
Asian Summer Monsoon Variability during 2022-2023: Beyond Canonical Teleconnection Patterns

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CLIVAR-GEWEX Monsoons Panel and WG Asian- Australian Monsoons

Monsoons Panel:

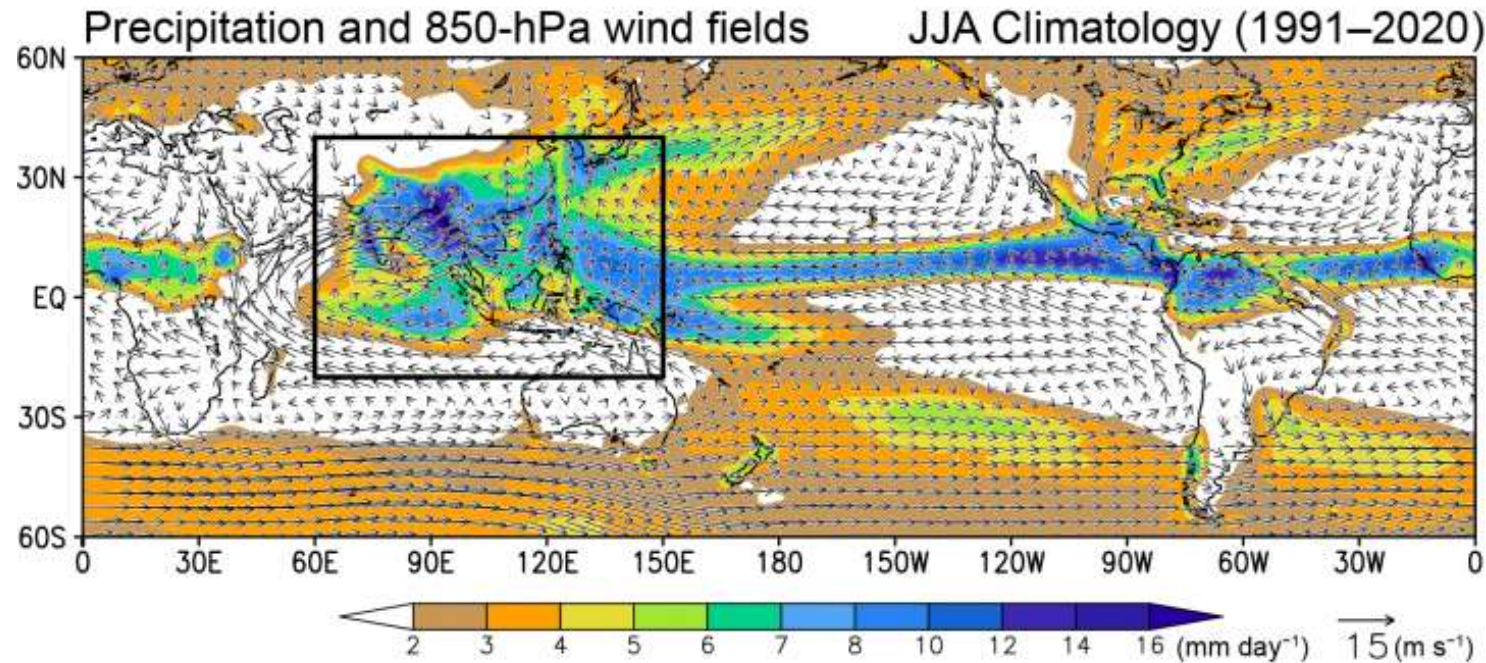
Global view of monsoon activities, enabling knowledge & best practices to be shared between monsoon regions, and coordinate monsoons research between GEWEX and CLIVAR, and the 3 regional working groups.

Regional Working Group on Asian-Australian Monsoons:

- To promote and facilitate engagement & interaction among research, operational predictions, and stakeholders in the different regional monsoon components of the Asian-Australian Monsoon;
- To provide authoritative information on processes understanding, models' fidelity in their (regional components) representations, and forecast skill assessment.

Asian summer monsoon

Outflows from the southern hemisphere bring summer monsoon rains over South Asia, East Asia, and parts of Southeast Asia.



