iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 Issue: XII Month of publication: December 2021

DOI:

Variability and Changes in Rainfall Observed Across Jharkhand Region (India)

Shraddha Yadav[1], Avaneesh Kumar Yadav[2], Deepika Singh[3], Manohar Lal[4]
[1]Assistant Professor, Department of Environmental Sciences, Amity University, Noida, (U.P.), India
[2]Assistant Professor, Department of Civil Engineering, REC, Ambedkar Nagar, (U.P.), India
[3]Research Scholar, Department of Civil Engineering, IET, Lucknow (U.P), India
[4]Associate Professor, Department of Indian Institute of Geomagnetism, KSKGRL, Prayagraj, (U.P), India

Abstract: Rainfall variability has a substantial impact on water supplies, agricultural output, and, as a result, the economy. It examines the historical spatiotemporal variability and trend of rainfall on Jharkhand's annual and seasonal time series state over a 60-year period (1954–2013). The goal of this study was to find trends in long and short-term changes in rainfall amounts in the Jharkhand region at various spatial scales. With the help of the wavelet technique, we were able to determine the periodicity of rainfall over time and identify active and break days in the monsoon season. When the OLR positive anomaly increases, rainfall decreases (Break days), and when the OLR negative anomaly increases, rainfall increases (Active days).

The Indian summer monsoon extreme is also strongly linked to the Equatorial Indian Ocean Oscillation (EQUINOO), which is based on surface zonal wind across the central equatorial Indian Ocean. Because the Bay of Bengal is next to Jharkhand, local disturbances or cyclonic events are also discovered and their impact on rainfall is investigated.
Keywords: Rainfall, ENSO, Wavelet Transform, Active and Break days, Cyclone, Climate Change.

I. INTRODUCTION

Water is a valuable natural resource, and the majority of it comes in the form of precipitation. Reduced rainfall has a negative impact on water supplies, agricultural output, and the economy, among other things. The state's cropland covers roughly 1.8 million hectares, or about 22% of the total land area (Shonam Sharma and Prasoon Kumar Singh ,2017). In this state, the soil is still forming and has a high capability for humus formation. The main crop is Kharif, which is harvested between June and September, hence the state is strongly reliant on the monsoon. This crop has been severely harmed in recent years due to a decrease in rainfall. Natural climatic variability, such as decadal fluctuations, and human-induced variability, such as land cover and greenhouse gas emissions, both affect rainfall patterns. As a result, it's worth looking into studying altering rainfall patterns in the spatio-temporal domain to spot locations that are rapidly changing. In India, the monsoon season usually begins in late May or early June. By June-end/July, it will have covered the whole Indian landmass. The monsoon season in India finishes in September. The current study considers a spatio-temporal analysis of rainfall in the Jharkhand region of India.

Study of the short and long-term trends and periodicities of rainfall is an important parameter which needs to be investigated. The identification of periodicities is important for understanding of the rainfall variability, so Morelet wavelet analysis was also carried out during rainfall to know the periodicity and to test the significance of periodicity using the power spectrum method. Some other factors may also be there that may contribute towards the climatic changes. For the check of extremity of rainfall due to local disturbances this study has also examined systematically the interannual variations of TC activity (both intensity and frequency) over the Bay of Bengal and their possible relationship between local ENSO and other parameters. The traditional break days as followed by Ramamurthy et. al, (1969). Gadgil and Joseph (2003). Krishnamurthy and Shukla (2008) using out going long wave radiation (OLR)data reveals two dominant intraseasonal oscillatory modes and two large-scale standing patterns, one over the equatorial Pacific and the other over the equatorial Indian Ocean. It is seen that the large positive correlation of ISMR with convection over the western equatorial Indian Ocean is a manifestation of the link of the interannual variation of ISMR with Equatorial Indian Ocean Oscillation (EQUINOO) (Gadgil et al 2004, 2007). The standing persistent modes over the Indian-west Pacific region identified by Krishnamurthy and Shukla (2008) are the EQUINOO modes. Gadgil et al (2003, 2004) showed that there is a strong relationship between the extremes (droughts and excess monsoon seasons) and a composite index.

