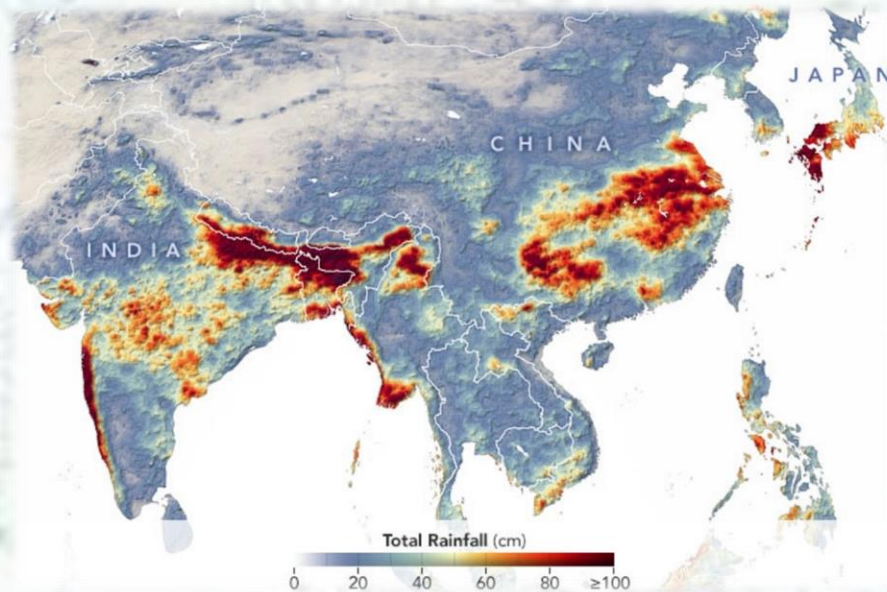




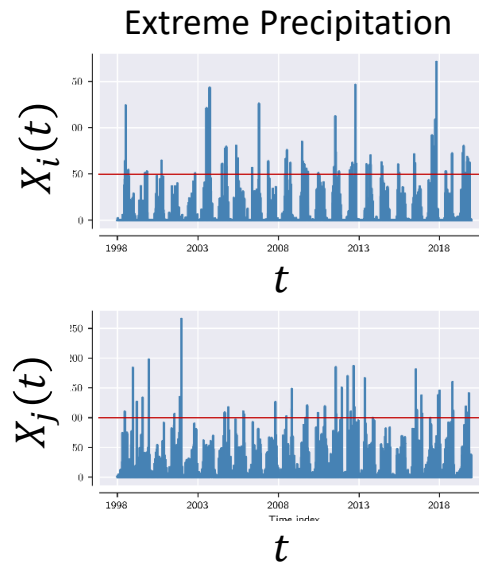
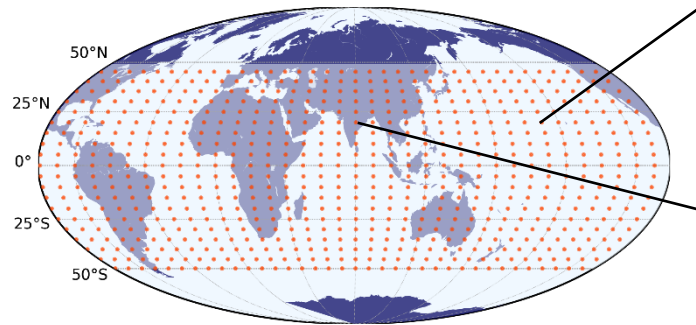
Interrelation between the Indian and East Asian Summer Monsoon: A Complex Network-based approach



Shraddha Gupta, Zhen Su, Niklas Boers, Jürgen Kurths,
Norbert Marwan, and Florian Pappenberger