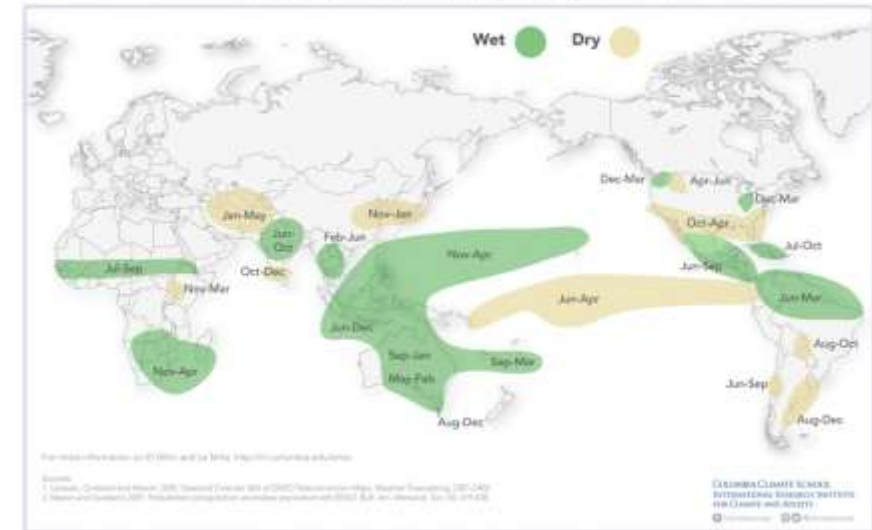
Data: GPCPv2.3 and JRA3Q 850hPa. Wind vectors around mountains are masked out.

Canonical Teleconnection Patterns: ENSO

<https://iri.columbia.edu/our-expertise/climate/enso/>

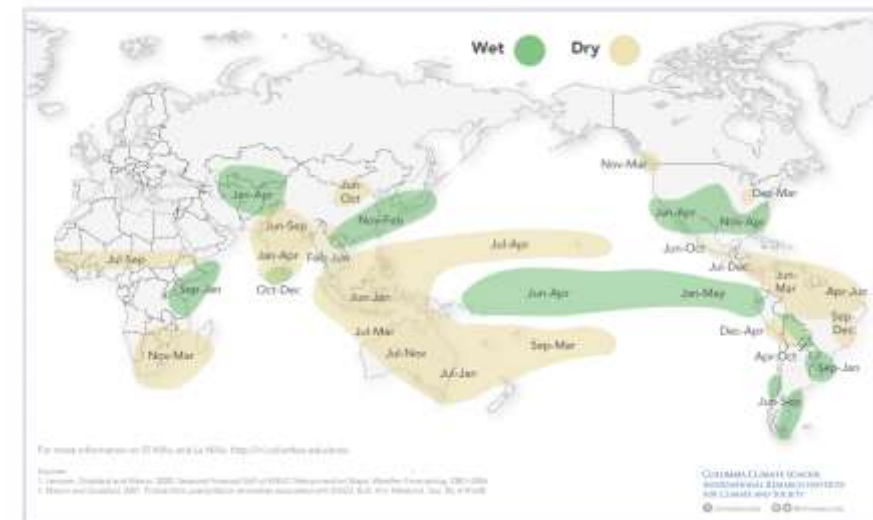
LA NIÑA AND RAINFALL

La Niña conditions in the tropical Pacific are known to shift rainfall patterns in many different parts of the world. The regions and seasons shown on the map below indicate **typical** but not guaranteed impacts of La Niña.