Aim of the present study was to identify the influencing atmospheric parameter of rainfall and trend of rainfall in Jharkhand region of India. To achieve this, analyse of historic data is carried out. It was also aimed to investigate the trend analysis and their significance which is not reported after year 2008 in Jharkhand region of India.

II. MATERIAL AND METHOD

Jharkhand is in northern India (geographically 22.8-2N, 83-87.5E) and covers an area of 94235Km^2. Long- term data records are important for detecting changes. In this study, the observed annual/seasonal: January-February (J-F), March-April-May (MAM), June-July-August-September (JJAS), October-November-December (OND) and monsoonal month June, July, August, September rainfall are used. Daily gridded rainfall data set (IMD4) at a high resolution (0.25° × 0.25°, latitude × longitude), from National Data Centre, Indian Meteorological Department (IMD), Pune for the period of 1954-2013 were used over Jharkhand region of India. For the same years we use the sunspot occurrence data from the National Geophysical Data Centre, Boulder, Colorado, USA, we used monthly QBO data (1954-2013) through (NOAA) NGDC, Oceanic Nino 3.4 index from www.cpc.ncep.noaa.gov/, Cyclonic data(1990-2015) from best track IMD, We have analysed daily OLR data to determine the patterns associated with breaks and active spells of the monsoon. Circulation patterns are obtained by analysis of the daily average data of NCEP-NCAR project (Kalnay et al 1996). EQUINOO is based on the zonal wind data from NCEP reanalysis.

A. Wavelet Transform (WT)

Wavelets are wave like fluctuating signals of finite bandwidth both in Time and in Frequency. Wavelets in signal processing link fills the missing link between time and frequency studies. WT is main character in both time and frequency signal in terms of sinusoids. In this investigation Indian rainfall data is examined by using different wavelets (Continous, Cross) at different levels through developing Matlab wavelet progamme produced by Torrence and Compo (1997). The wavelet transform can be used to analyse time series that contain continuous power at many different frequencies (Daubechies 1990). Assume that one has a time series, x_n, with equal time spacing ∂t and n=0…N−1. Also assume that one has a wavelet function, $\Psi(\eta)$ that depends on a dimensionless “time” parameter η. To be “admissible” as a wavelet, this function must have zero mean and be localised in both time and frequency graph (Farge 1992). One of the most widely used continuous wavelets is the complex Morlet wavelet (Morlet 1983). This form of wavelet consists of a plane wave modulated by a Gaussian envelope (Torrence and Compo 1997):

$$\Psi_0(\eta)=\pi^{-1/4}e^{i\,\omega 0\,\eta}e^{-\eta 2/2} \text{ …………… Eqn (1)}$$

Where ωo is the non-dimensional frequency, here taken to be 6 to satisfy the admissibility condition (Farge 1992). This is the basic wavelet function, but it will be now needed some way to change the overall size as well as slide the entire wavelet along in time. Thus, the “scaled wavelets” are defined as:

$$\Psi[(n'-n)\,\delta_t/s]=(\delta_t/s)^{1/2}\,\Psi_0\,[(n'-n)\delta_t/s] \text{... Eqn (2)}$$

Where s is the “dilation” parameter used to change the scale, and n is the translation parameter used to denote the change in time. The constant factor of $s^{-1/2}$ is a normalization to keep the total energy of the scaled wavelet constant. We are given a time series X, with values of x_n at time index n. Each value is separated in time by a constant time interval δ_t. The wavelet transform Wn(s) is just the inner product (or convolution) of the wavelet function with the original time series:

$$W_n(s)=\sum_{n'=0}^{n-1} x_{n'}\,\Psi_*[(n'-n)\delta_t/s] \text{……………..Eqn (3)}$$

where the asterisk (*) denotes complex conjugate. The above anti derivate can be evaluated for various values of the scale s (usually taken to be multiples of the lowest possible frequency), as well as all values of n between the start and end dates.

