



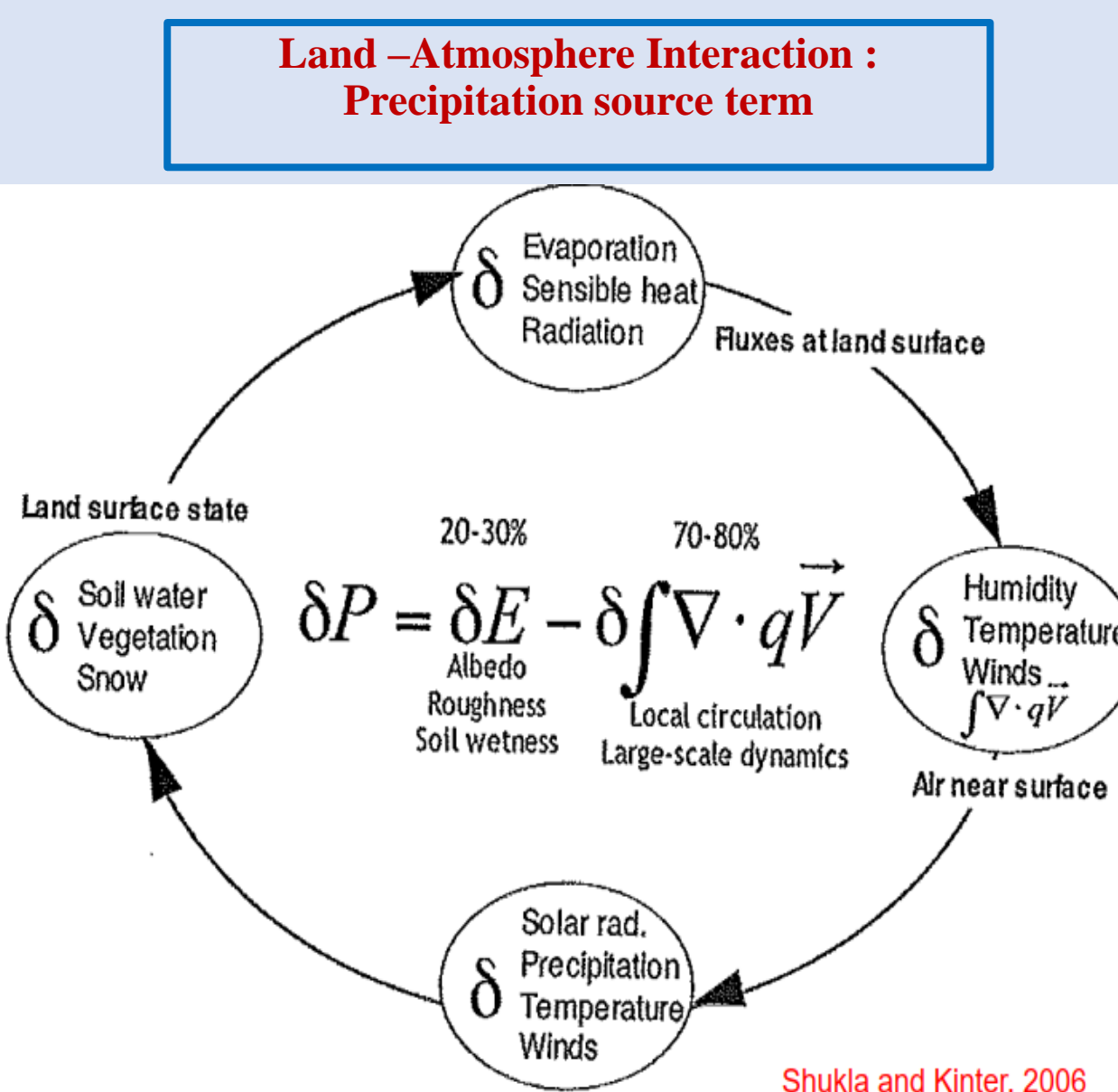
Intraseasonal Oscillations of soil-Moisture and its link with the active phases of the Indian Summer Monsoon