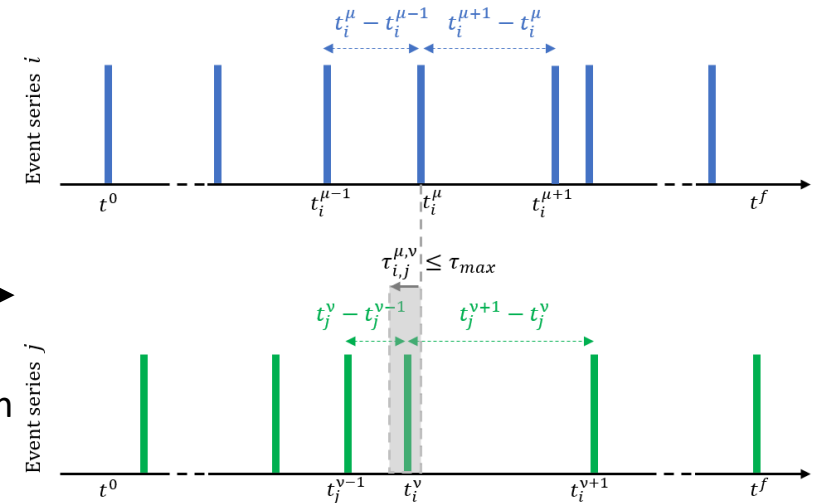
Climate Network Reconstruction – Extreme Precipitation

Climate Dataset: Nodes/ Grid points

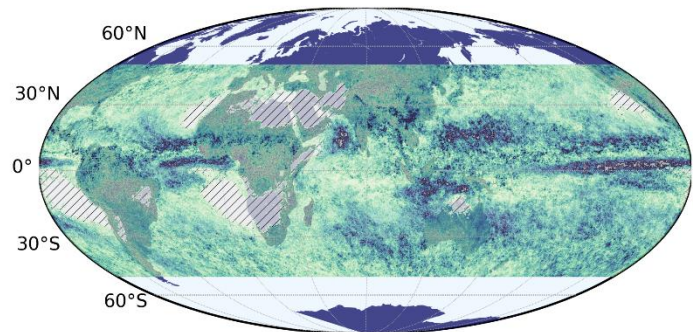


Compute similarity

– Event synchronization

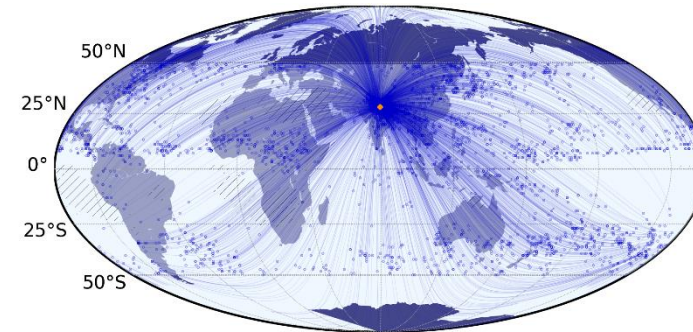


Counts number of “synchronized” events, $c(i|j)$



Quantify topology
Network Measure:

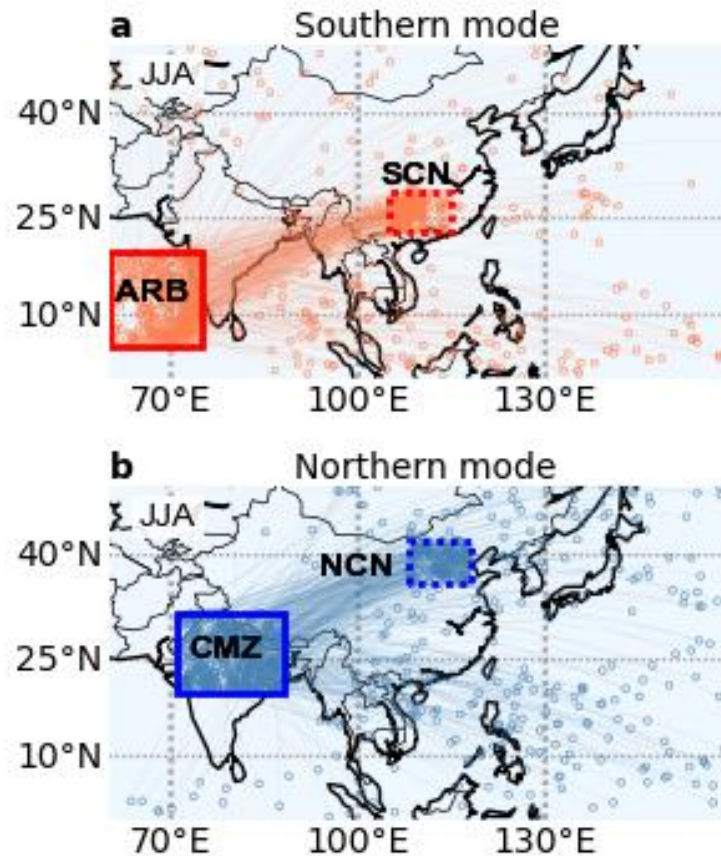
- Degree: No. of connections of one node with other nodes.



