

# Active and Break Spells of the Indian Summer Monsoon

M. Rajeevan <sup>1</sup>, Sulochana Gadgil <sup>2</sup>, Jyoti Bhate <sup>1</sup> and Ravi Kiran <sup>1</sup>

1. National Atmospheric Research Laboratory, Tirupati - 517502, INDIA  
2. Centre for Atmospheric and Oceanic Sciences, Indian Institute of Science, Bangalore- 560012, India.

## Objectives

- To identify objective criteria for identification of active and break spells of Indian summer monsoon based on rainfall, which can be used operationally.
- To examine the statistics and long term trends of active and break spells
- To examine the relationship of active and break with inter-annual variation of seasonal rainfall
- To examine atmospheric circulation and thermodynamic structure associated with the active and break spells

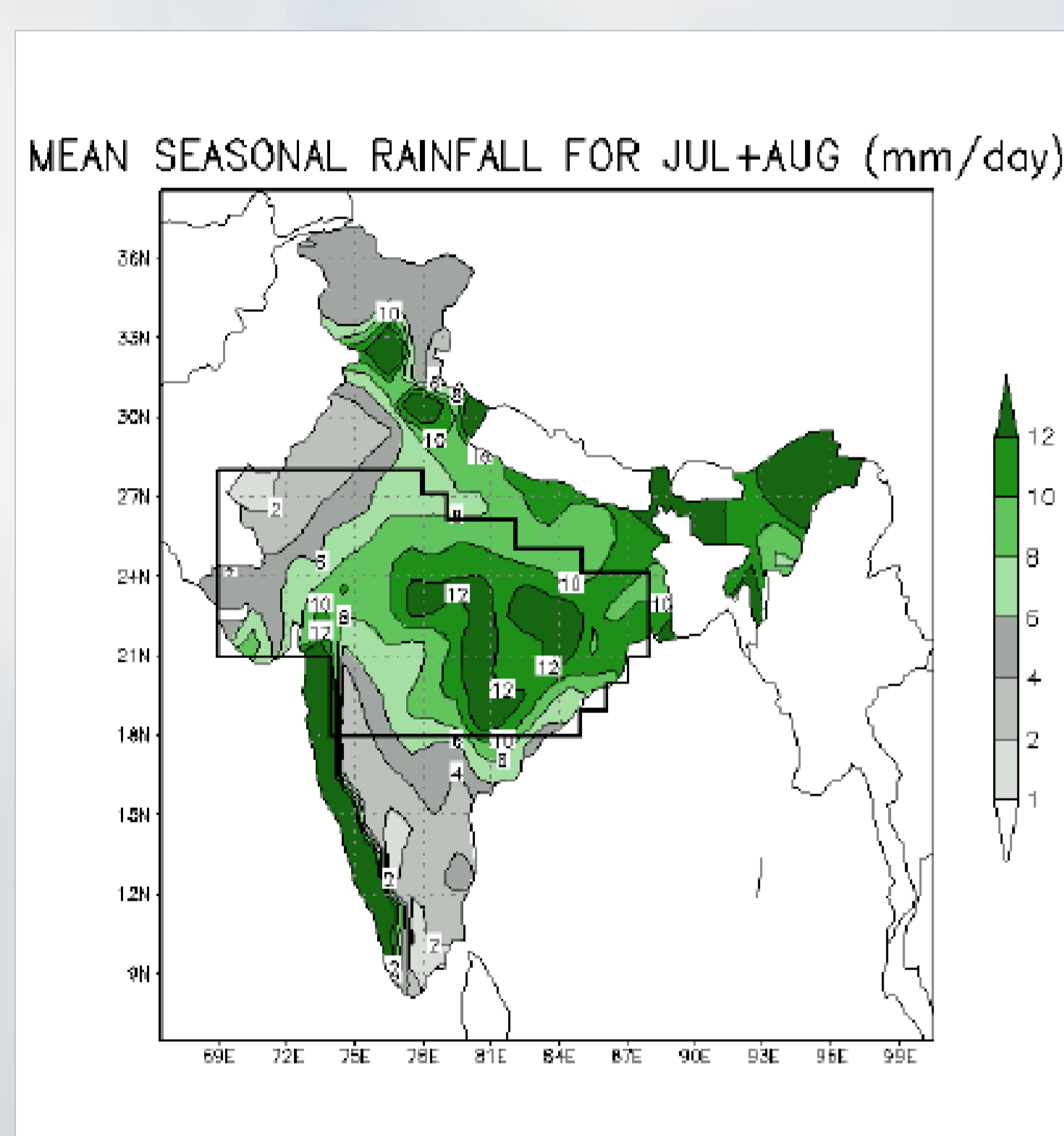
## Data Used

- Daily gridded rainfall (1 X 1 degree) over the Indian region, June to September, 1951-2007
- NCEP/NCAR daily reanalysis, NOAA Daily OLR data
- MODIS Aerosol and cloud data