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Introduction



If the equation (1) is a function of time
 $\delta P(t) = \delta E(t) - \delta \int F(t)$
Where $F = \nabla \cdot qV$
Fourier transform of above equation is -

$$\delta P(\omega) = \delta E(\omega) - \delta \int F(\omega)$$

- ❖ Low frequency precipitation mode thus can be related to low frequency “local forcing” and “large scale forcing” as shown for MJO type intraseasonal modes(Chen & Zhang, 2019).
- ❖ Large scale forcing of monsoon ISO is already studied by several papers (Jiang et al. (2004).
- ❖ **What about the role of local land surface factors i.e. first term in this equation?**

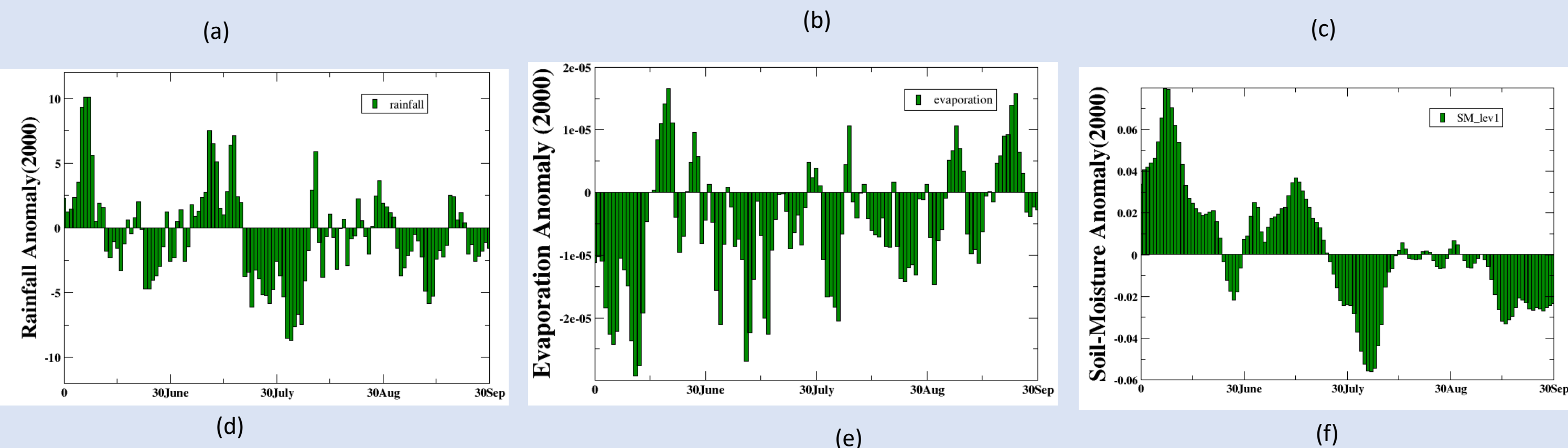
Data and Methodology

- ❖ The present research uses ERA5 reanalysis datasets) for soil moisture at level 1 (07-10cm), level 2 (10-28cm), level 3 (29-78), and level 4 (79-100cm), along with evaporation for the period 1989-2019.
- ❖ We also used IMD (India Meteorological Department) gridded rainfall data from Pai et al. (2014). The gridded rainfall data are available for the entire Indian subcontinent (6.5N–37.5N and 66.5E–101.5E).