Thresholding – significant links

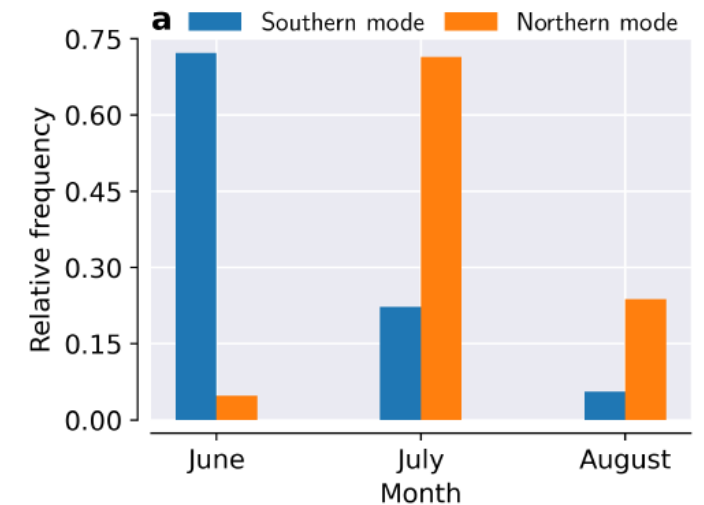
- Dataset – TRMM 3B42 V7, daily total precipitation (1998-2019), 0.25°x0.25° spatial res., Jun-Jul-Aug
- Events > 90th perc. of wet days for each location.

Precipitation Networks – *ISM-EASM Interaction*



- We identify two dominant synchronization pathways between ISM and EASM
 - **Southern Mode:** Arabian Sea and South-western part of India with Southern China (Yangtze river basin – Meiyu rainfall)
 - **Northern Mode:** Northern and Central part of India with Northern China (Beijing, Tianjin etc., near the Yellow River)

