

# DEVELOPING A FRAMEWORK FOR EVALUATING SOURCES OF PREDICTABILITY FOR EXTREME EVENTS ON SUBSEASONAL TIMESCALES IN SOUTHEAST ASIA & LATIN AMERICA

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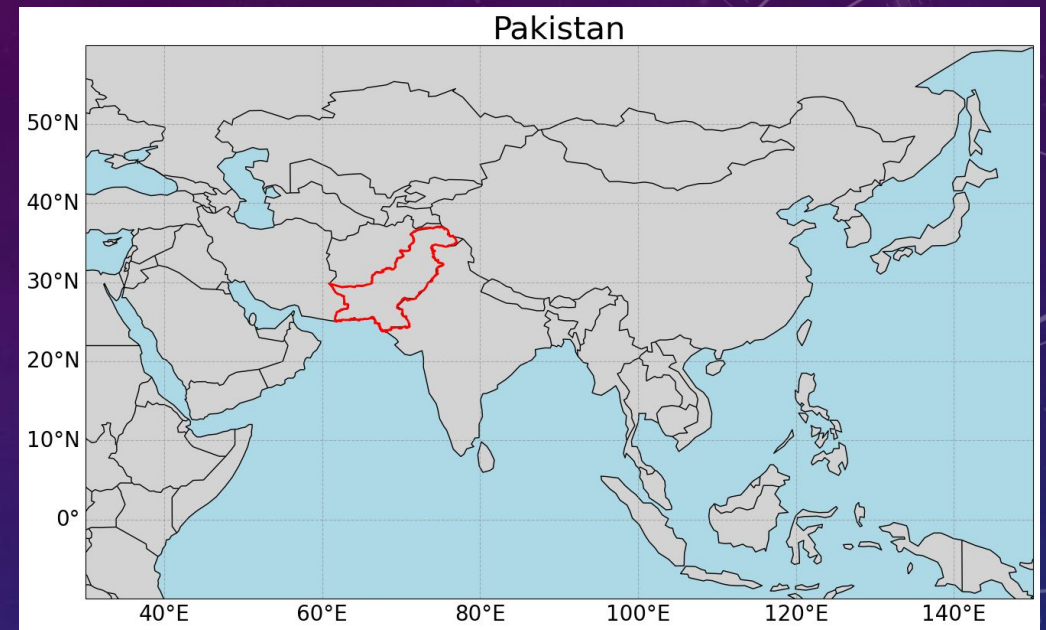
# MOTIVATION

- Climate change can increase global insecurity
- Enhance accuracy and lead time of subseasonal predictions
- Identify key drivers and mechanisms contributing to predictability in various geographic regions



# DATA & METHODS

- Case studies:
  - 2022 Pakistan extreme precipitation
  - 2023 Peru cyclone & extreme precipitation
- Datasets:
  - Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS, 1981 – 2023)
  - ECMWF Reanalysis Version 5 (ERA5, 1940 – 2023)
  - NSF NCAR Community Earth System Model Version 2 (CESM2) subseasonal forecasts & re-forecast experiments

