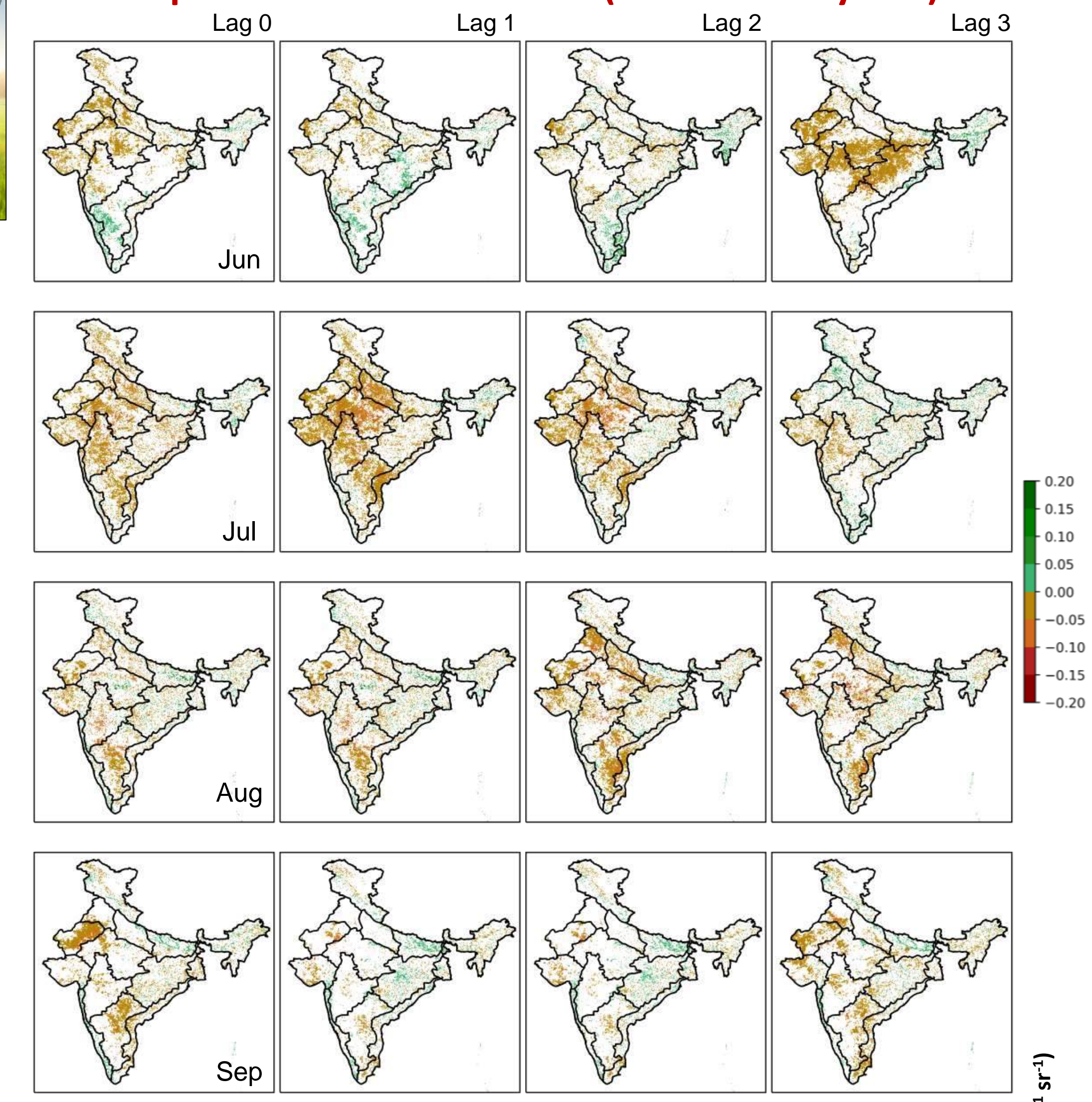


# Tropical Pacific Ocean SST Teleconnections for the Vegetation Photosynthetic Activity in India

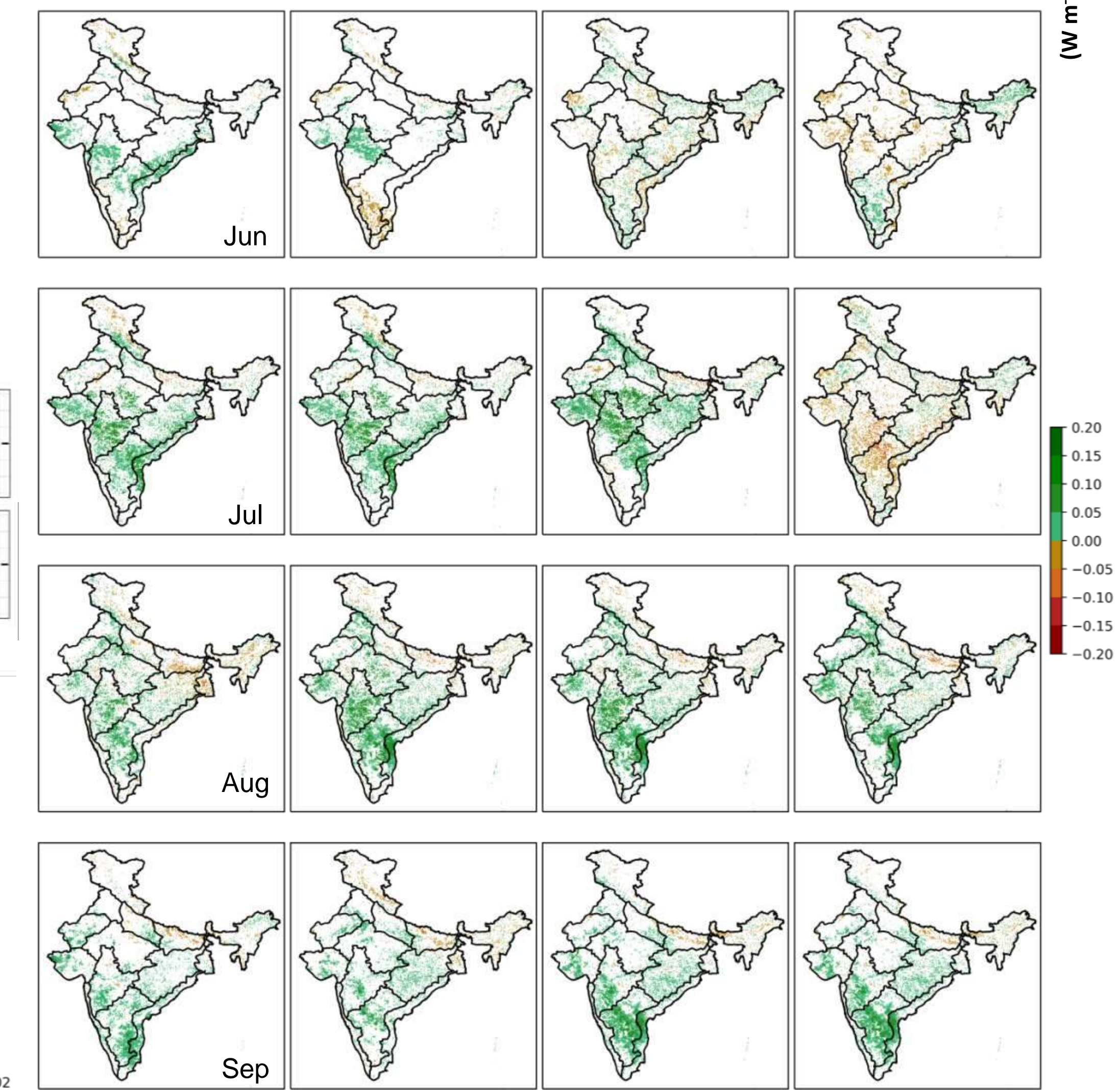
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## Composites of SIF anomalies (Positive SST years)



## Composites of SIF anomalies (Negative SST years)

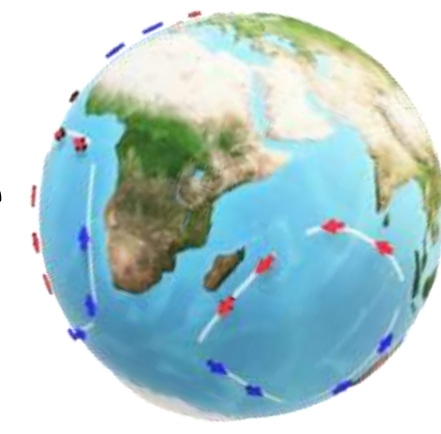


- Warm anomaly in Nino 3 region – Negative SIF anomalies
- Cold anomaly in Nino 3 region – Positive SIF anomalies
- Strong SST-SIF link in July
- Water-limited ecosystems are severely affected by the SST variations