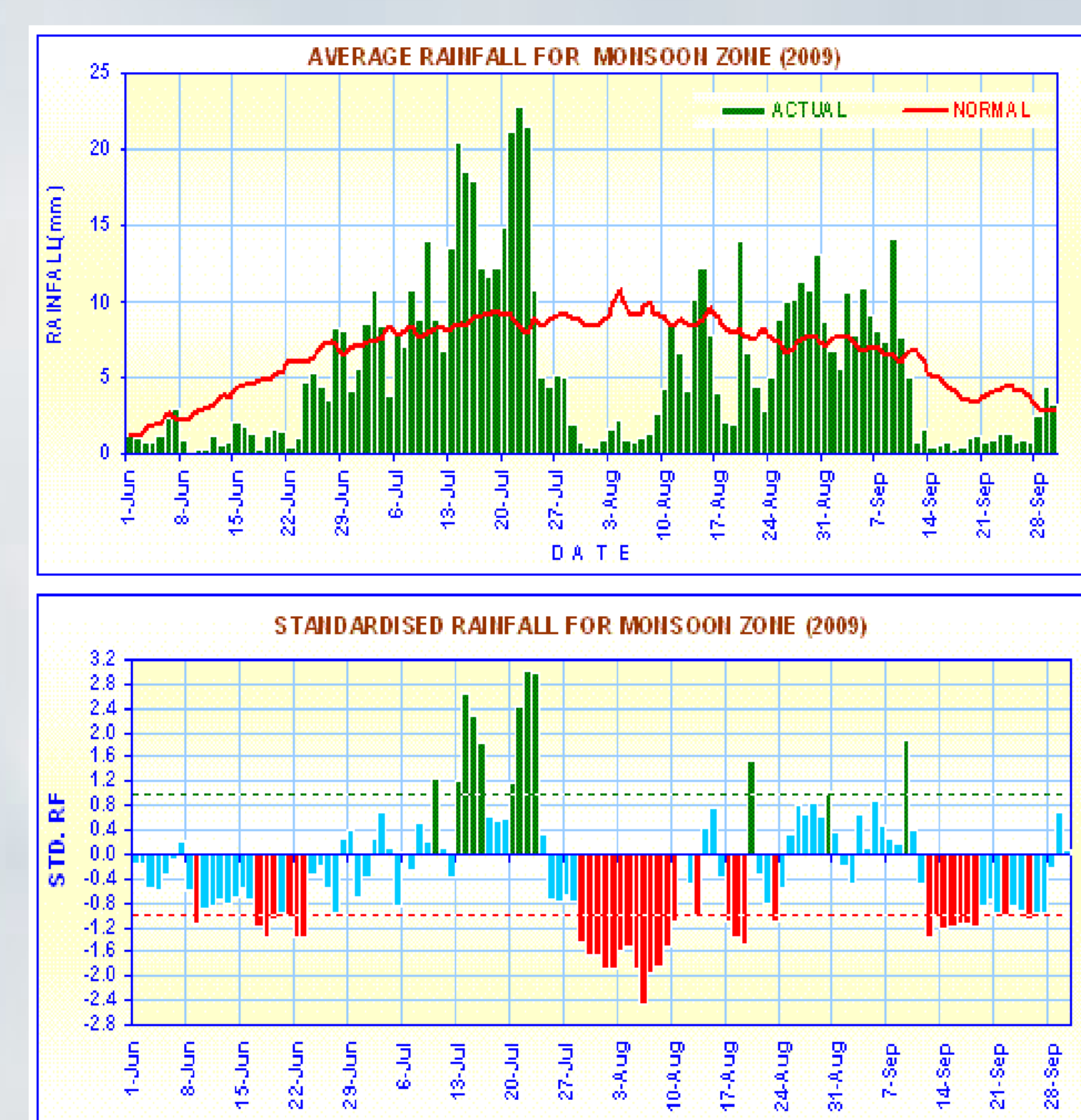
## Definition

- Active and break events were identified by averaging daily rainfall over the monsoon core zone and standardizing the daily rainfall time series.
- The break (active) spell has been identified