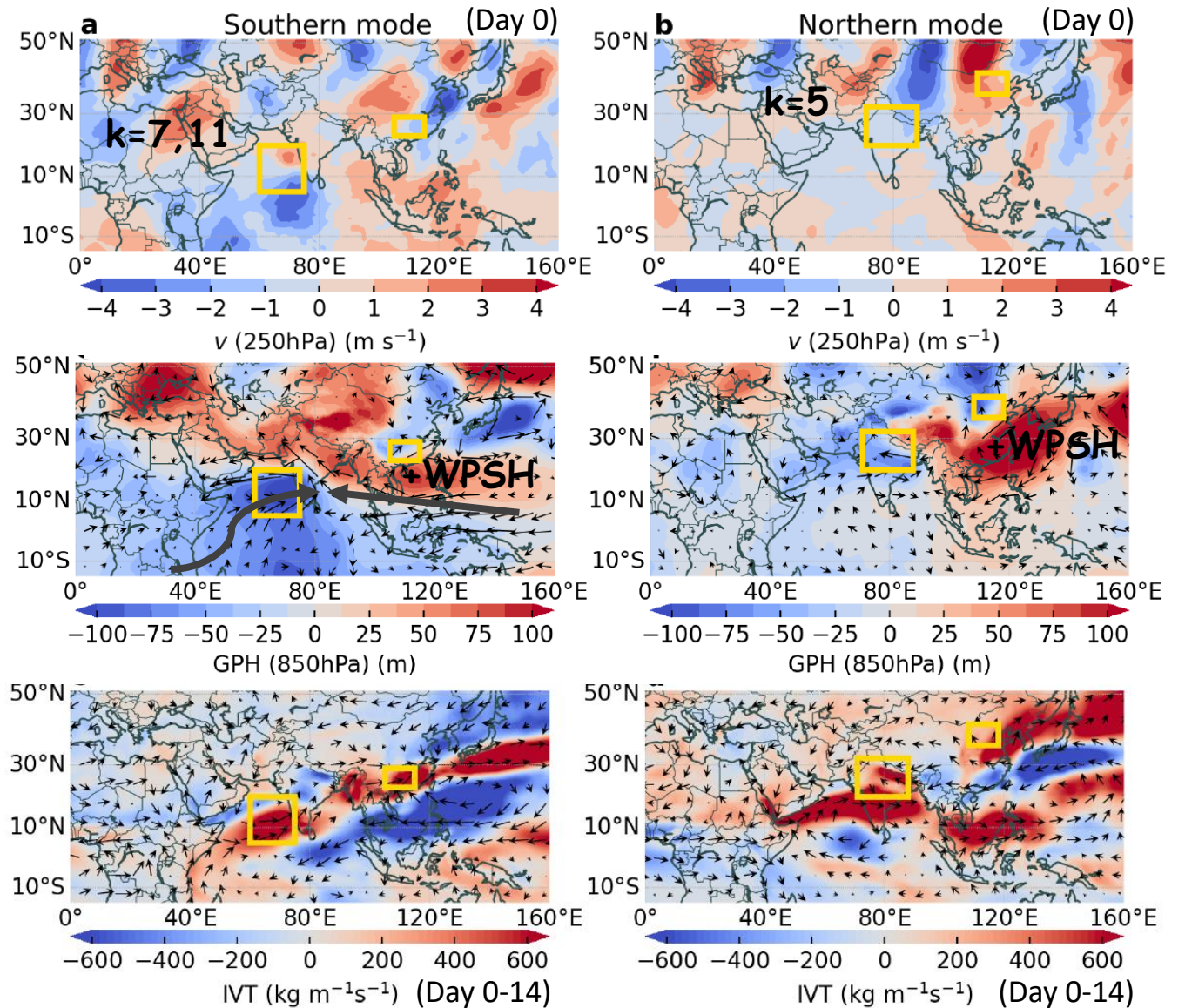
- The month-wise distribution of days with high Extreme Rainfall Events synchronization
 - **Southern Mode:** June
 - **Northern Mode:** July



Gupta *et al.*, 2022 (*Under Review*)

Atmospheric Circulations – *ISM-EASM Interaction*

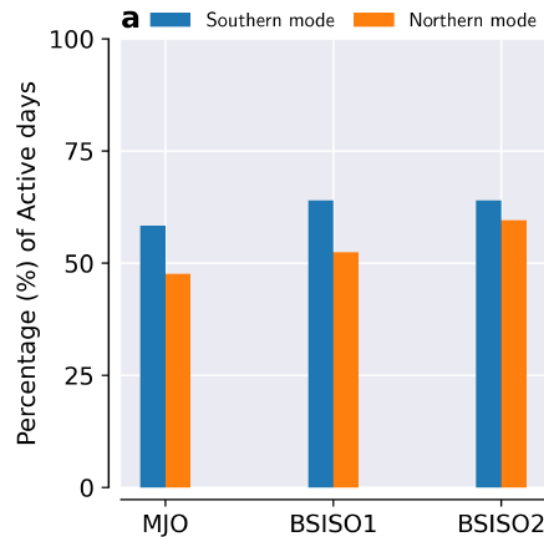
- Identification of specific times of high rainfall synchronization for each mode.
- Compute composites of associated large-scale atmospheric circulation (Wind, GPH, etc.) and moisture transport patterns.