## Background

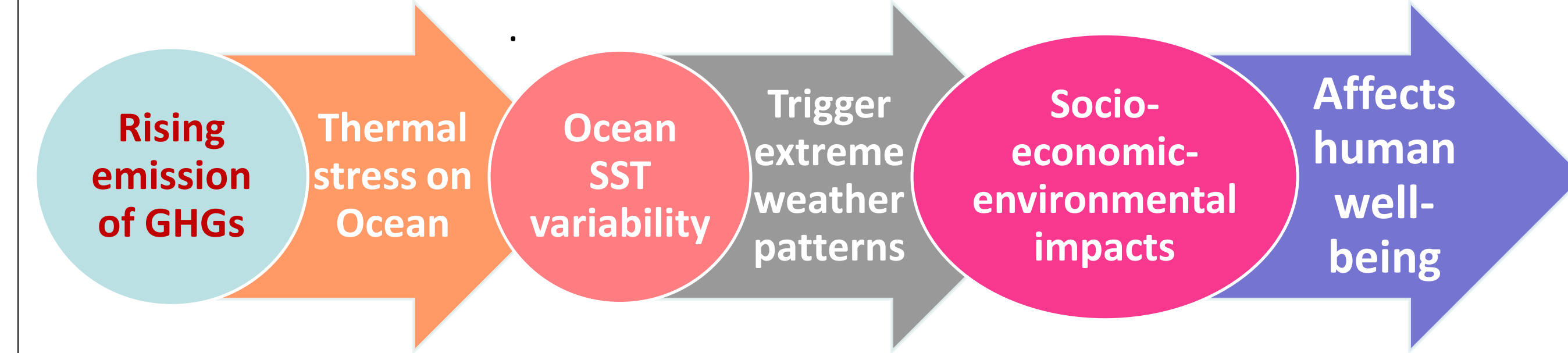
Oceans “the essential elements of earth’s climate system”

- ✓ Regulates climate by Storing and distributing heat across the globe
- ✓ Air-sea interactions



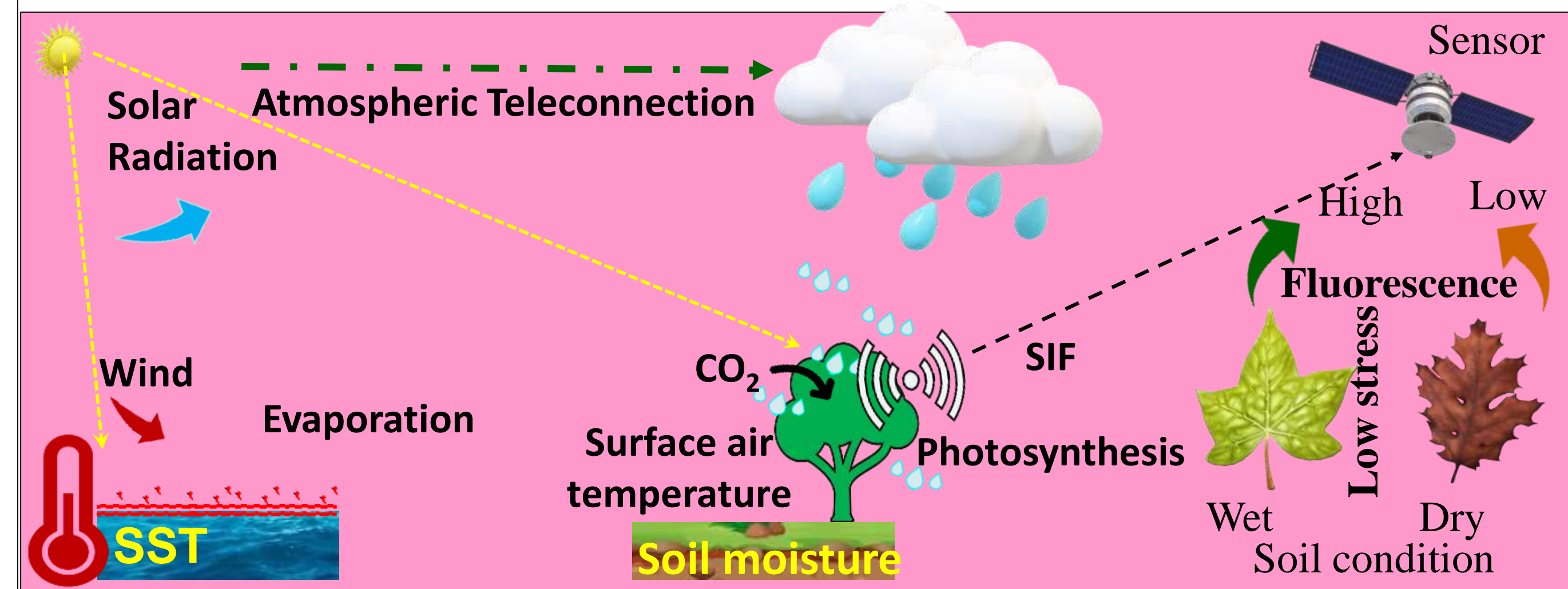
## Sea surface temperature (SST)

- Measure of ocean surface heat
- Critical climate variable



## Motivation

The ecological impacts of SST variations are a matter of global concern as it put huge pressure on the basic requirements on which all life forms ultimately depends.



