

# Can Soil Moisture Anomalies Trigger Extreme Precipitation Events Over India? (GC54C-07)

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# Motivation



- SM – P coupling studies – yet unresolved problem
- Modelling studies, moisture recycling and water vapour tagging
- Indirect interaction should also be considered<sup>2,3</sup>
- Positive feedback / negative feedback
- Difficulties in establishing causal relationship
- Need for data driven exploratory tools

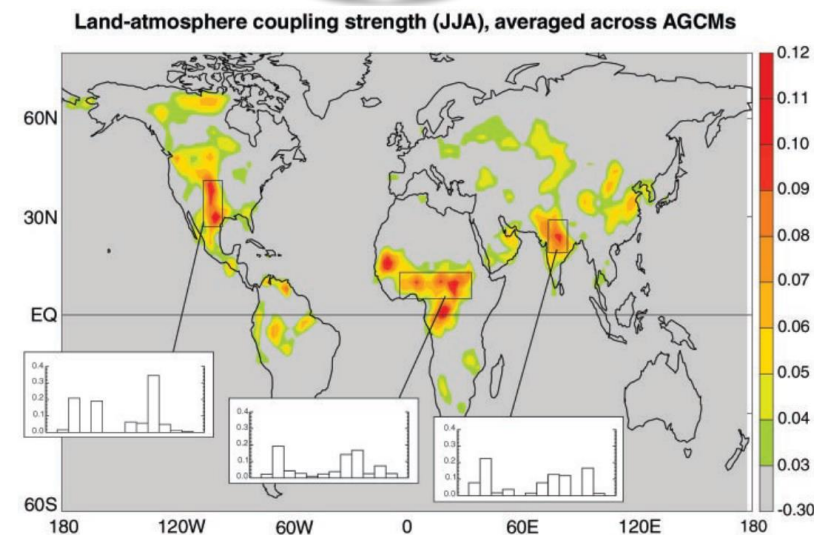
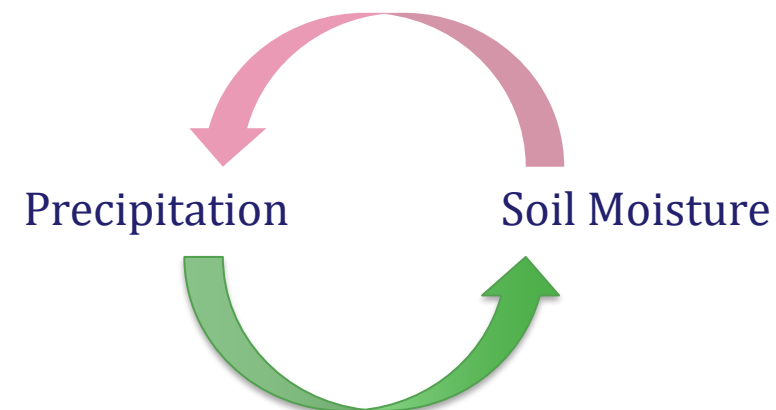
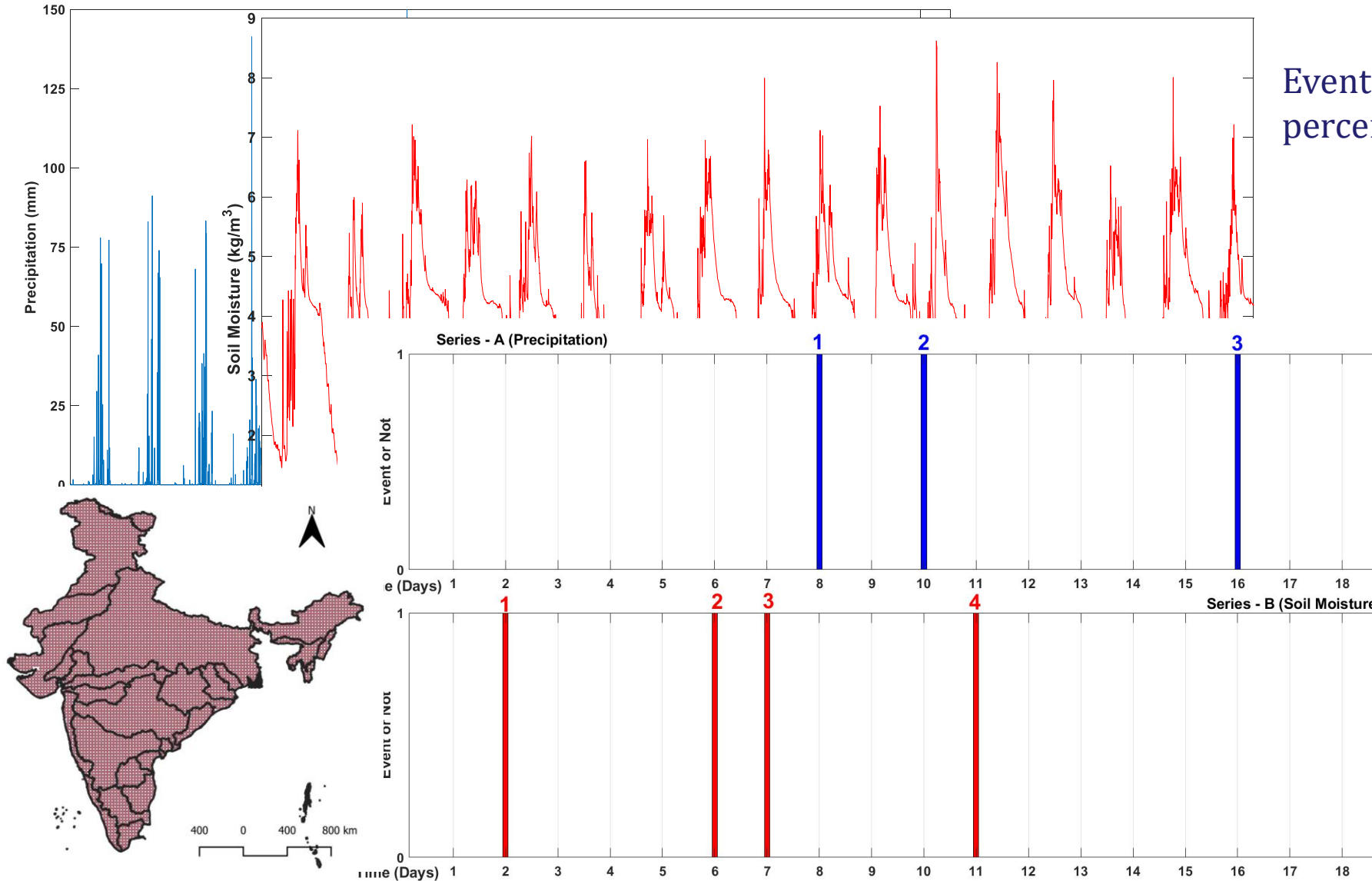