as the period during which the standardized rainfall anomaly is less than  $-1.0$  (more than  $+1.0$ ), consecutively for three days or more.

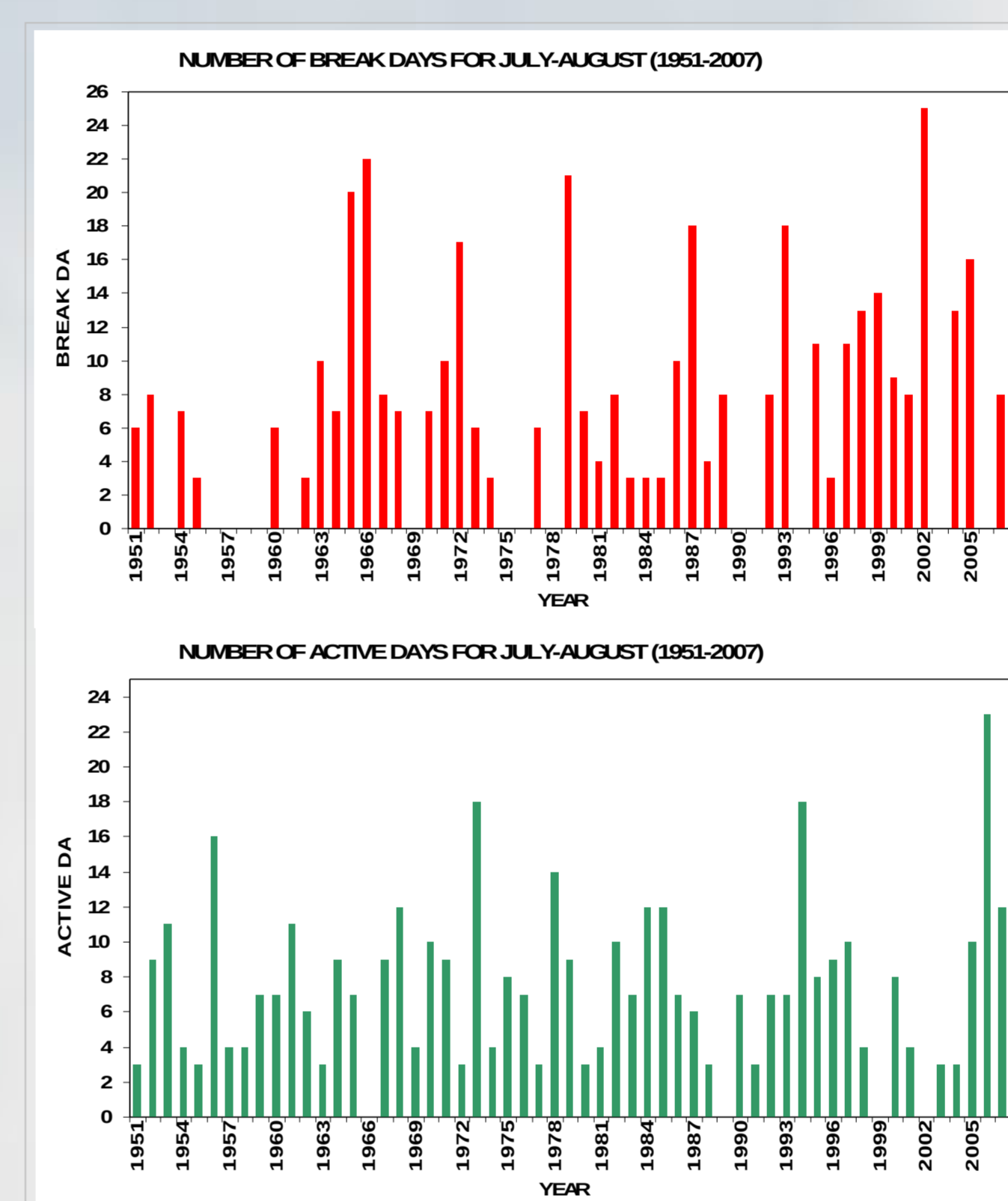
Monsoon core region shown as the box over central India