• SST influence both marine and terrestrial ecosystem dynamics  
**SST variations - Control the fluxes of heat and moisture over land and modulate the vegetation photosynthesis**

• Terrestrial vegetation is known to influenced by SST variations, especially in the tropical belt (Pereira et al., 2016; Huang et al., 2019; Yan et al., 2019; Kim et al., 2021; Lu et al., 2023)

Effects of SST on Indian vegetation photosynthetic activity have not yet been thoroughly investigated

## Solar-induced chlorophyll fluorescence (SIF)

Some of the solar photons absorbed by the pigments (mainly chlorophyll) in plant leaves are emitted at longer wavelengths as fluorescence.

- Remote sensing of SIF is a rapidly advancing front with diverse applications in terrestrial vegetation
- Represents the actual plant photosynthetic activity
- Better proxy of vegetation productivity than greenness based vegetation indices
- Respond rapidly to stress

- Vegetation activity in India - determined by hydrologic fluctuations, particularly rainfall
- Rainfall variability across India resonate with SST variations in the tropical Oceans, especially in the equatorial Pacific

## Objective

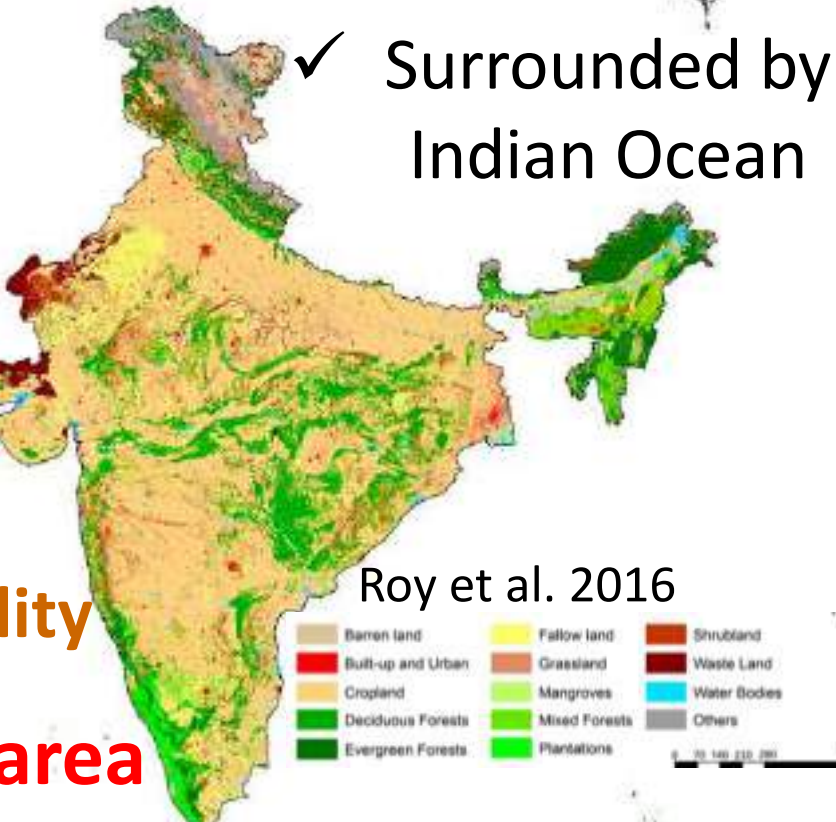
Therefore our study primarily aims to

Evaluates the relationship between NINO3 SST variability and SIF anomalies across India to assess the spatial and temporal variability in the ocean-vegetation interactions