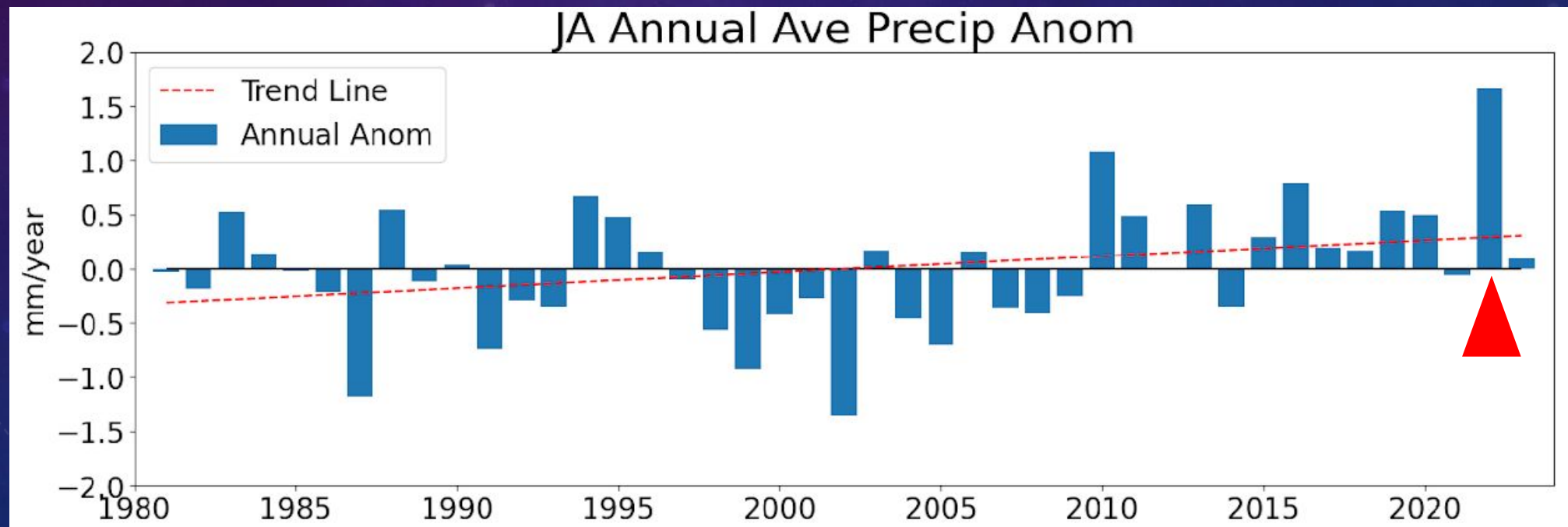


# RESEARCH QUESTIONS

1. What are the defining characteristics of the extreme event?
2. How far in advance could useful predictive information have been provided?
3. What earth system components contributed most to the predictability of the event?