Results

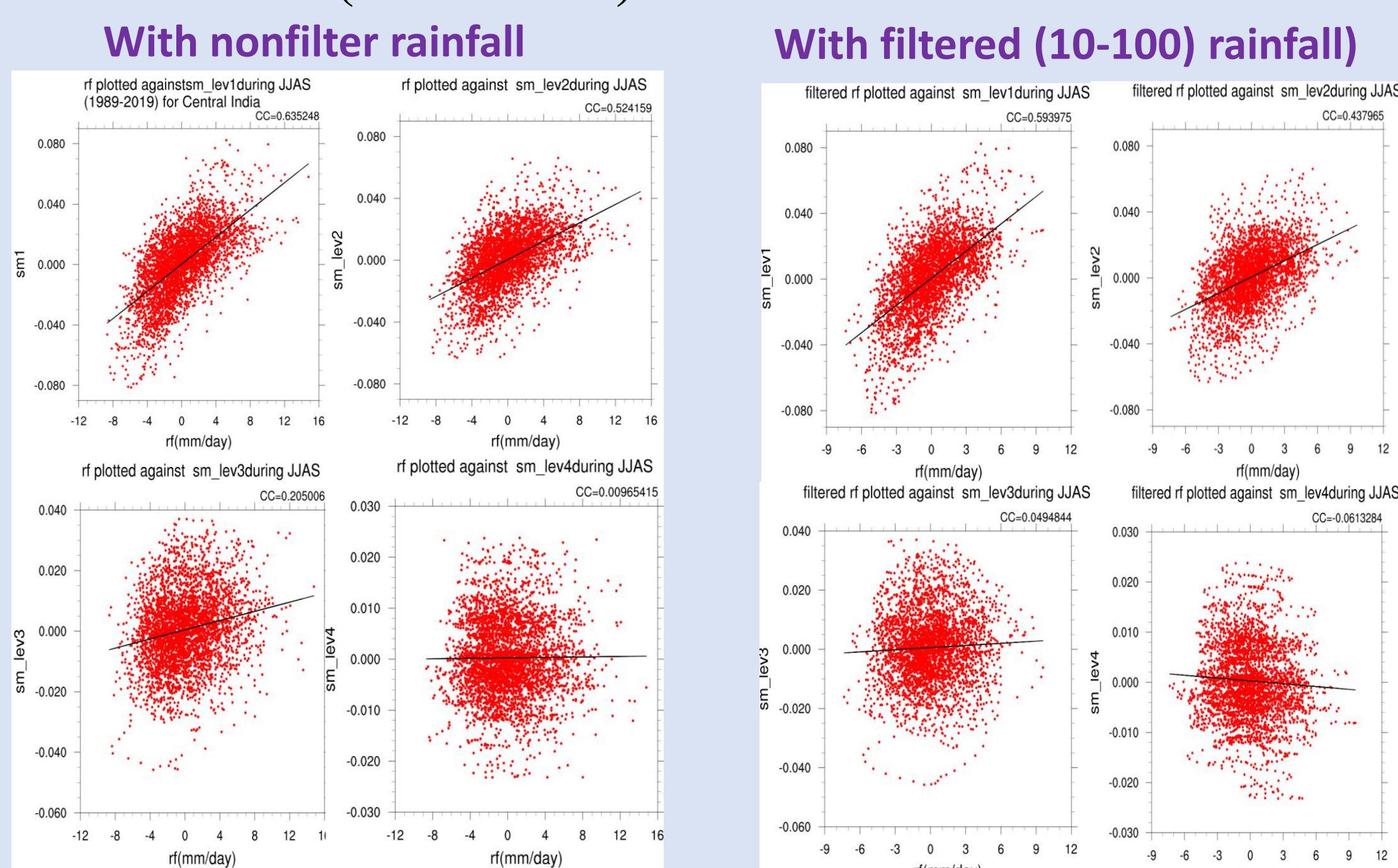
1) Intraseasonal oscillation for various surface parameters

Fig 1 (a) ,(b) and (c) represent the time-series plot for rainfall, evaporation and SM-1 anomaly during JJAS over Central India for the year 2000.(d) ,(e) and (f) shows its power spectra pattern during JJAS for the period (1989-2019).



2) Correlation b/w rainfall ISO and surface parameters during JJAS (1989-2019).

At lag 0 soil moisture is well correlated with rainfall for the top two levels. The correlation decreases as the Depth increases.



3) Propagation of moisture and identification of precondition role

Previous studies have shown that moisture pre-conditioning is extremely important for maintaining ISO and sea surface temperature, and evaporative fluxes over the ocean and atmospheric boundary layer are essential regulators of moisture convection feedback. But over the core monsoon zone, are there any such mechanisms for land ITCZ and active phases of monsoon? This is explored next here.

Active days are defined ,when the standardized anomalies of rainfall over monsoon core zone of India exceeds 1 based on the filter data(20-100 days).

Fig 3) Latitude section of (a) anomalous soil moisture at lev 1 (*0.001 m³/m³)(shaded) and rainfall(mm/day)(contour) anomalies averaged over 68-96E. Where day0 is rainfall maxima.(b) ,(c) and (d) same for different soil levels.