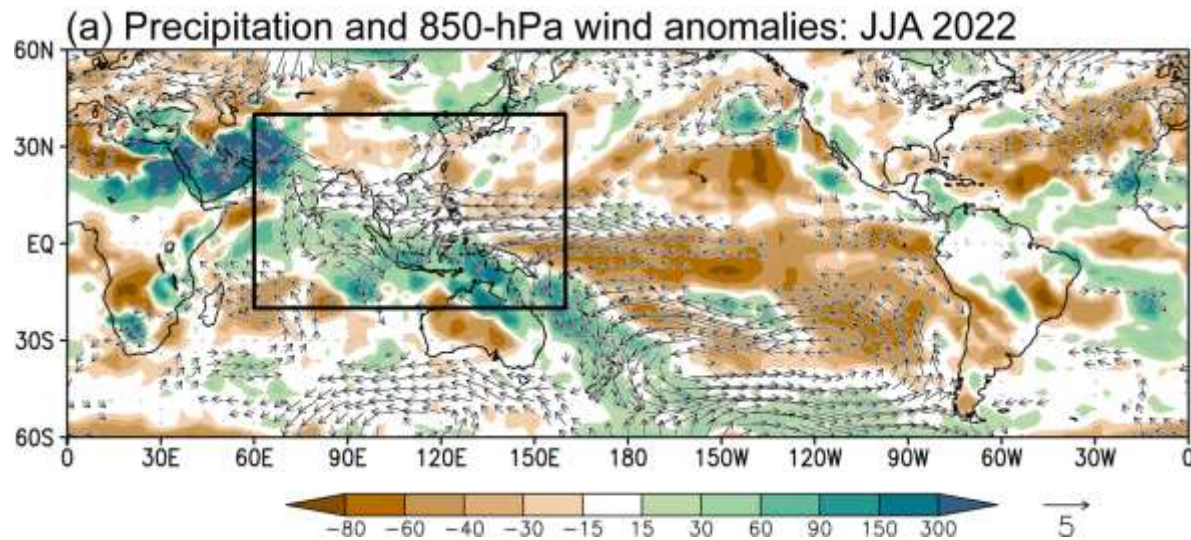


EL NIÑO AND RAINFALL

El Niño conditions in the tropical Pacific are known to shift rainfall patterns in many different parts of the world. The regions and seasons shown on the map below indicate **typical** but not guaranteed impacts of El Niño.



Asian summer monsoon 2022



Drivers:

- Midway through 'triple dip' La Niña
- Negative IOD developed around the middle of 2022

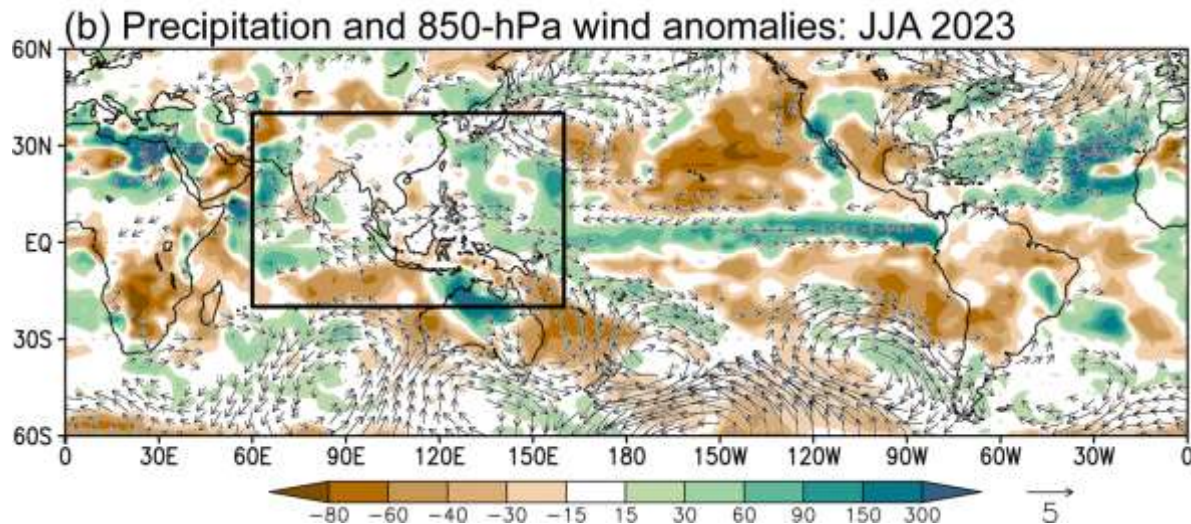
Monsoon:

Above-normal rainfall over western parts of India, Sri Lanka, and the Maritime Continent

Weak monsoon westerlies over Bay of Bengal into Mainland Southeast Asia (with associated suppressed convection)

Onset near average or earlier

Asian summer monsoon 2023



Drivers:

- La Niña ended in early 2023, El Niño conditions established by September 2023 (warmer SSTs for much of the tropics)
- Positive IOD developed in August 2023
- Prolonged global heatwave
- Weaker MJO and BSISO activity