## Methodology

India is an agriculture based country with rich natural vegetation

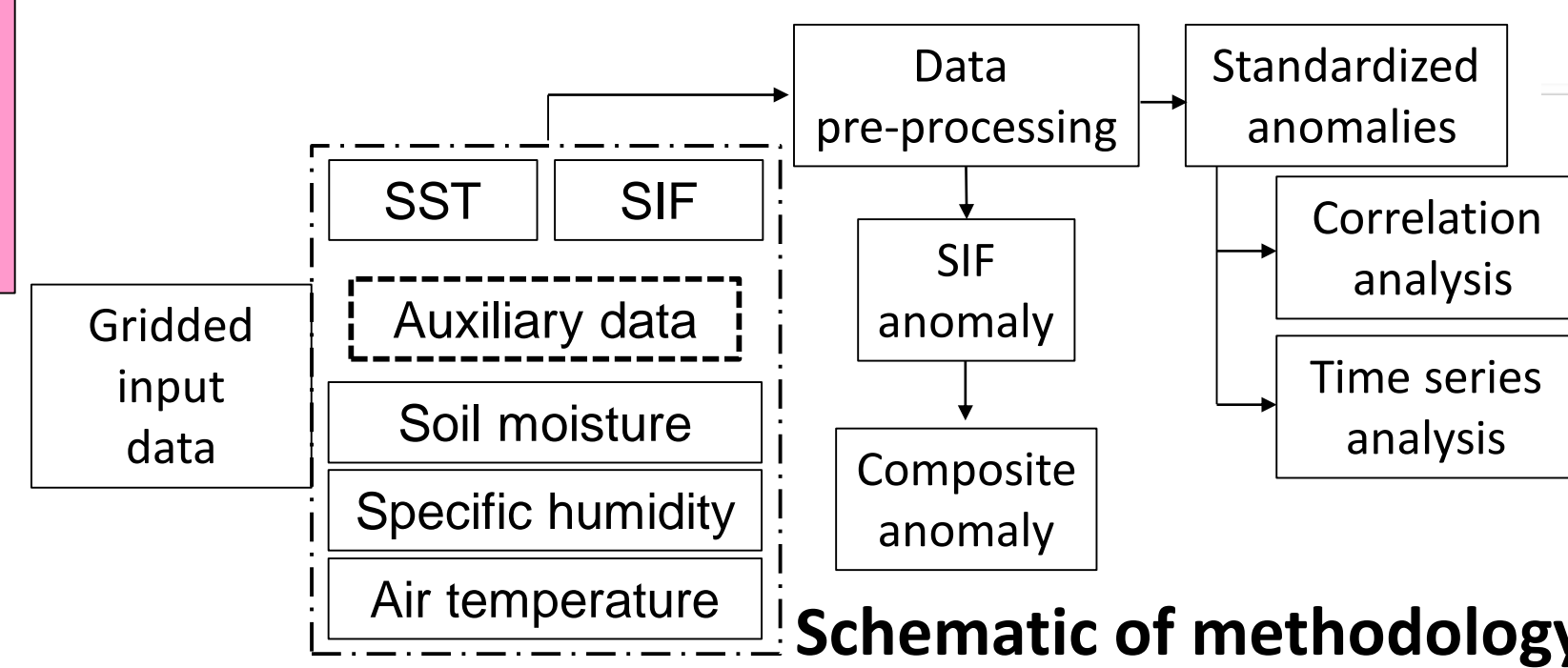
- ✓ Characterized by the monsoon climate



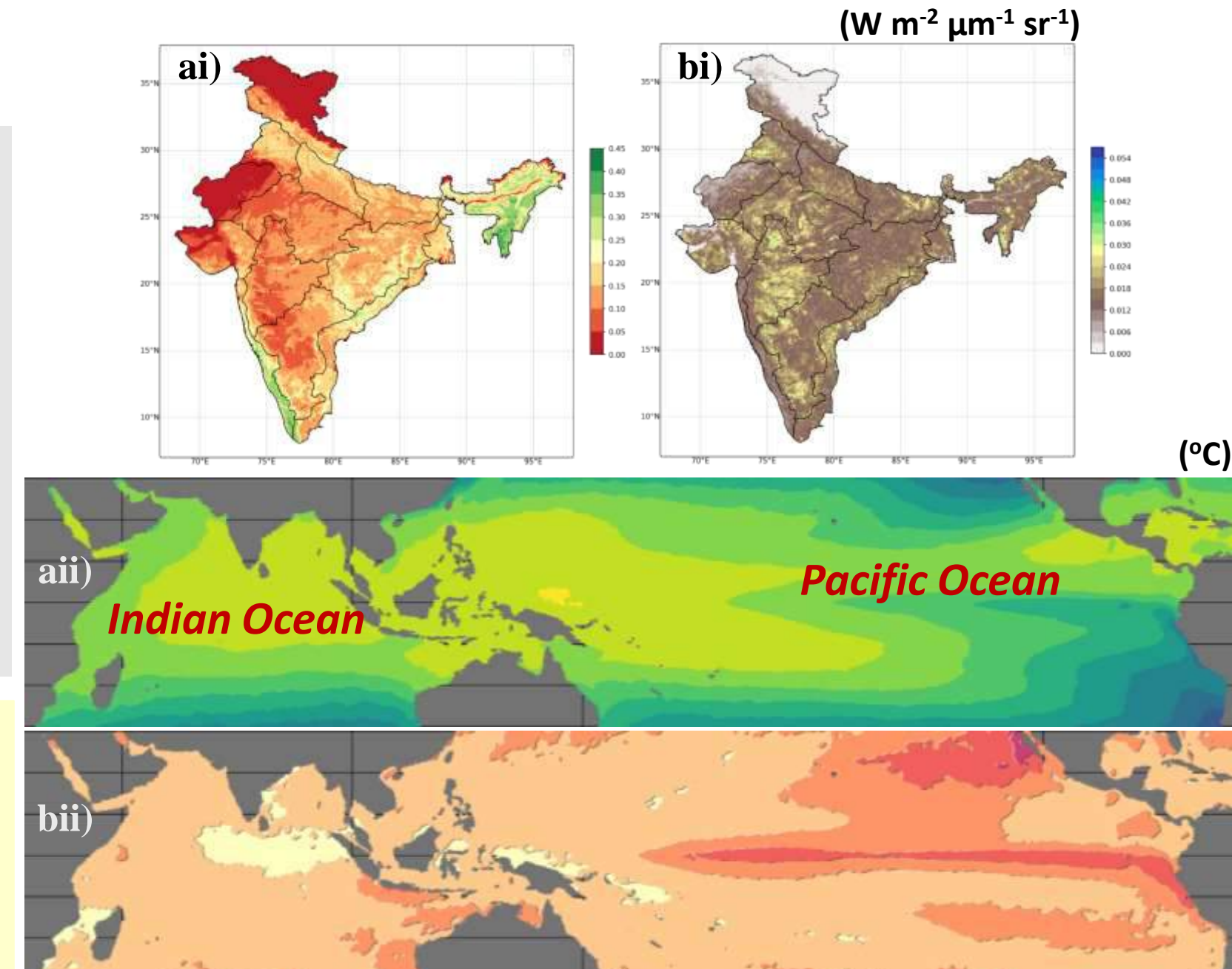
Economy of the country relies on monsoon variability