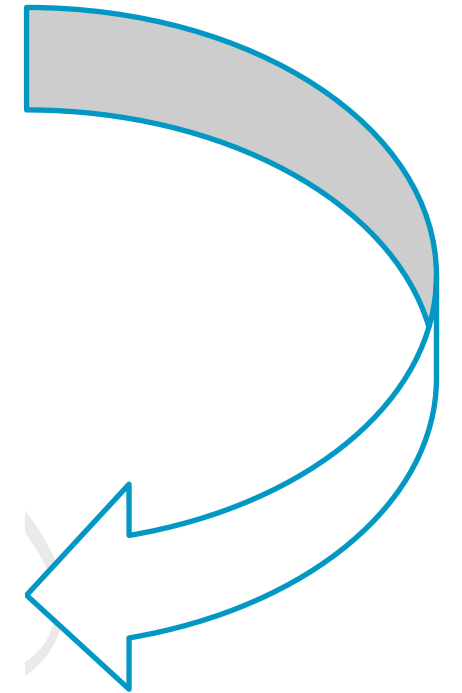
Image from Koster *et al.*, 2004

- 1) Koster *et al.*, 2004
- 2) Seneviratne *et al.*, 2010
- 3) Brimelow *et al.* 2011

# Methodology

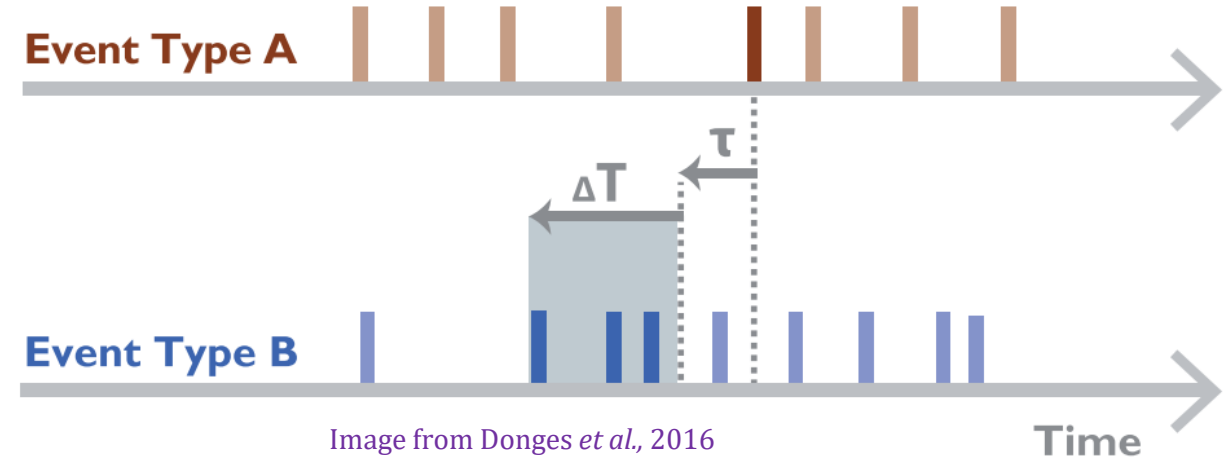
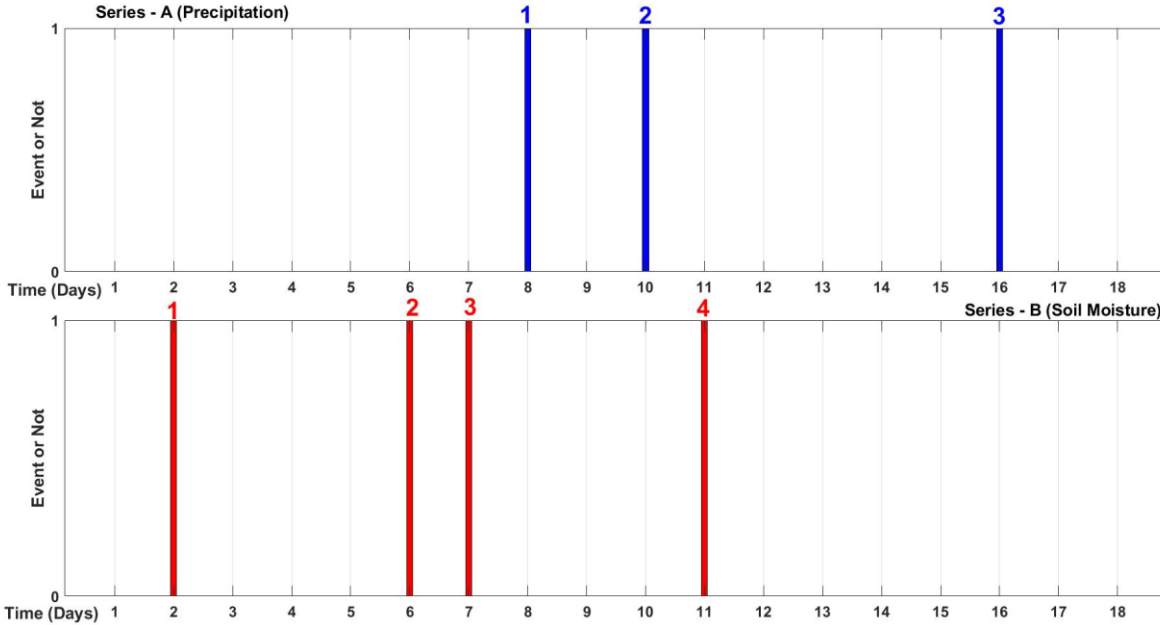