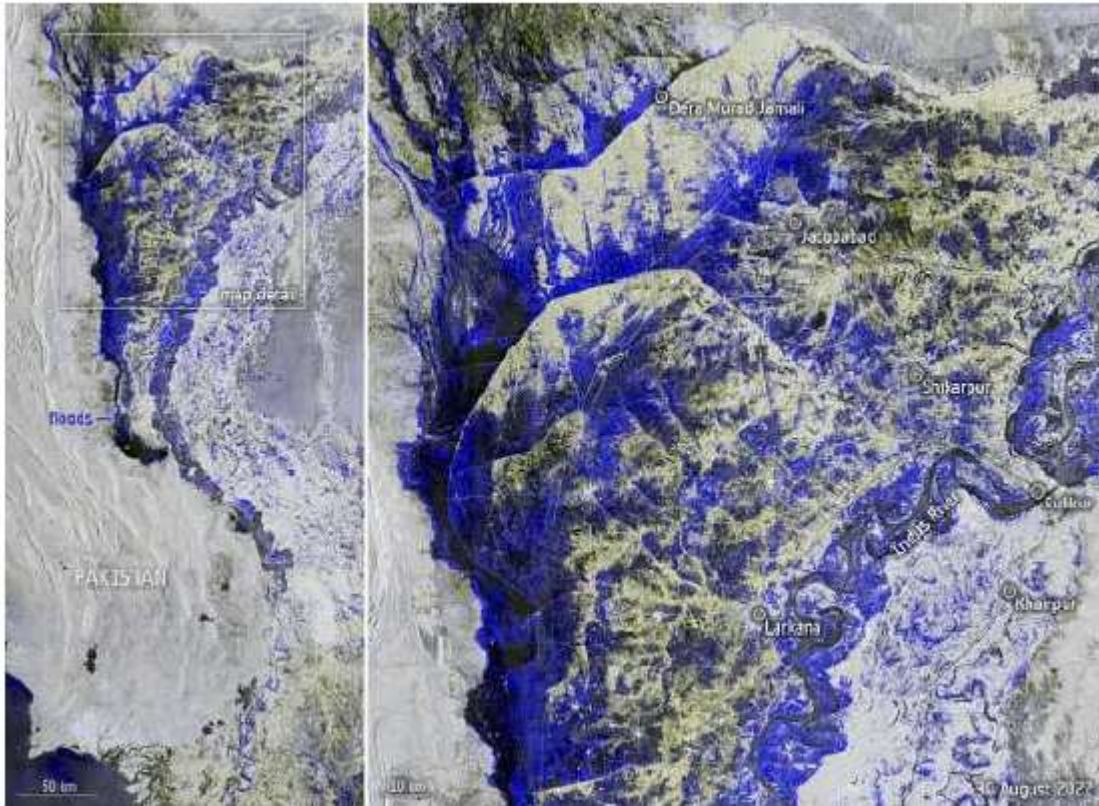
Monsoon:

Enhanced rainfall western Pacific and East Asia, less rainfall northeast India

Fewer notable wind and rainfall anomalies

Slight delays in onset

Extreme event: 2022 Pakistan

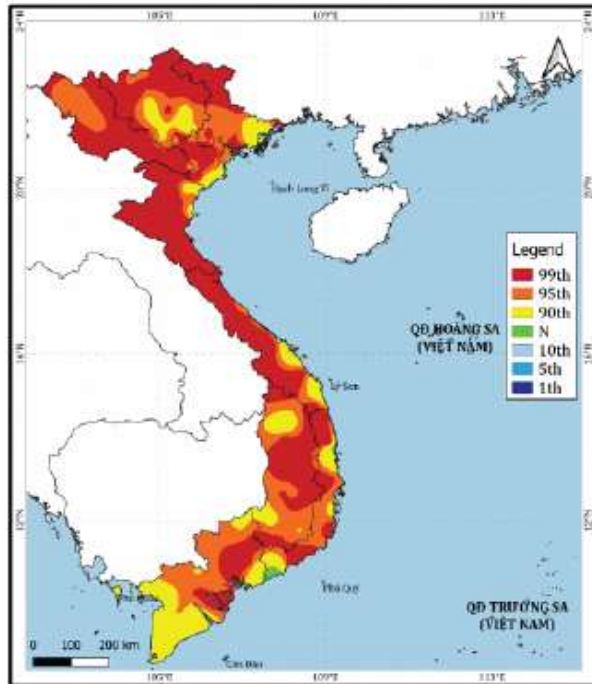


In the first three weeks of the monsoon season, the country received 60% of average monsoon rainfall.

Almost 14% of the Pakistan population were affected, including 8 million people displaced. During June – August, 1.4 million hectares of agricultural land was wiped out.

Flooding in Pakistan on 30 August,
State of the Climate in Asia, 2022
report

Extreme event: 2023 heatwaves



Temperature anomaly percentile over Viet Nam in May 2023

ASMC Bulletin #11

Prior to summer monsoon, prolonged heatwave in April/May extending from Bangladesh and eastern Indian to southern China, and Mainland Southeast Asia.