## Study area

Data	Resolution	Source
SST	0.25 x 0.25	NOAA OISST V2.1
SIF	0.05 x 0.05	GOSIF V2
Soil moisture	0.1 x 0.1	FLDAS
Specific humidity	0.5 x 0.625	MERRA – 2
Air temperature	0.5 x 0.65	MERRA – 2

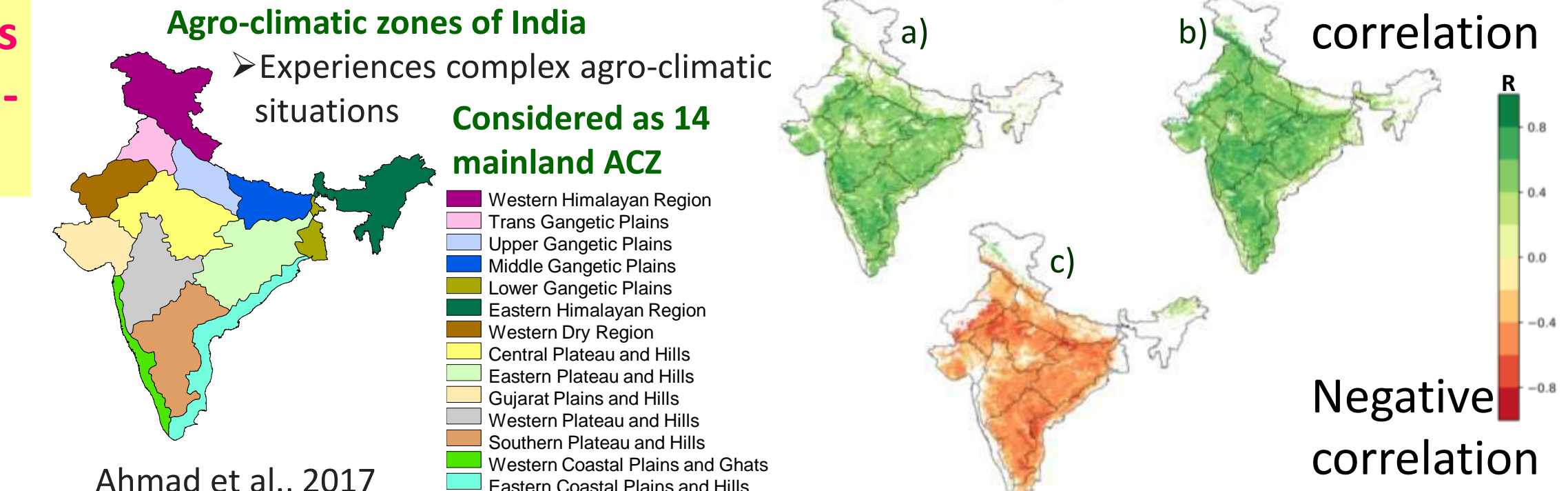


Annual a) climatology and b) standard deviation of i) SIF over India and ii) SST across tropical Indo-Pacific during 2001-2020