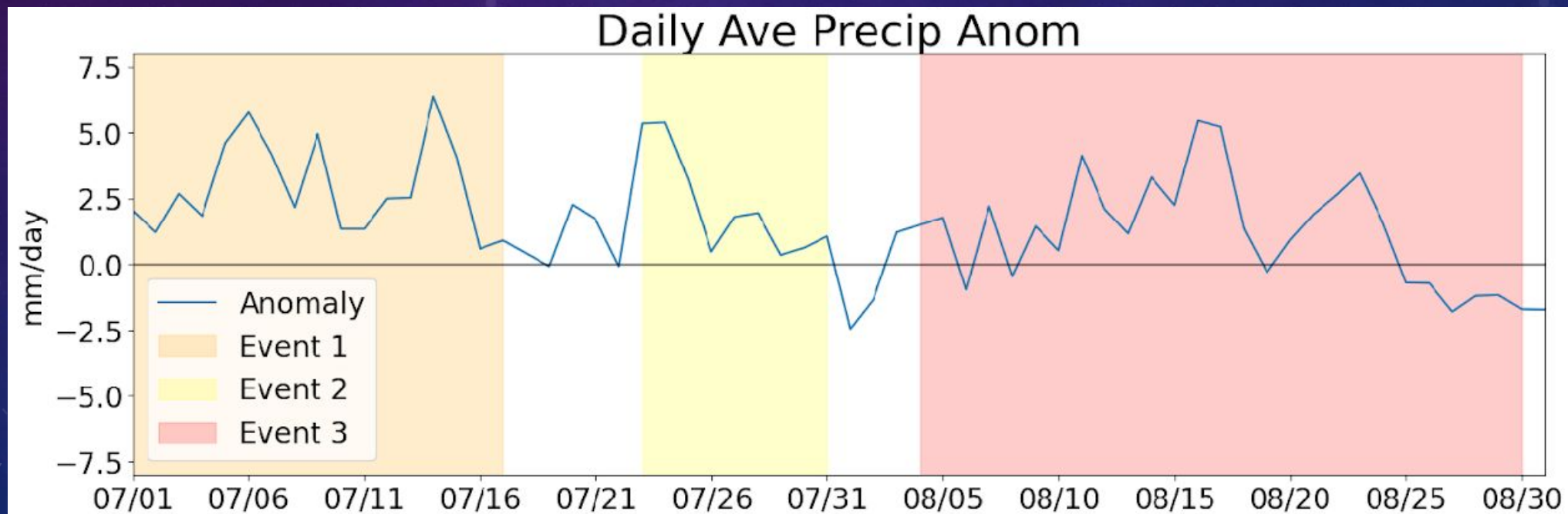
# PAKISTAN PRECIPITATION OVERVIEW

- Pakistan experienced anomalous precipitation in July and August (JA) 2022



# PAKISTAN PRECIPITATION OVERVIEW

- Pakistan experienced anomalous precipitation in July and August (JA) 2022
- Extreme precipitation separated into events



# POTENTIAL DRIVERS

- **Monsoon pulses**
  - Strengthened monsoon pulses
- **Sea – surface temperature (SST)**
  - Negative SST anomalies in Indian Ocean Basin
- **Zonal wind**
  - Anomalous easterly wind south of the Tibetan Plateau
- **Synoptic – scale circulation**
  - Blocking pattern elsewhere led to a circulation pattern over Pakistan that was conducive for precipitation in August

# NSF NCAR CESM2 EXPERIMENT DATA

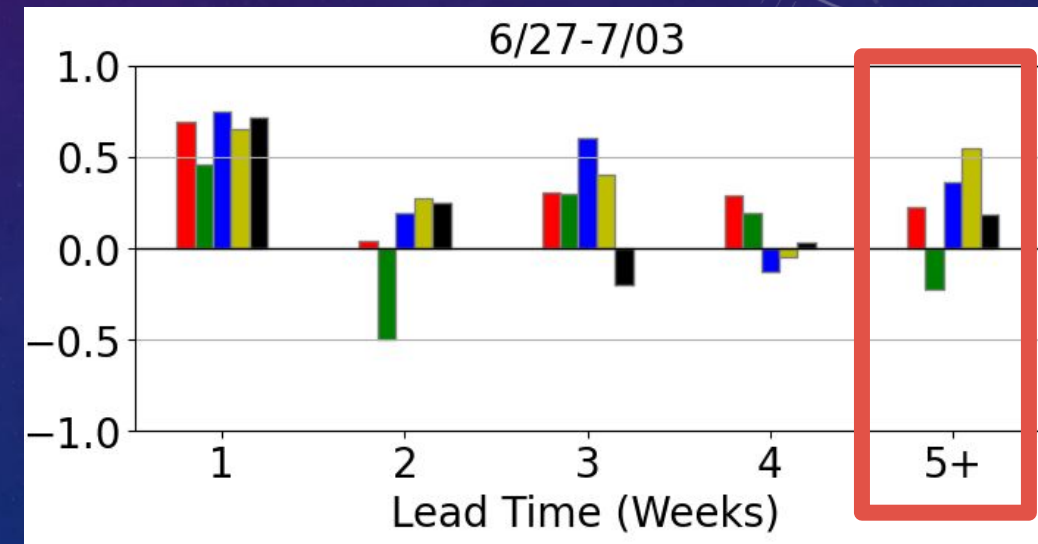
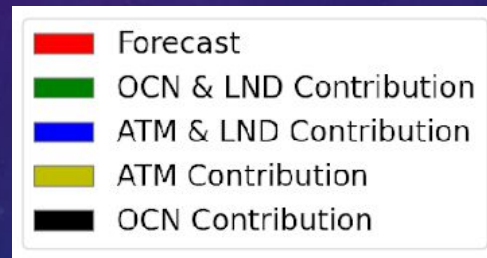
- Unique set of initialized prediction experiments
- Earth system components
  - Atmosphere (ATM)
  - Ocean (OCN)
  - Land (LND)
- Climatological initial conditions

EXP	ATM	OCN	LND
CNTRL	✓	✓	✓
ATM	CLIMO	✓	✓
OCN	✓	CLIMO	✓
LND	✓	✓	CLIMO
ATMOCN	CLIMO	CLIMO	✓
ATMLND	CLIMO	✓	CLIMO
OCNLND	✓	CLIMO	CLIMO
ALL	CLIMO	CLIMO	CLIMO