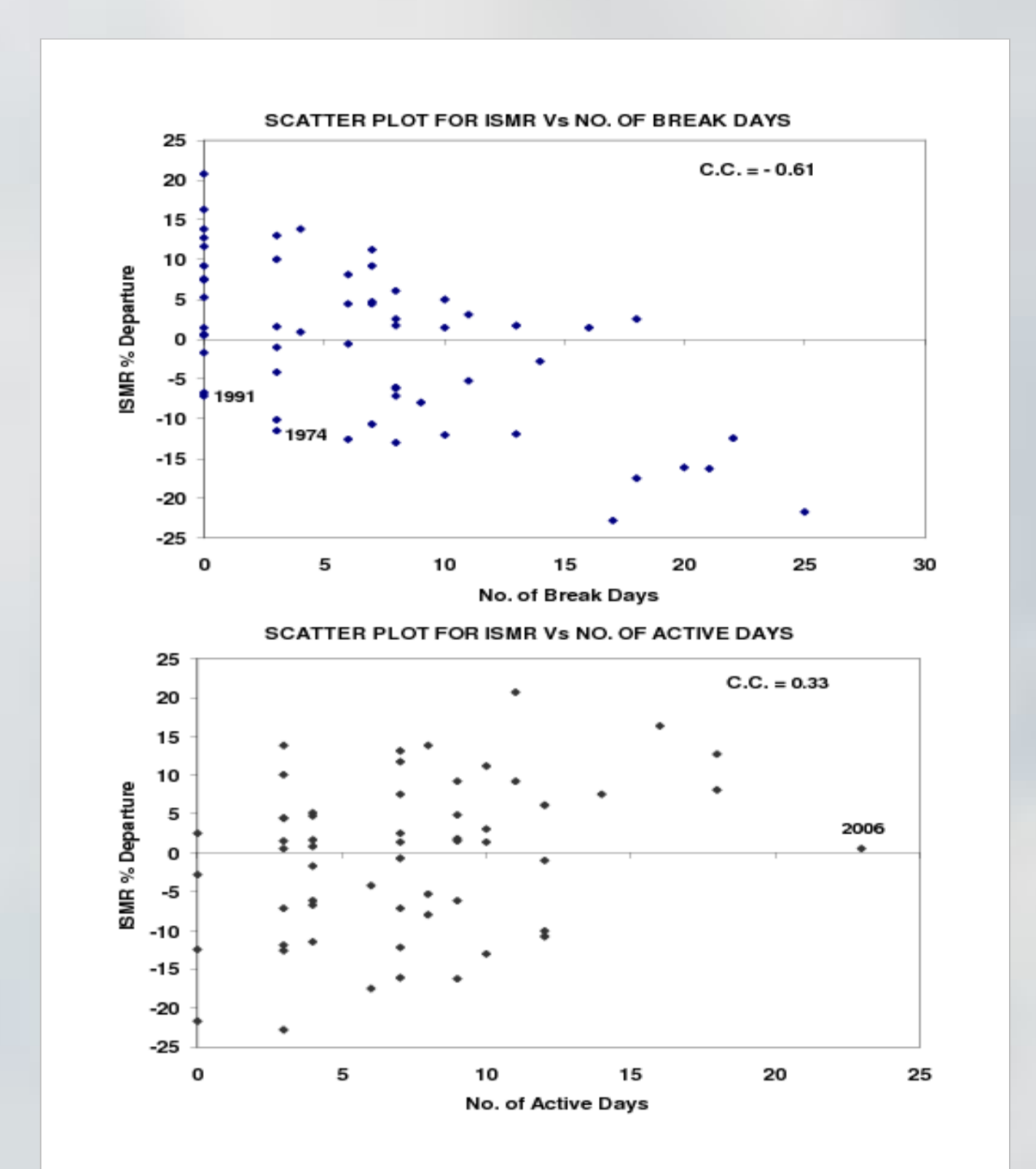
Daily average rainfall over the Monsoon zone in 2009 (above) and standardized rainfall (below). Red (Green) lines show break (active) days.