During monsoon:

21 June – 9 July, heatwave in north China (70% of station above 40°C)

Japan had its hottest summer on record (since 1898)

Extreme events

Number of hazardous events both years in June – August (JJA)

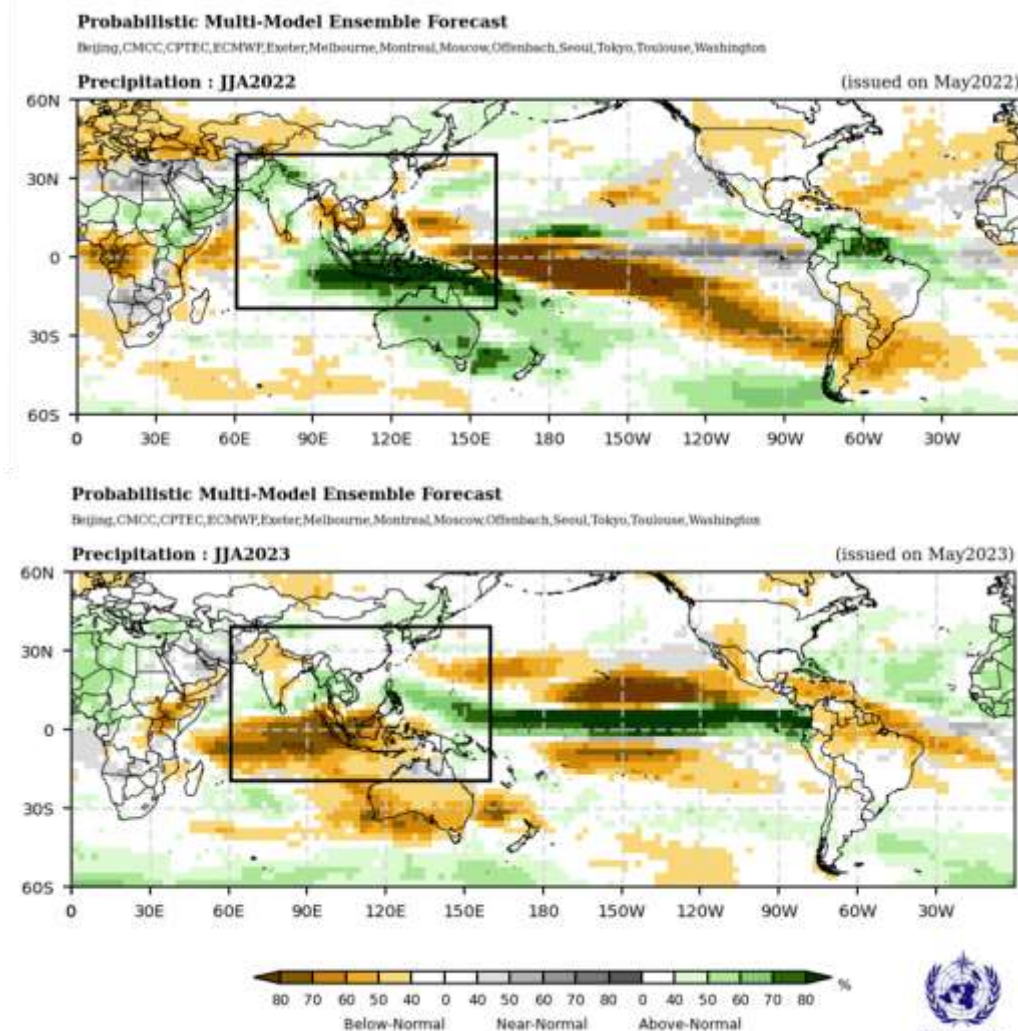
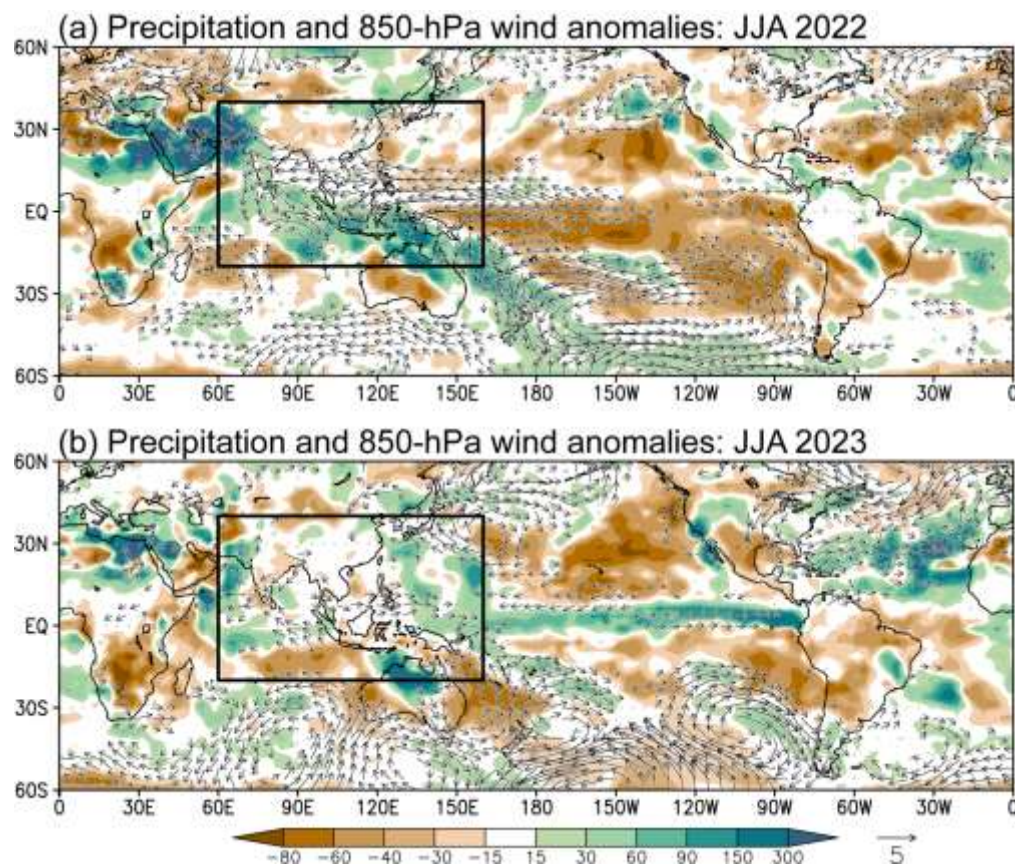
Numerous floods, heatwaves both years, 2023 lowest number of typhoon landfalls in North Pacific since 1981