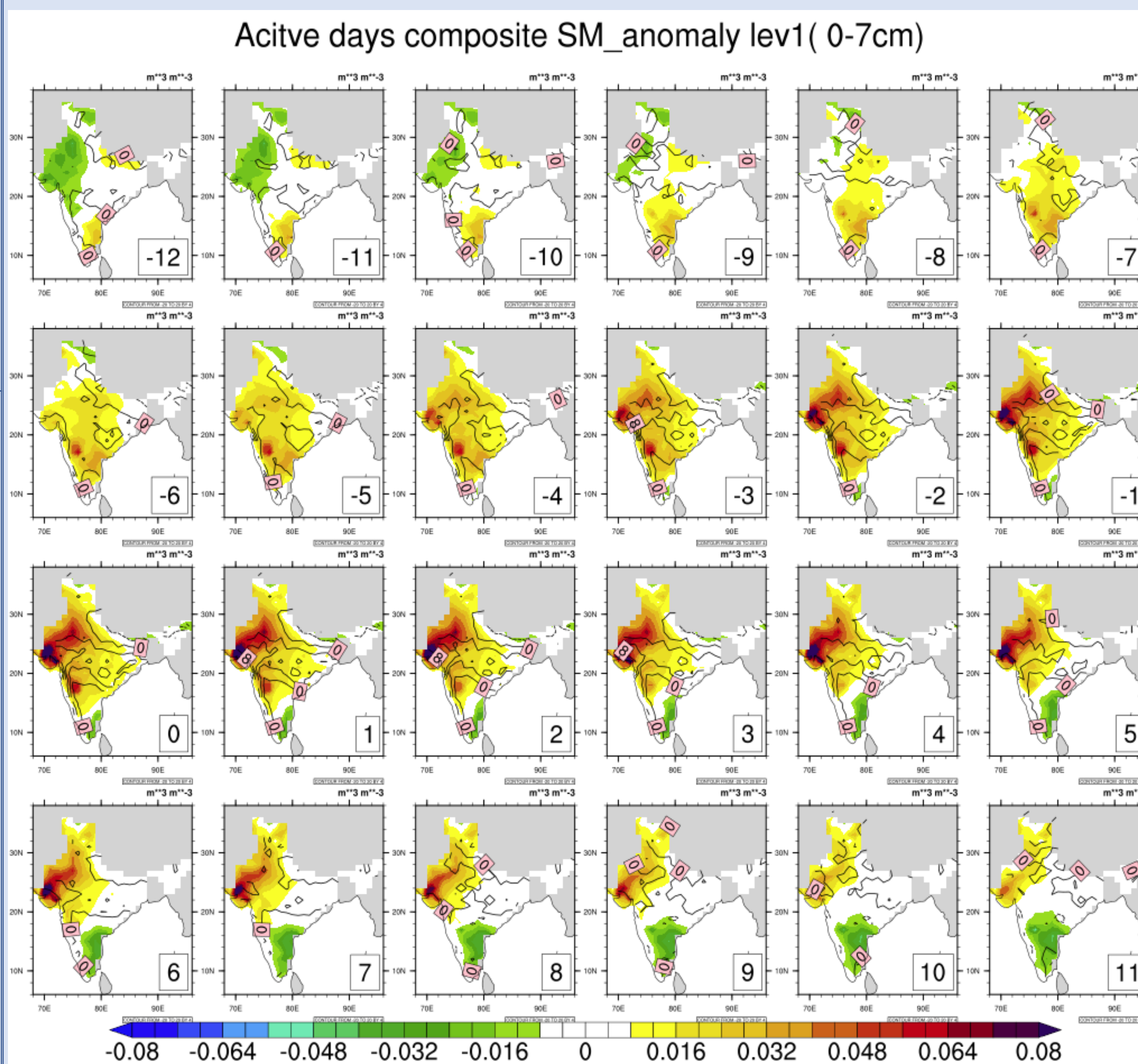
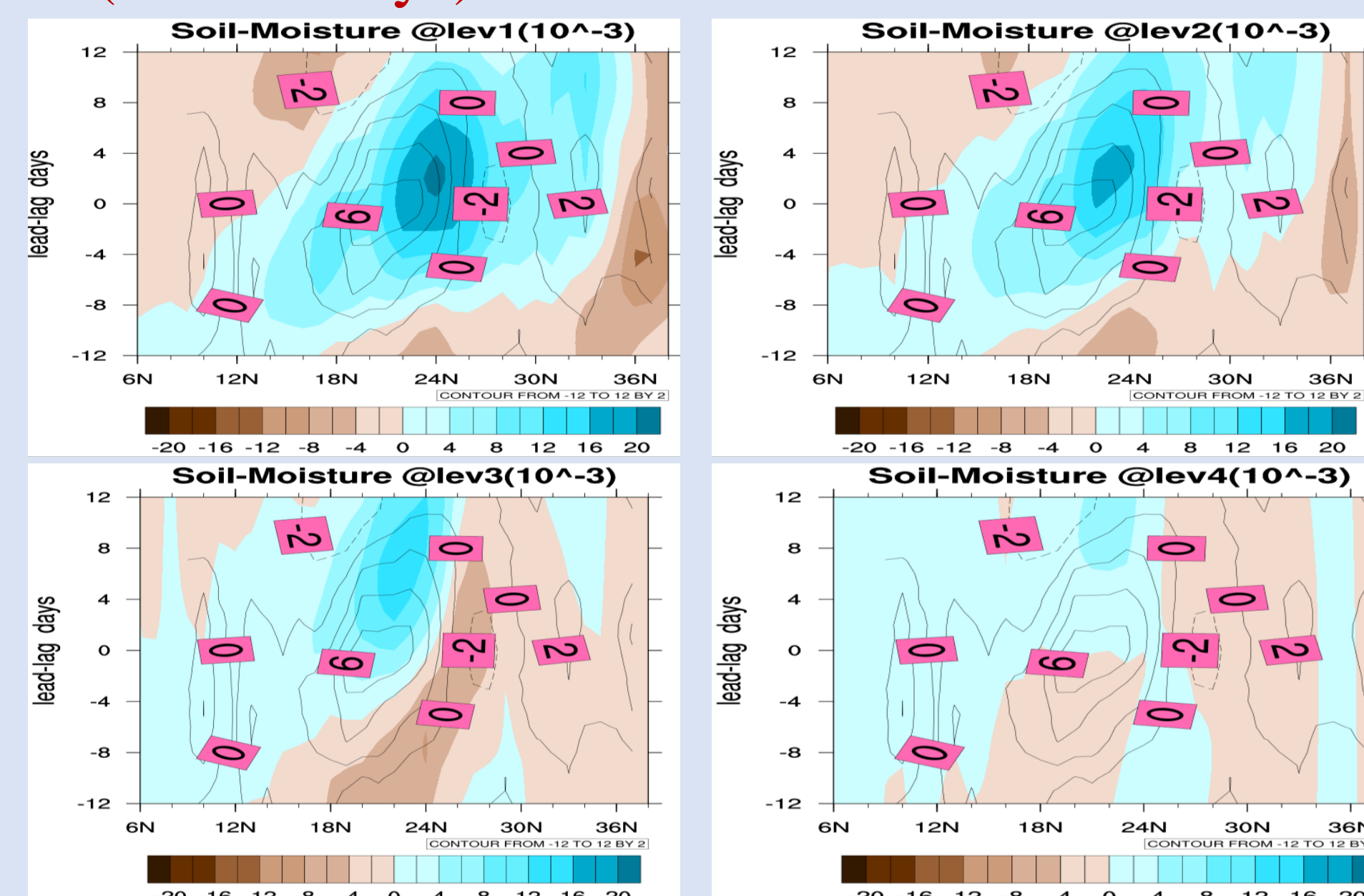


Fig 4) Spatial Distribution of anomalous SM-1(m³/m³) (shaded) during active phase (lag 0).Rainfall(mm/day) is shown as contours .

Day 0 represents the rainfall maxima.

Summary

- ❖ Like rainfall ,soil moisture and evaporation also shows low frequency variability.
- ❖ At lag 0 top two layers are in phase with rainfall and is moderately correlated.
- ❖ Only top two layers are strongly positive i.e. in-phase relationship.
- ❖ Over Indian region active phases are related to SM preconditioning.
- ❖ Spatially non-overlapping distribution of soil-moisture and rainfall.

References

Pratibha Gautam, Rajib Chattopadhyay, Gill M. Martin, Susmitha Joseph, A.K. Sahai. (2023); *Intraseasonal Oscillation of Land Surface Moisture and its role in the maintenance of land ITCZ during the active phases of the Indian Summer Monsoon.*[Under review - *Quarterly Journal of the Royal Meteorological Society*, Manuscript ID: QJ-23-0004].

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