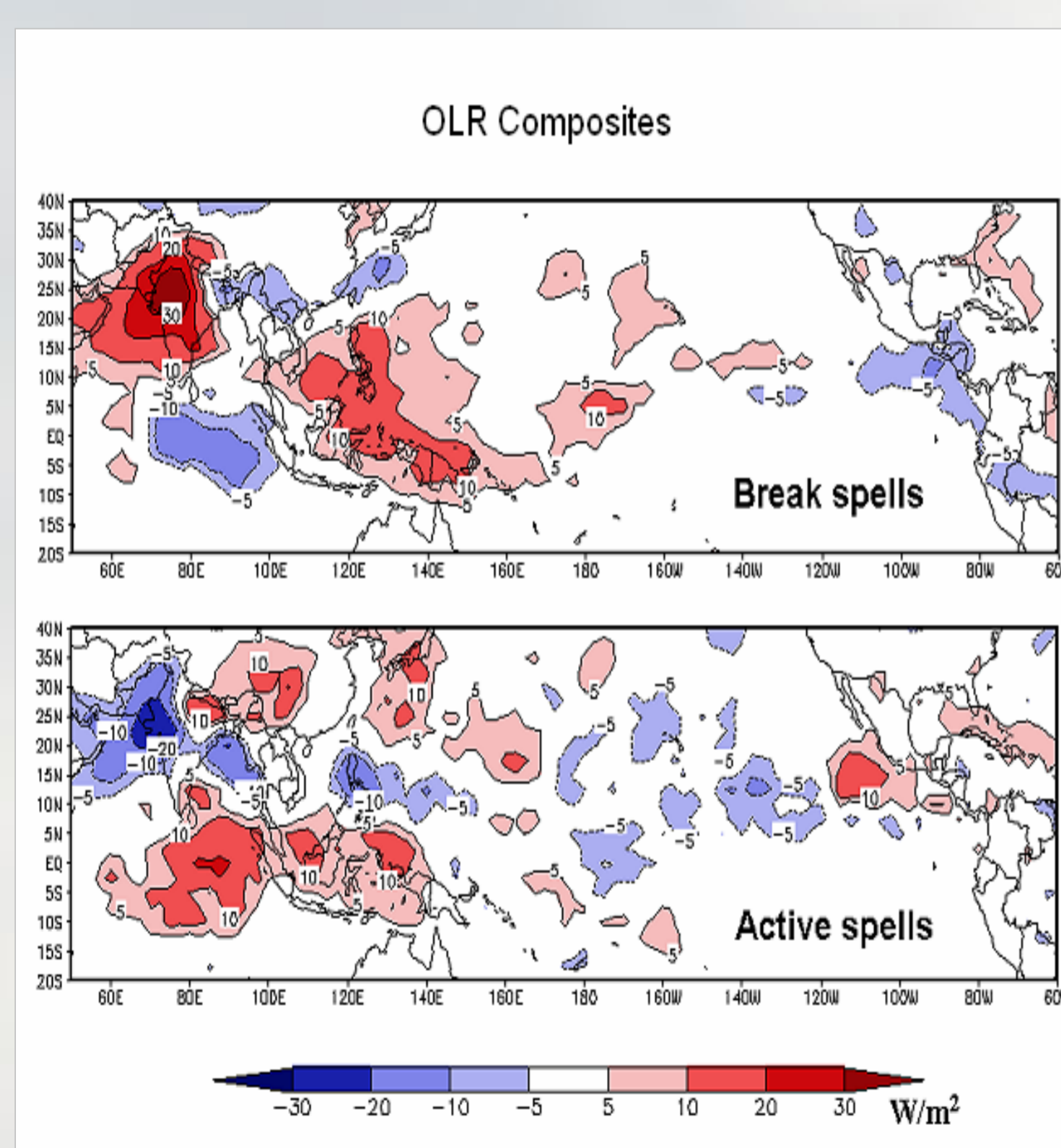
Time series of break days (above) and Active days (below) during July and August.