>> not all covered (in terms of reporting, and those outside JJA, e.g. heavy rainfall over Sri Lanka in September)

		2022	2023
Warm and/or Dry	Heat wave	Bangladesh (July–August) Eastern China (June–August) Hong Kong, China (July) Eastern, western Japan (June–July)	North China (June–July) Hong Kong, China (June–August) Uttar Pradesh, India (June) Northern, eastern Japan (June–September) Republic of Korea (May–August)
	Fog/haze/smog	–	Malaysia (July–October)
	Drought/dry spell	Yangtze River, China (July–November) Pakistan (March–June) Eastern parts, Papua New Guinea (May–October)	–
Wet	Flood	Assam, India (May–July) Sulawesi, Indonesia (July) Pakistan (July–August) Thailand (August)	Beijing-Tianjin-Hebei, China (July) Raigarh and Shimla, India (July–August)
	Landslide/mud-slide & debris flow	Noney and Asaam, India (June)	Vietnam (August)
	Rain/wet spell	Maldives (July) Myanmar (July–August) Bangkok, Thailand (July)	Pakistan (June) Republic of Korea (July)
	Tropical cyclone	South China (July)	South and east China (July) Pakistan (June) Republic of Korea (August)
	Thunderstorms/squall lines	Bihar, India (June)	–
	Lightning	India (June, July)	–

Forecast

- MME outlooks show reversal between 2022 and 2023
- Less agreement in 2023 – may be due to the later El Niño development



Outstanding challenges

- Changing climate:
 - Increases in some of the extremes
 - Changes in the 'conventional teleconnection patterns' from drivers such as ENSO
- Predicting patterns within season, particularly extremes

>> requires coordinated diagnostic and modelling activities among researchers, forecasting community, and international resources

More information: Ajayamohan et al., on behalf of the CLIVAR/GEWEX Regional Working Group on Asian-Australian Monsoons (2024) Asian Summer Monsoon Variability during 2022–2023: Beyond Canonical Teleconnection Patterns. GEWEX Quarterly, vol 34, no 3, Quarter 3, 2024.

>> Goal to further incentivise the wider community to look into this more

Thank you

Ajayamohan et al., on behalf of the
CLIVAR/GEWEX Regional Working Group on
Asian-Australian Monsoons (2024) Asian Summer
Monsoon Variability during 2022–2023: Beyond
Canonical Teleconnection Patterns. GEWEX
Quarterly, vol 34, no 3, Quarter 3, 2024.

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