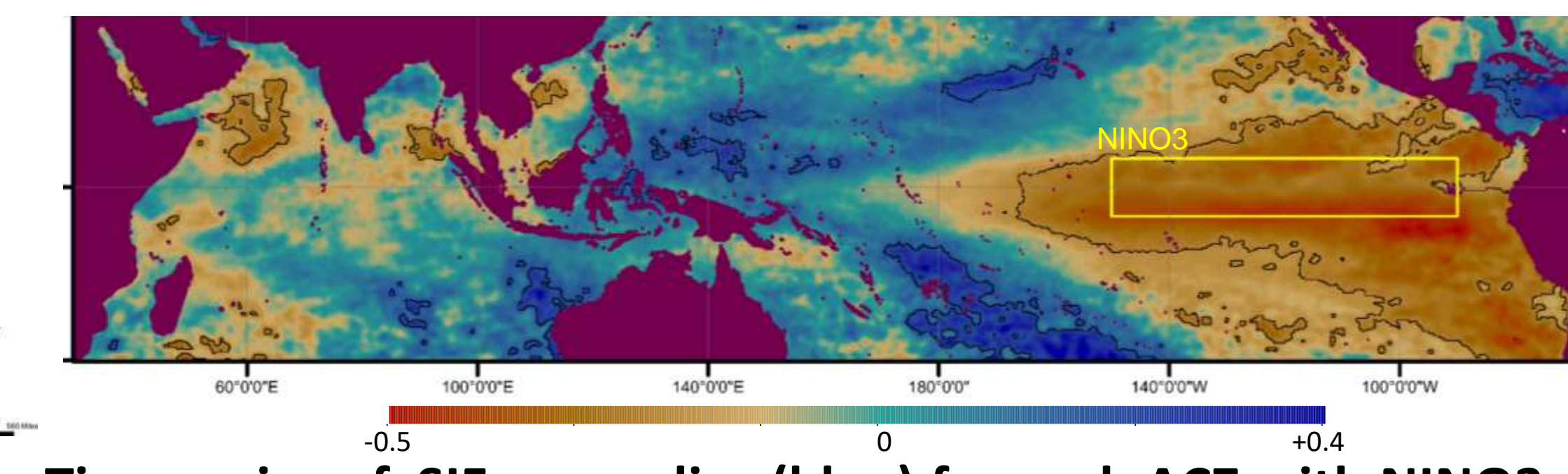


## Major Findings

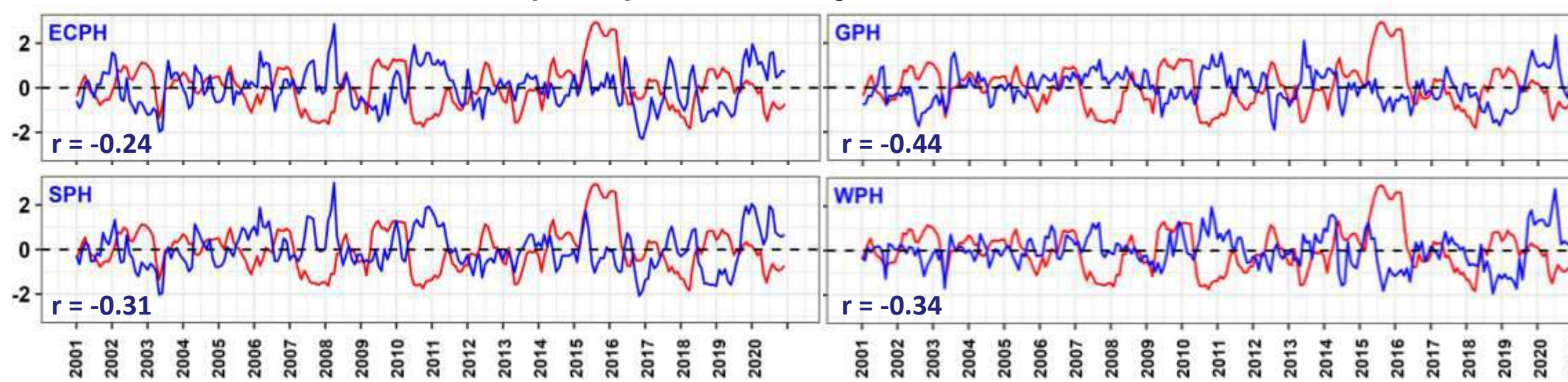
Correlation of SIF anomaly with a) soil moisture, b) specific humidity and c) air temperature