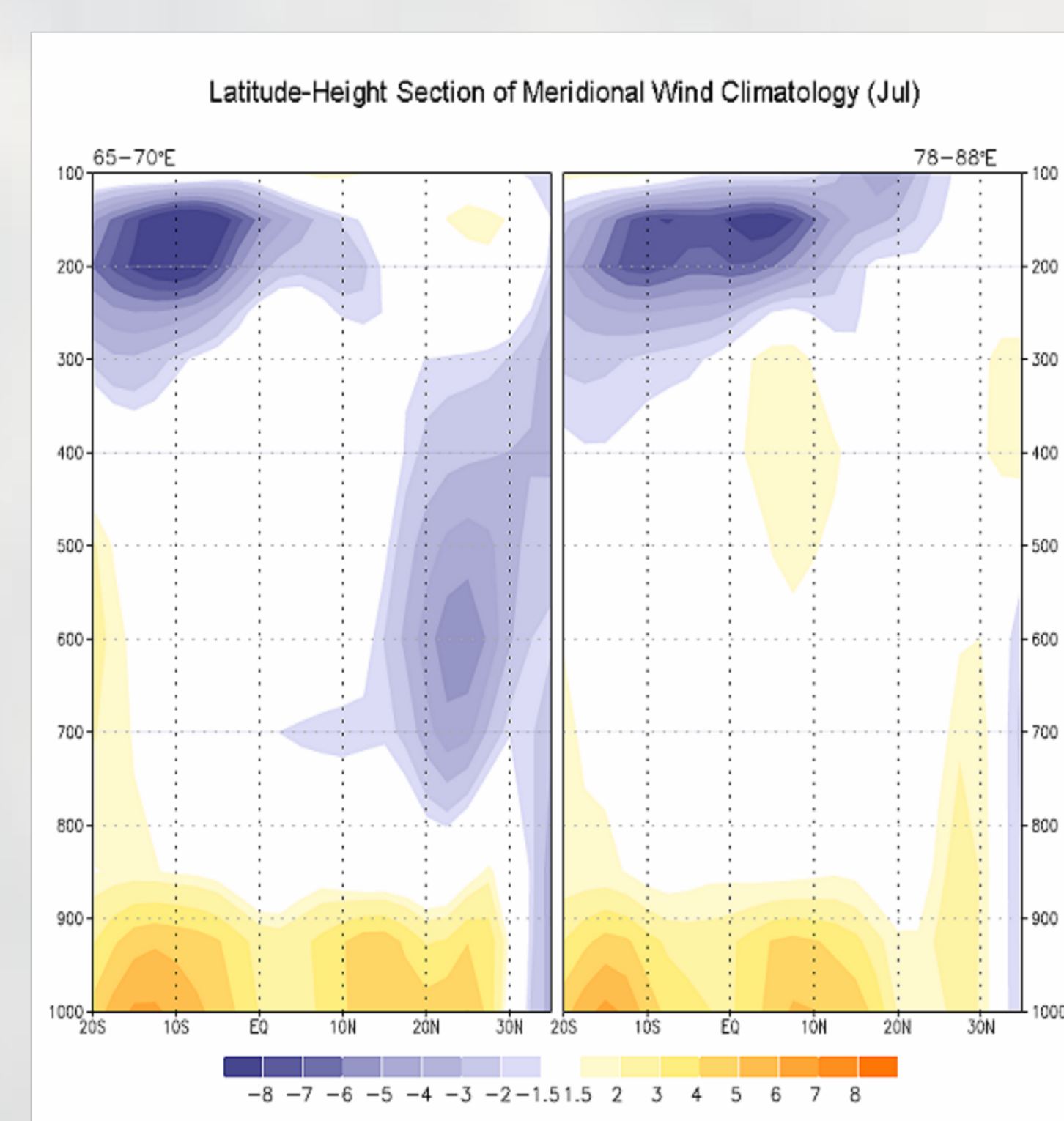
Scatter plot between Indian Summer monsoon rainfall (% Departure) and no of break days (above) and no of active days (below)