Event Series is extracted by using percentile cut-offs (90<sup>th</sup> Percentile)





# Methods - ECA



$$I_{[0, \Delta T]}(x) = \begin{cases} 1, & x \in [0, \Delta T] \\ 0, & \text{else} \end{cases}$$

$$H(x) = \begin{cases} 1, & x \geq 0 \\ 0, & \text{else} \end{cases}$$

$$\text{Precursor coincidence rates, } r_p(\Delta T, \tau) = \frac{1}{N_A} \sum_{i=1}^{N_A} H \left( \sum_{j=1}^{N_B} I_{[0, \Delta T]}(t_i^A - \tau) - t_j^B \right)$$

$$\text{Trigger coincidence rates, } r_t(\Delta T, \tau) = \frac{1}{N_B} \sum_{j=1}^{N_B} H \left( \sum_{i=1}^{N_A} I_{[0, \Delta T]}(t_i^A - \tau) - t_j^B \right)$$

Significance test ( $\alpha = 0.10$ ) to ensure that observed coincidences are not due to randomness

## Soil Moisture

- NASA's Global Land Data Assimilation System
- $0.25^\circ \times 0.25^\circ$
- GLDAS – CLSM 2.2

*Li et al., 2019, Rui et al., 2020*

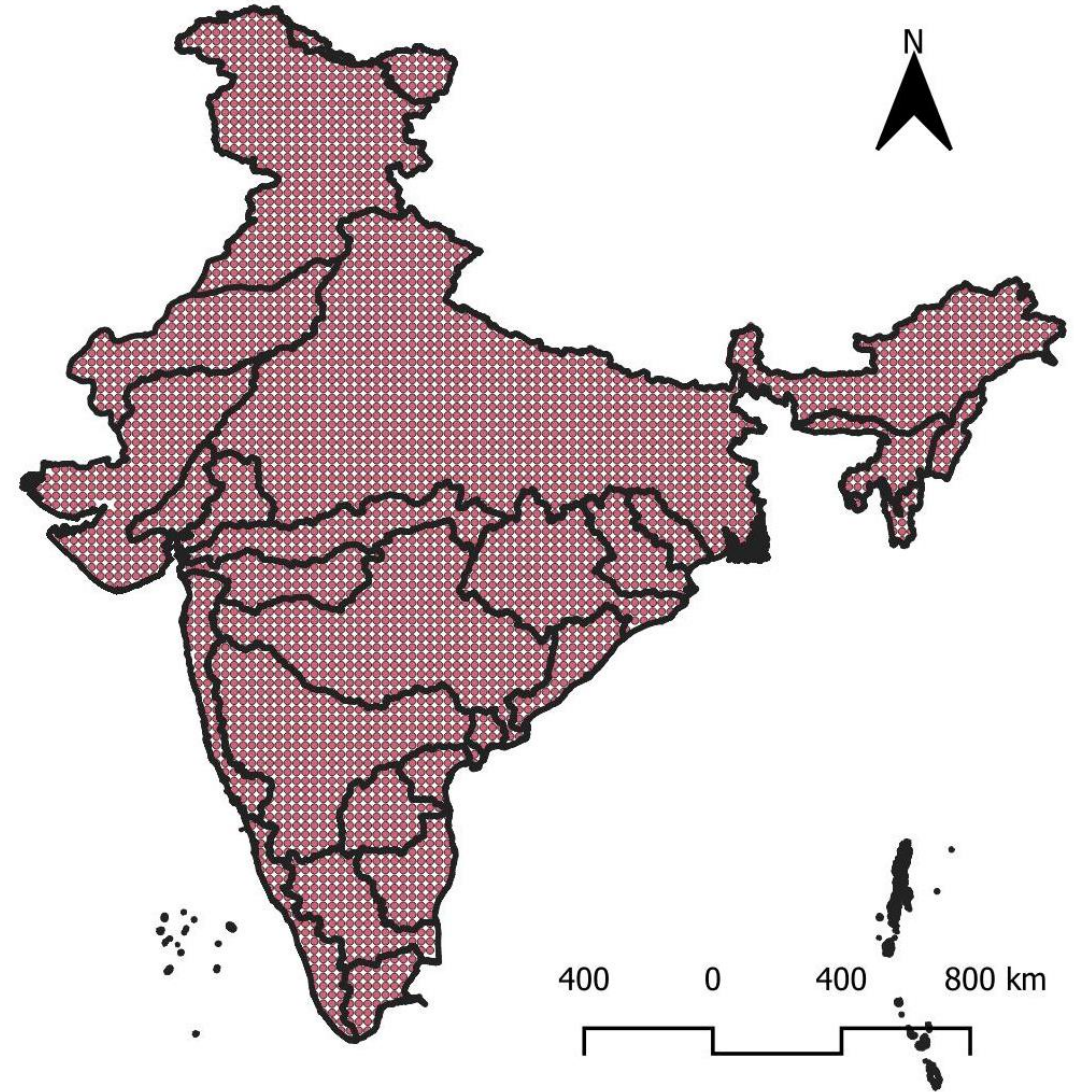
<https://doi.org/10.5067/TXBMLX370XX8>

## Precipitation

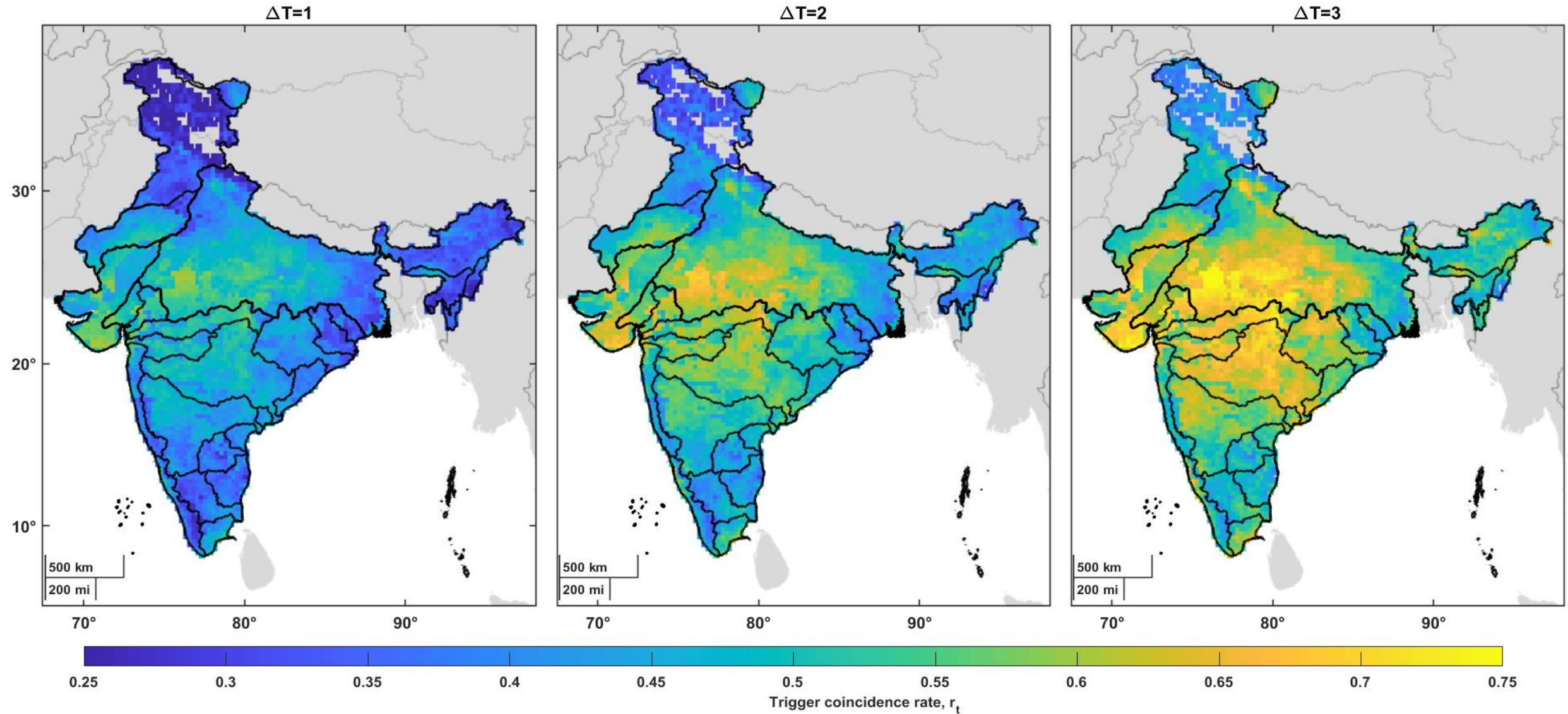
- GPM – Global Precipitation Mission
- $0.1^\circ \times 0.1^\circ$
- IMERG – Version 06

*Huffman et al., 2020*

<https://doi.org/10.5067/GPM/IMERGDF/DAY/06>



