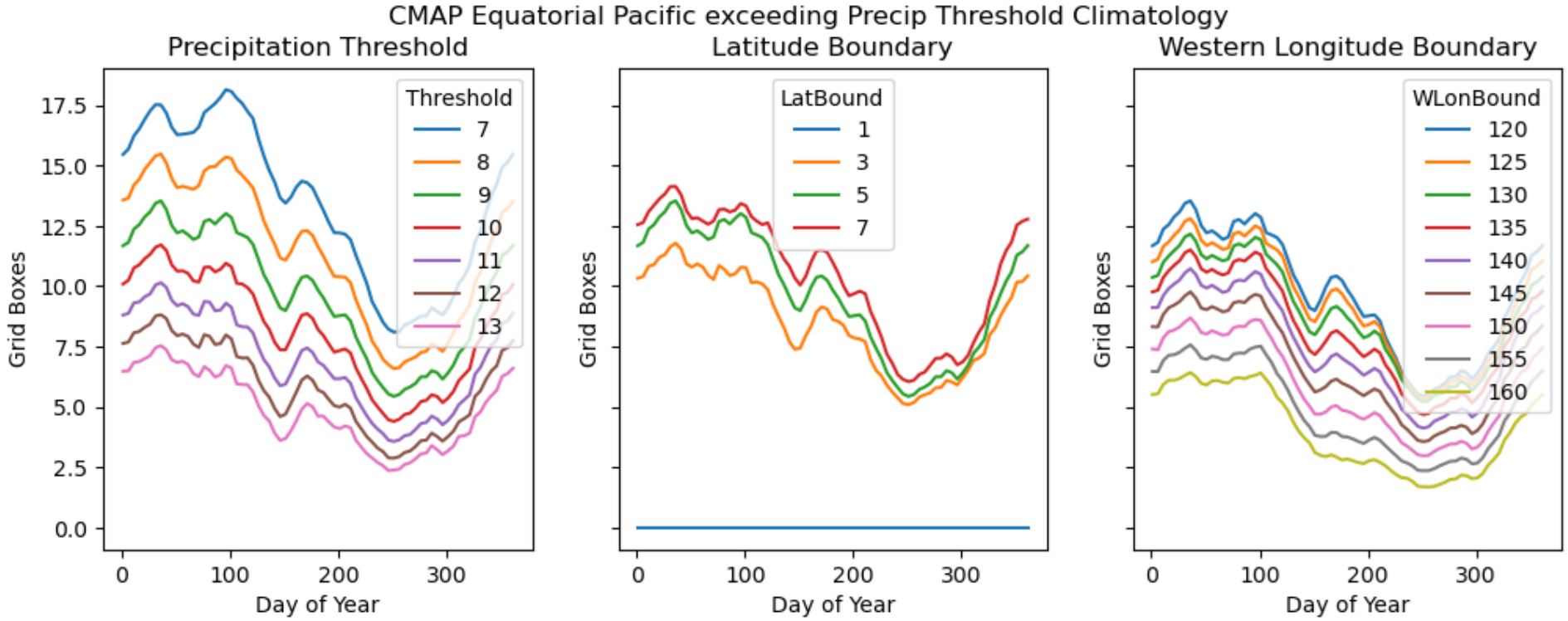


CMAP Precipitation and El Niño

- La Niña shows reduced precipitation area from March
- El Niño has enhanced precipitation later, but longitude dependent (clearer upcoming)

Figure Info: Cumulative sum of anomalous heavy precipitation grids, based on future winter ENSO state
Line is median and shading is IQR