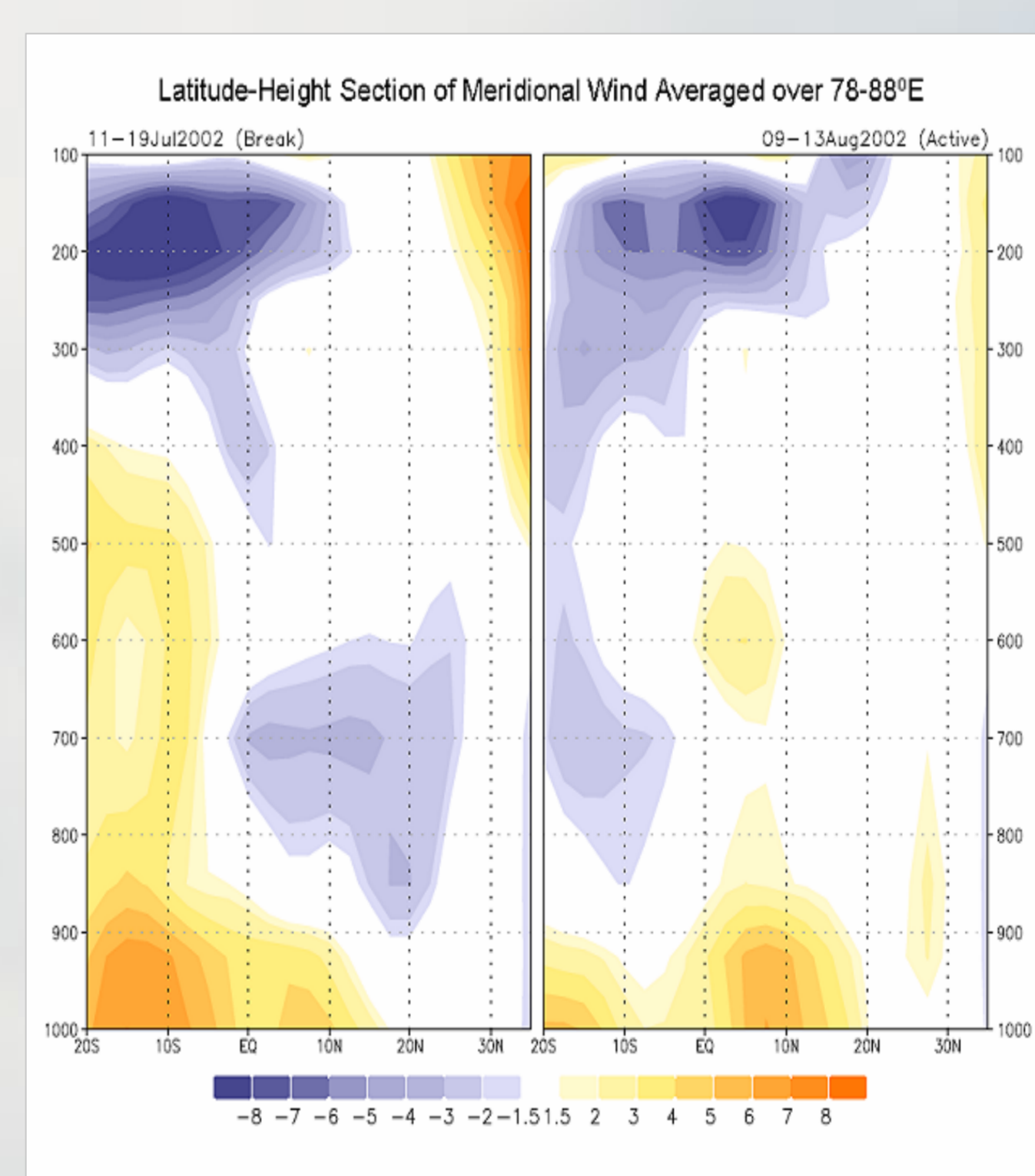
OLR composites for break and active spells during the period 1979-2007