# Results

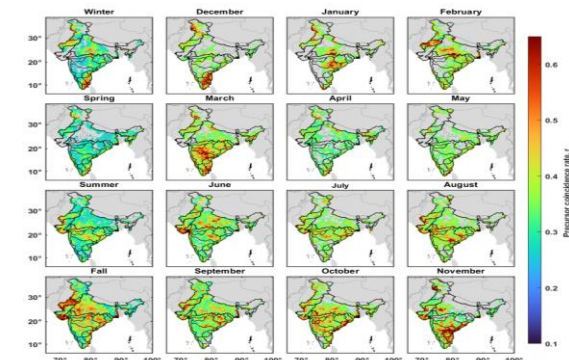
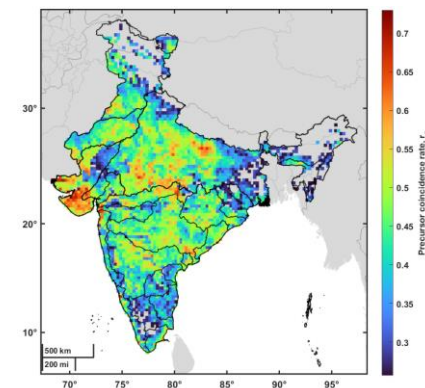






# TAKE HOME MESSAGE

- ECA used to disentangle SM-P coupling over India
- Trigger hotspots bear similarity to continental hotspots – Koster et al. 2004
- Tendency of the hotspots to concentrate over the middle of Central India
- Results support the hypothesis of increased coupling in transitional regions
- Early warning systems can be modelled to consider such coupling phenomenon
- May prove helpful in flood forecast purposes.



# THANK YOU

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