B. Analysis of Active and Break Days

In the past, similar tabulated datasets (1954–2013) were used to observe the intraseasonal variability of the Indian summer monsoon. The active–break periods during the southwest monsoon season were identified by present rainfall datasets. Long intense breaks are often connected with poor monsoon seasons, and they have a large affected on agriculture.

In the present analysis, the active and break periods during the southwest monsoon season have been identified in the following way. The area-averaged daily rainfall time series for each year from 1954 to 2013 has been prepared by simply taking the arithmetic average of all rainfall at all grid points over Jharkhand region.. For each calendar day, the climatological mean and standard deviation of rainfall were formulated using the data of 1954– 2013. Then for each year, the area averaged daily rainfall time series has been converted to standardized rainfall anomaly time series, by subtracting the climatological average from the daily rainfall time series and then dividing by its daily standard deviation.

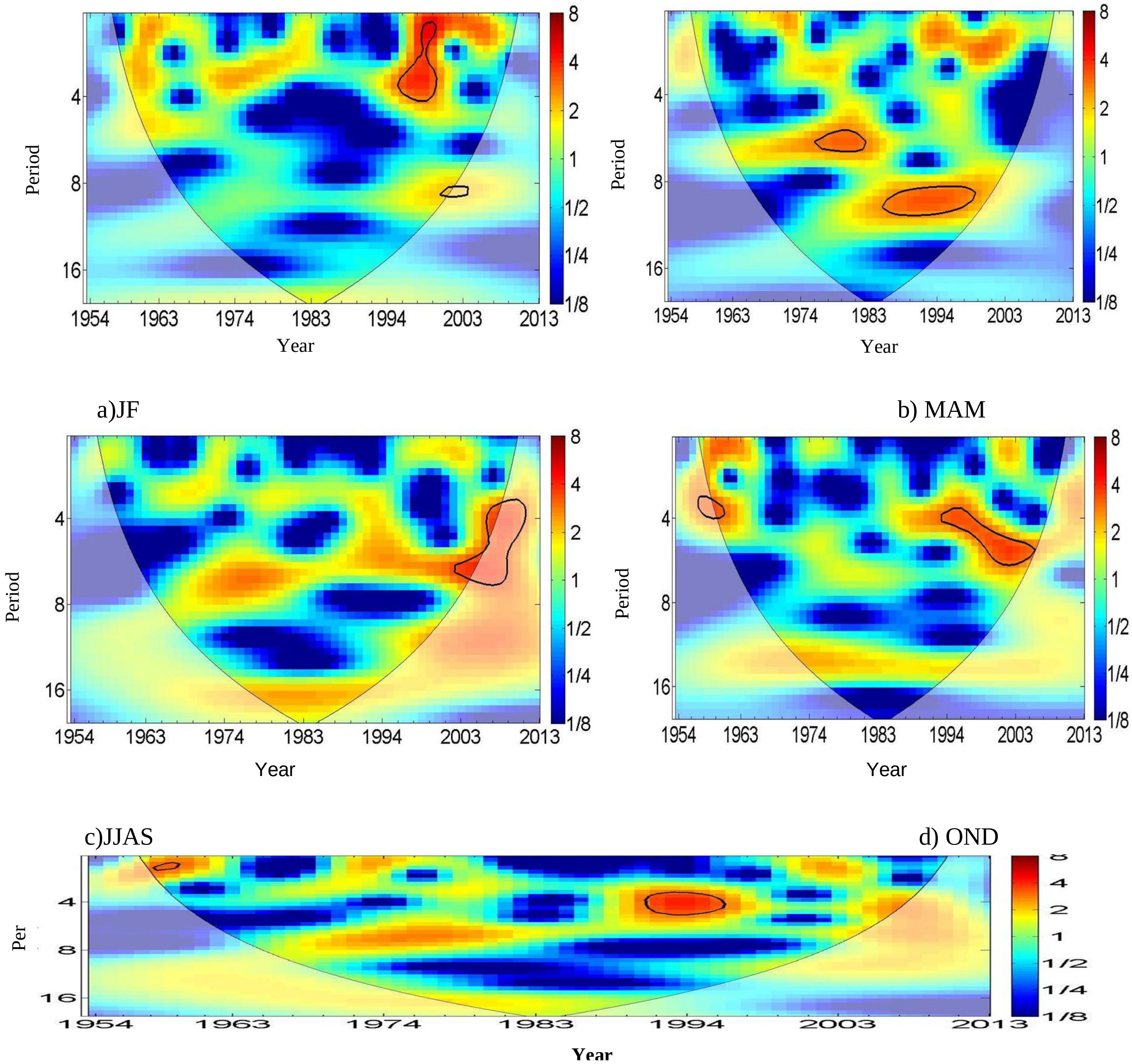
International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue XII Dec 2021- Available at www.ijraset.com