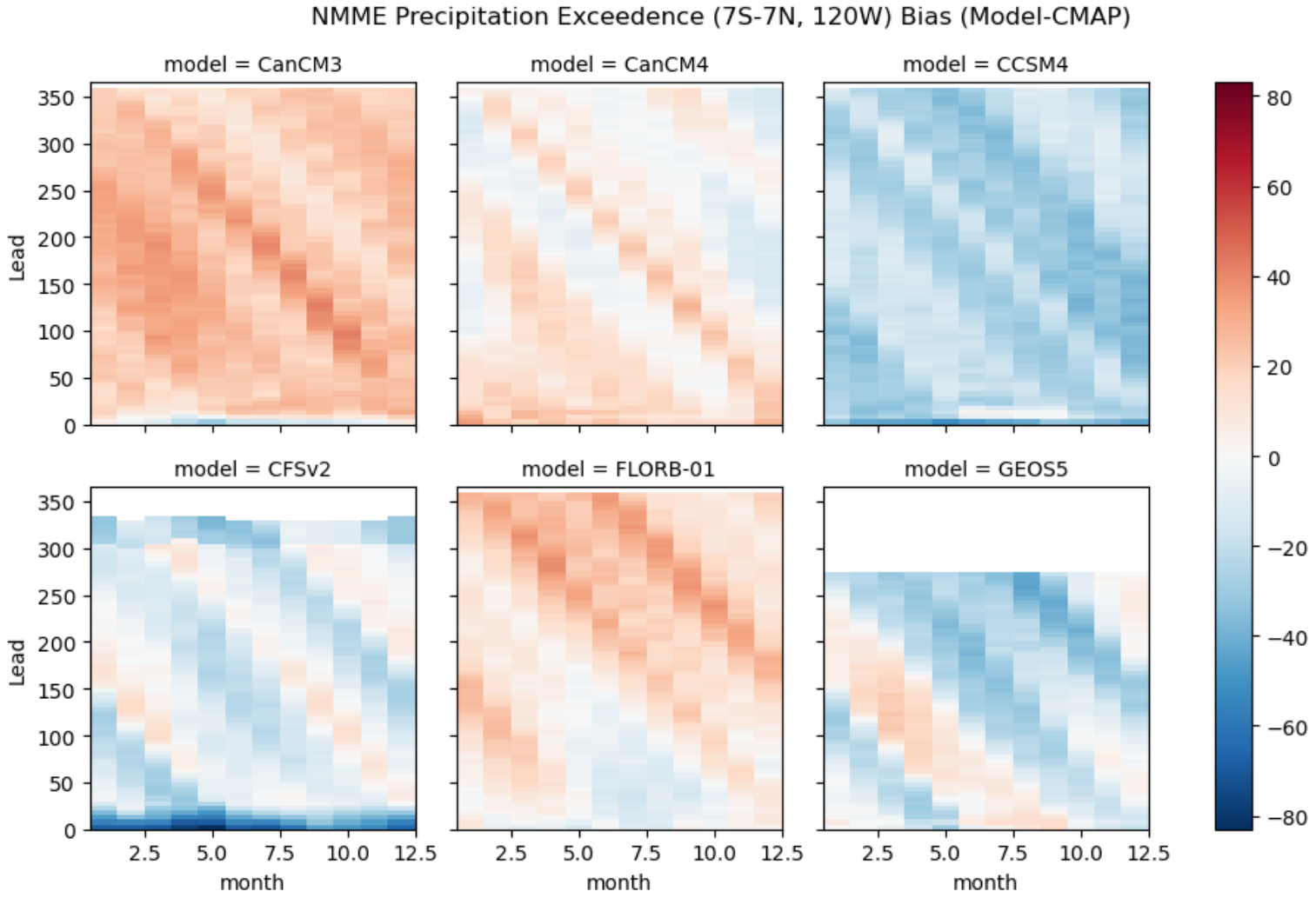
CMAP Climatology and Boundary Impacts



- Climatology of western Pacific heavy precipitation events is minimally impacted by choices of box size or threshold

Figure Info: When not being varied, the precipitation box is 120W-90E, 5S-5N and the precipitation threshold is 9mm/day