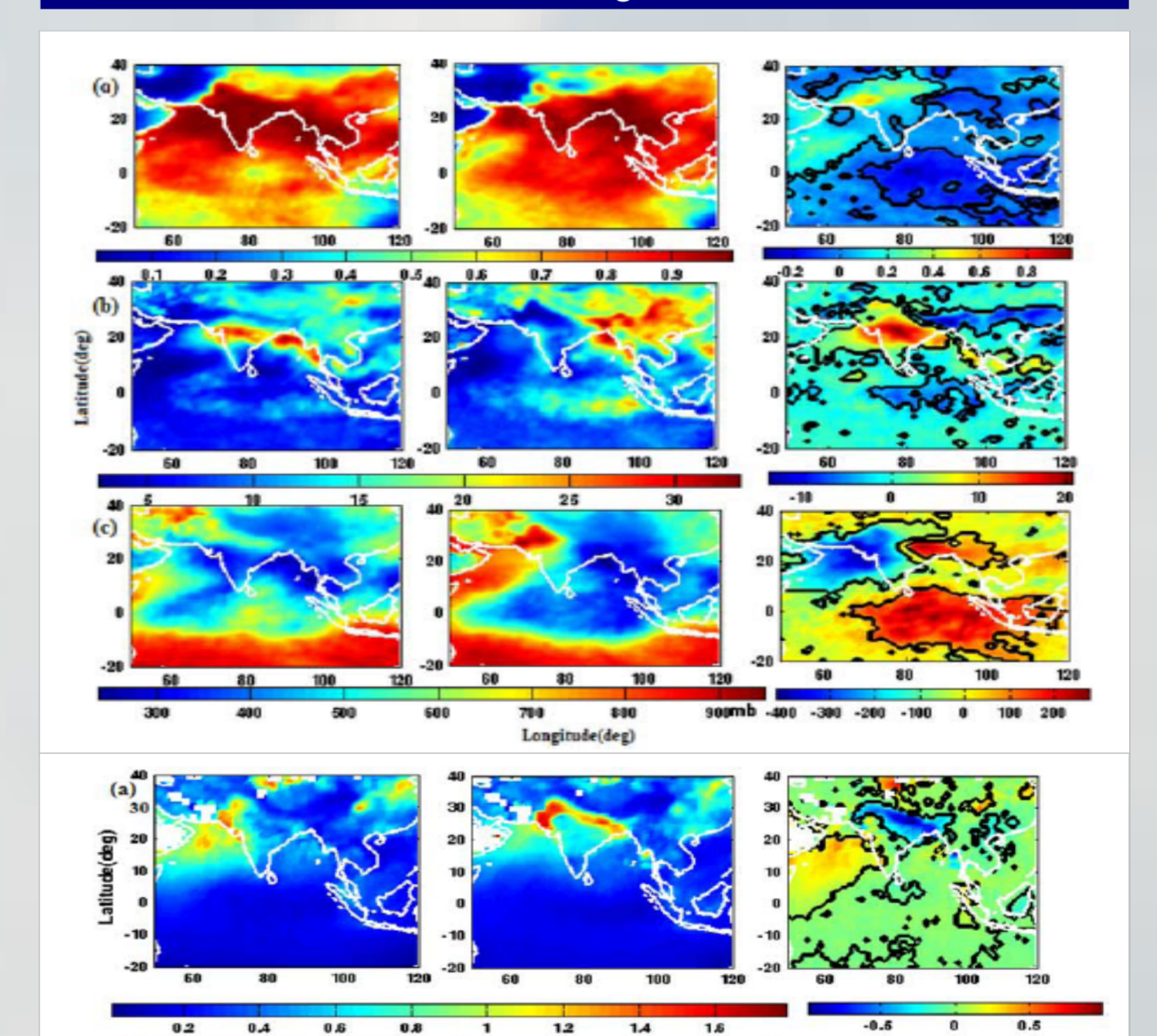
Latitude-height section of meridional wind climatology (ms-1) during July



Latitude-Height section of meridional wind (ms-1) averaged over 780-880 E during  
a) break period, 11-19 July 2002 and  
b) active period, 9-13 August 2002



a) Mean cloud fraction during active (left) and break (middle) and the difference (right) between active and break (active-break) days.  
b) the same but for cloud optical depth,  
c) for cloud top pressure and d) for aerosol optical depth  
The statistically significant differences at 95% level are contoured using thick lines



## Conclusions

- On an average, there are 7 days of active and break events from July through August.
- We find that breaks tend to have a longer life-span than active spells, 32% of break spells lasted for a week or longer
- There are no significant trends in either the days of active or break events.
- While weak spells are characterized by weak moist convective regimes, long intense break events have a heat trough type circulation which is similar to the circulation over the Indian subcontinent before the onset of the monsoon.
- During intense monsoon breaks, large scale of advection of aerosol loading is observed over the monsoon core region