The break period has been identified as the period during which the standardized rainfall anomaly is less than –1.0, provided it is maintained consecutively for three days or more. Similarly, the active period has been recognized as the period during which the standardized rainfall anomaly is more than 1.0, provided it is maintained consecutively for three days or more. We feel that the rainfall data density considered in this analysis is good enough to identify the active and break periods using this criterion. Gadgil and Jospeh (2003) used about 150 stations from Central India to identify the break spells. They have taken into a criterion using actual rainfall amounts to identify breaks, which may be sensitive to the density of the rain-gauge network considered.

III. RESULTS AND DISCUSSION

A. Wavelet Analysis

With the help of wavelet technique, we identify the periodicity of the rainfall. To investigate whether a more direct association between solar activity and rainfall can be established, we now present a wavelet analysis in the form of colour-coded contour maps of wavelet power spectra as functions of time and period. The individual wavelet power spectra for annual and seasonal rainfall of Jharkhand shown in the Figure 1. In winter season (JF) maximum power spectra showed in decade V and periodicity of rain is 2.5-5 years as shown in figure 1.

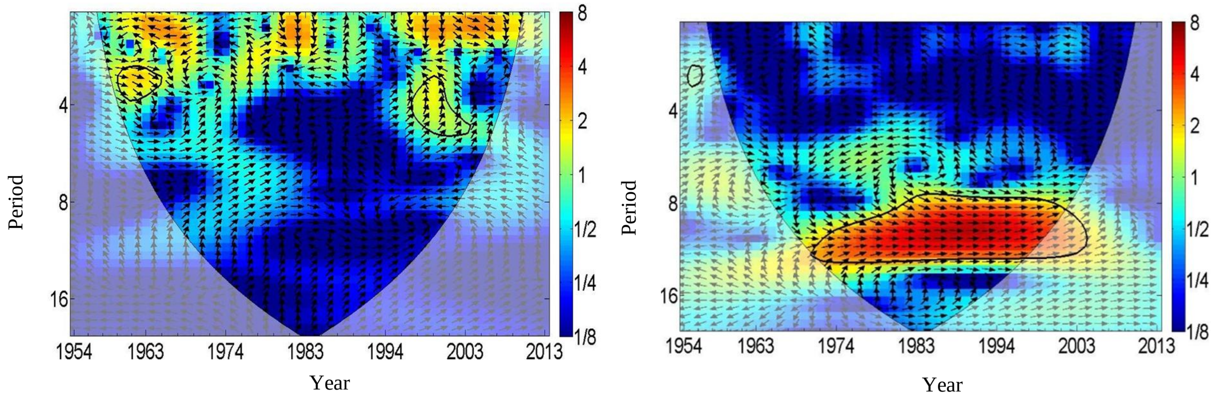


e) Annual

Fig .1 Continuous wavelet transform of Jharkhand Rainfall time series (1954-2013). The 5% significance level against red noise is shown as a thick contour