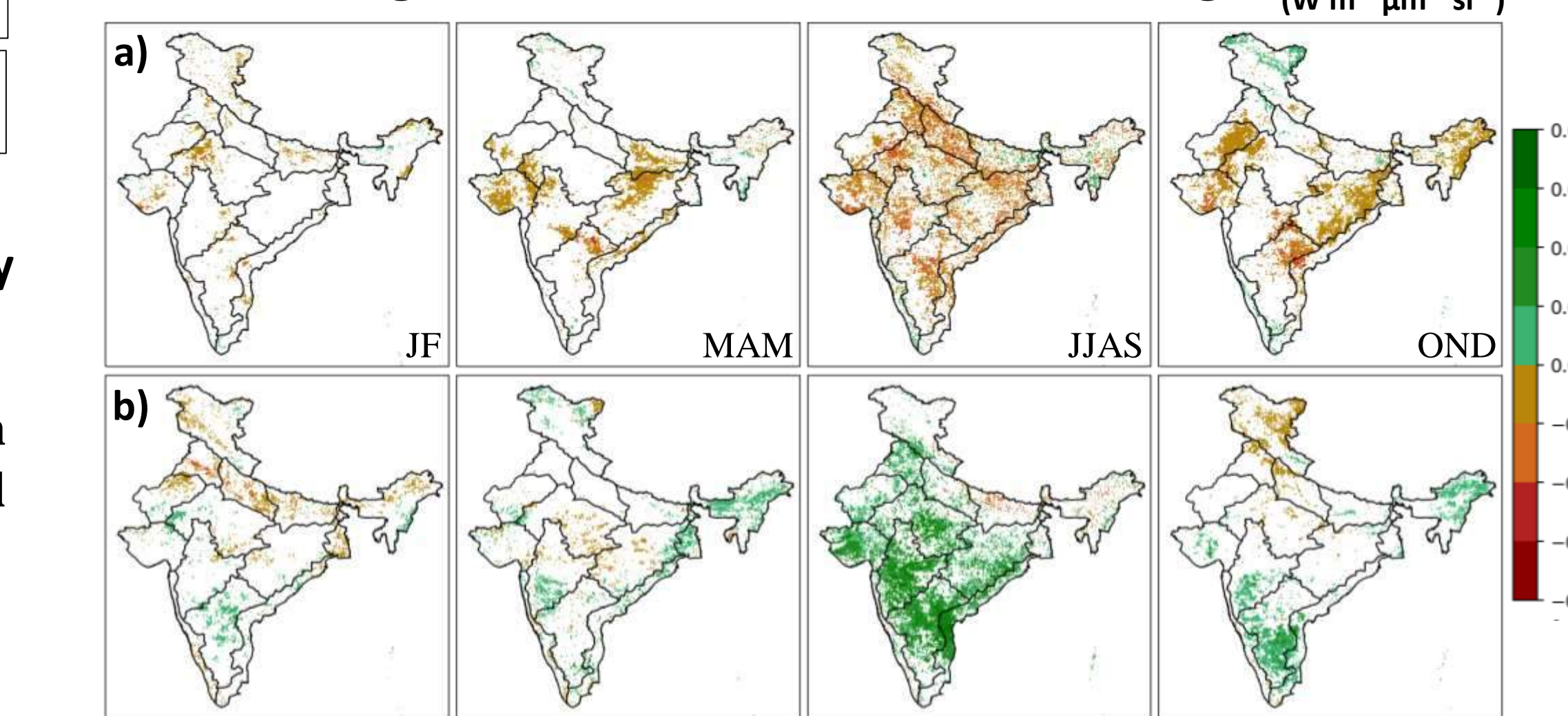
Correlation of SIF anomaly over India with the SST anomalies



Time series of SIF anomalies (blue) for each ACZ with NINO3 SST indices (red) for the period 2001 to 2020



Composite anomalies of SIF during the years of a) positive and b) negative SST anomalies in NINO3 region



➤ Strong SST-SIF link in the summer monsoon

## Conclusion

- SST variability in the Niño 3 region over the tropical Pacific is negatively correlated to the SIF anomalies across Indian mainland.
- High spatial and temporal variability in the observed SST-SIF relationship
- SST influence – Strongest in the summer monsoon season across arid and semi-arid regions
  - More strong and significant after the summer monsoon onset (June)
- There exist a considerable time lag in the SST influence, which can be used to predict SIF anomalies during summer monsoon months

## Future Scope

- The identified SST-SIF relationship would be beneficial to generate a simple framework that aids in the detection of the probable impact on vegetation growth across India associated with the rapidly varying oceanic climate conditions.

## Acknowledgment

- We thank Dr. Jingfeng Xiao and Dr. Xing Li for providing GOSIF data (Xiao et al., 2019; Li, X. and Xiao, J 2019)