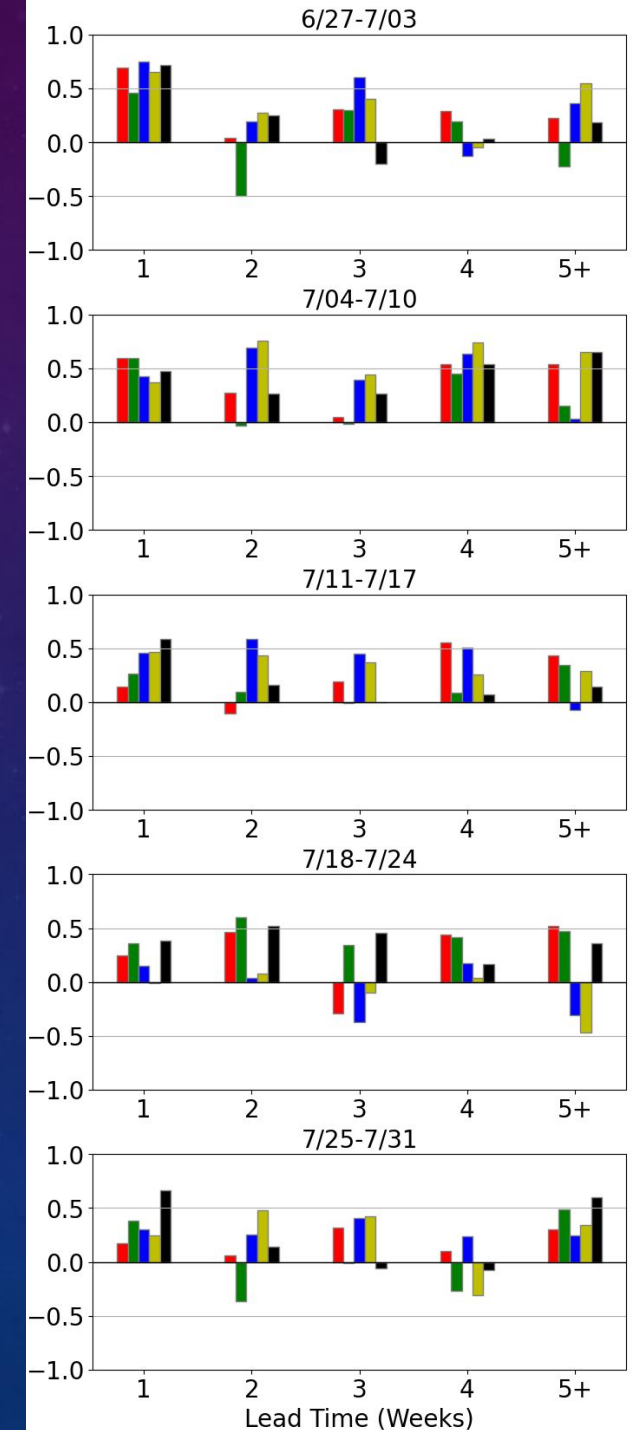
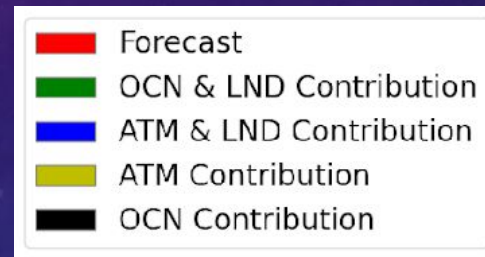
# NSF NCAR CESM2 EXPERIMENT METHODS

- Forecast & experiment data converted to anomalies
- Anomaly correlation coefficient (ACC)
  - -1.0: Perfect incorrect forecast
  - 0: No skill
  - 1.0: Perfect forecast