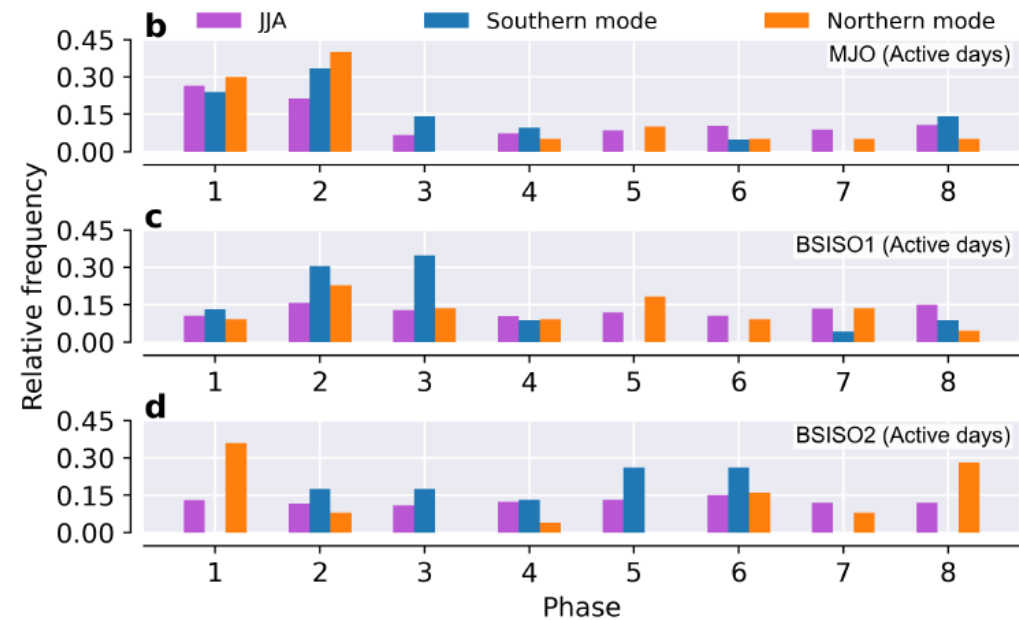
Gupta *et al.*, 2022 (*Under Review*)

Intraseasonal Oscillations – ISM-EASM Interaction

- Classify the days when high synchronization occurs for each mode according to active/inactive MJO, BSISO.



- ~40% of days of high rainfall synchronization are inactive in BSISO/MJO.



- Extreme rainfall events over the Asian monsoon region are favoured by certain phases of the lower frequency mode (MJO, BSISO1), while
- The higher frequency mode (BSISO2) may support the switch between the two interaction modes.

Gupta *et al.*, 2022 (*Under Review*)

Conclusion – *ISM-EASM Interaction*

- Complex network approach sheds light on the intricate relationship between the different components of Asian Summer Monsoon.
- Identification of two modes of interaction between Indian and East Asian Summer Monsoon.
- Southern mode of synchronization occurs in **June** while Northern mode peaks in **July**.
- **Southern mode:** Mainly associated with convergence of Somalian Jet with easterly winds in the lower boundary of the Western North Pacific Subtropical High (Onset of ISM and Meiyu over Yangtze).
- **Northern mode:** Associated with Silk Road Teleconnection.
- Particular phases of MJO and BSISO are associated with enhanced rainfall synchronization between ISM and EASM.

Further References:

- Gupta, S., Su, Z., Boers, N., et al., (2022). *Interconnection between the Indian and the East Asian Summer Monsoon: spatial synchronization patterns of extreme rainfall events*, (Under Review)
- Boers, N., Goswami, B., Rheinwalt, A., et al. (2019). *Complex networks reveal global pattern of extreme-rainfall teleconnections*. *Nature*, 566, 373–377.
- Liu, Y., Liang, P. and Sun, Y. (2019) *The Asian summer monsoon: characteristics, variability, teleconnections and projection*. Elsevier.

Image Courtesy in Title slide:

- NASA/GSFC, GMP/IMERG
- <https://p.dw.com/p/3M1TF>
- <https://p.dw.com/p/3rx9l>
- <https://en.wikipedia.org/wiki/Monsoon>
- <https://www.tripsavvy.com/traveling-during-the-monsoon-season-1458706>