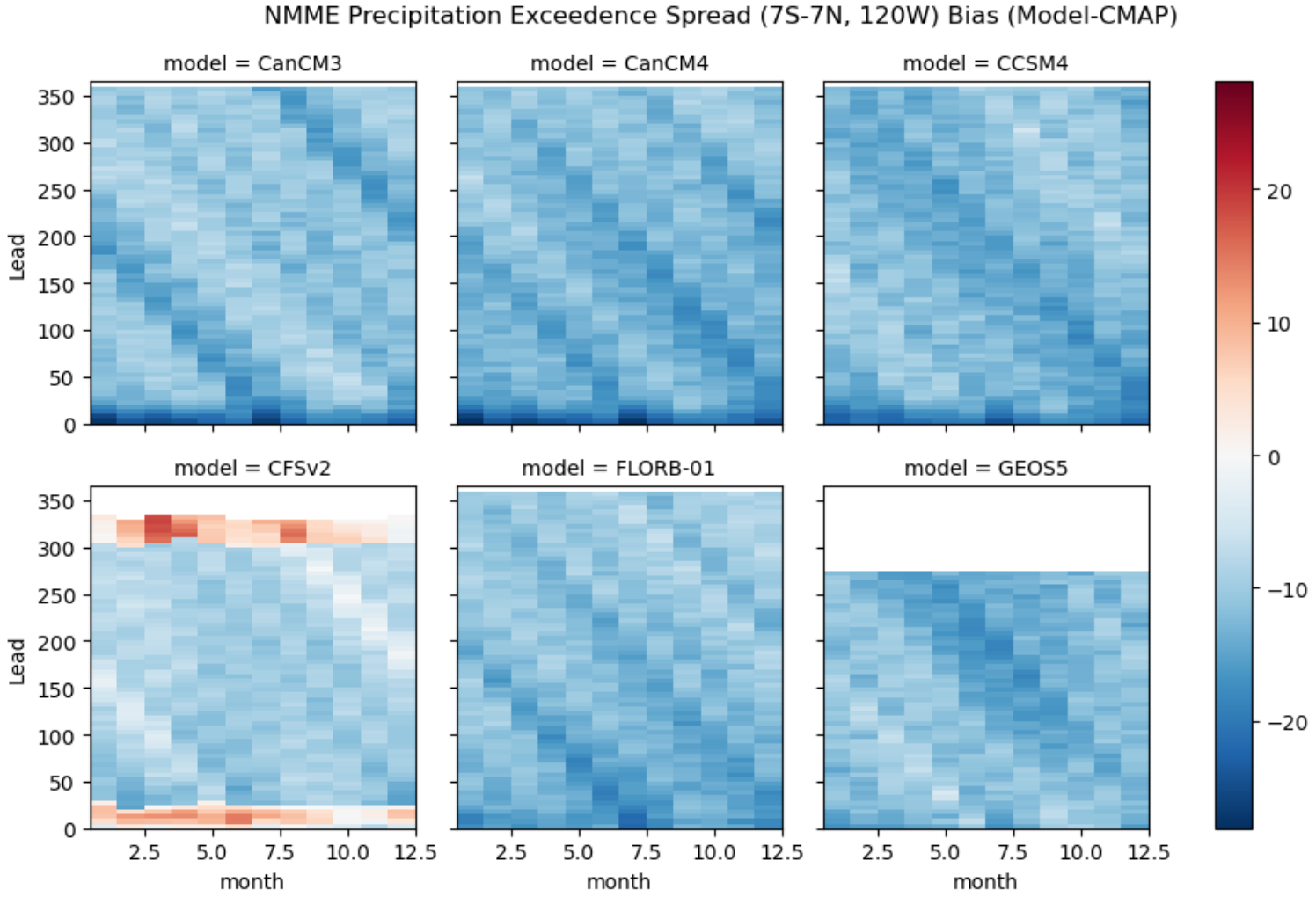
NMME Climatological Bias



- Models mostly follow seasonal cycle at all leads (constant diagonals)
- Large spread in simulated mean heavy precipitation between models

Figure Info: The precipitation box is 120W-90E, 7S-7N and the precipitation threshold is 9 mm/day

NMME Climatological Spread Bias



- Model spread important for capturing potential range of outcomes
- Seasonal cycle of spread well captured (near constant bias at leads)
- All models have too little spread

Figure Info: The precipitation box is 120W-90E, 7S-7N and the precipitation threshold is 9 mm/day