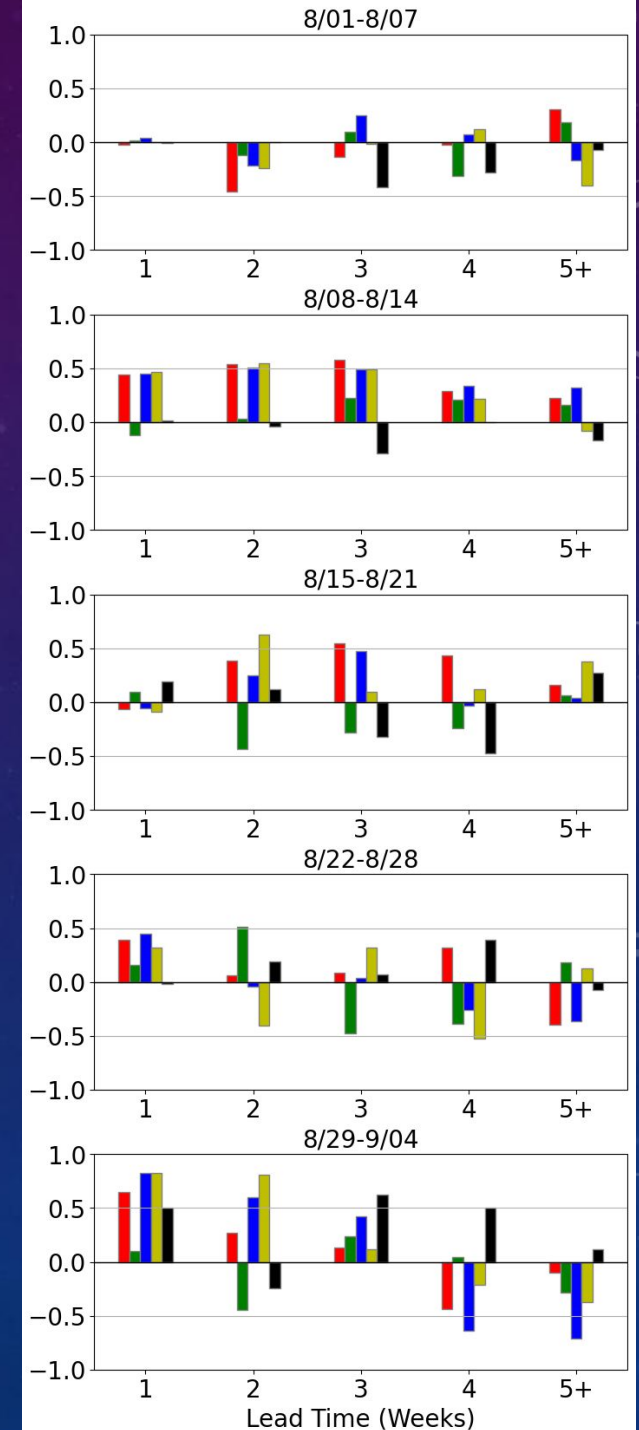
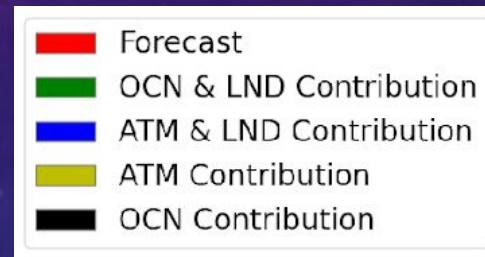
# SOURCES OF PREDICTABILITY - JULY

- Forecast does not predict at a consistent lead time
- Increased atmosphere contribution through early - mid July
- Ocean contribution increases during 18 – 24 July



# SOURCES OF PREDICTABILITY - AUGUST

- Increase in variability with both forecast and experiments
- Increased atmosphere contribution through early - mid Aug



# CONCLUSIONS

## 1. What are the defining characteristics of the extreme event?

- Variety of drivers identified as potentially playing a role in the extreme precipitation events

## 2. How far in advance could useful predictive information have been provided?

- Predictive skill varied by week, with limited consistency

## 3. What earth system components contributed most to the predictability of the event?

- Atmosphere dominated in predictability with ocean showing episodic but significant contributions

# NEXT STEPS: PERU 2023 CYCLONE YAKU & EXTREME PRECIPITATION

- Anomalous precipitation for March, April, and May (MAM)
- Cyclone Yaku occurred in early March
- Coastal El Niño is a potential driver