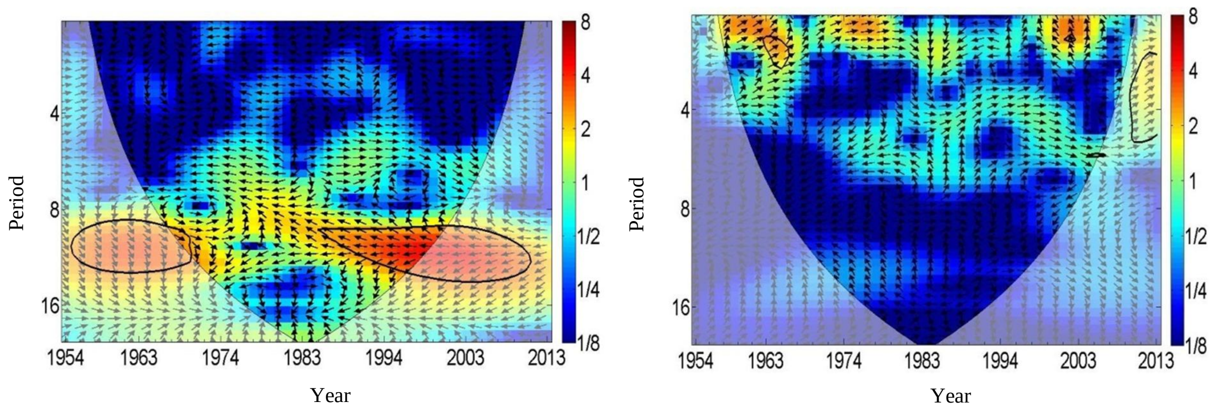
International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue XII Dec 2021- Available at www.ijraset.com

This type of periodicity is due to QBO. The period 2.5-5 years in the power spectrum of rainfall variability may be due to well-known QBO (Quasi-biennial oscillation) phenomenon in the earth's atmosphere which in turn might have been influenced by the solar activity (Elias and Marta, 2003, and references there in). This relationship established in cross wavelet analysis, in- phase relation showed during this period, rainfall is increases with increases QBO. In pre-monsoon season (MAM) IV to V decade high power spectra showed in CWT analysis periodicity of rainfall is 8-16 years. SSN is responsible for this type of periodicity. This relationship as shown in figure 2 in XWT, in-phase relation of rainfall with SSN during this period, greater solar activity is associated in all cases with greater rainfall (S. Bhattacharyya and R. Narasimha 2005). In monsoon season (JJAS) maximum rainfall showed in CWT analysis in decade VI and periodicity is 3-8 years. Cyclonic storm (2007) maximum wind 65 Km/hr, lowest pressure is 986 hPa. In 1983 periodicity is 8-16 years SSN is responsible here (S. Bhattacharya and R. Narasimha,2005), antiphase relation in XWT analysis showed in figure 2. Increase in solar activity decreases the intensity of galactic cosmic rays flux which consequently results in high rainfall, significant studies have been carried to establish a correlation with Indian rainfall occurrences (Hiremath,2006; Jagannathan and Bhalme, 1973; Bhattacharya and Narasimha, 2005), the rain fall activity is high for low sunspot activity and low rainfall activity for higher sunspot occurrences (R. Samuel Selvaraj et al 2013). In post-monsoon season (OND) periodicity of rainfall is 5 years showed in CWT analysis in decade V. In cross wavelet analysis in-phase correlation showed with QBO during this decade.



a) JF-RAIN and QBO

b)MAM-RAIN and SSN



c)JJAS-RAIN and SSN

d) OND RAIN and QBO

Fig. 2 Cross wavelet transform of the U. P a) JF rainfall-QBO b) MAM-Rainfall and SSN c) JJAS Rainfall and SSN d) OND Rainfall and QBO. The 5% significance level against red noise is shown as a thick contour. The relative phase relationship is shown as arrows (with in-phase pointing right, anti-phase pointing left).

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue XII Dec 2021- Available at www.ijraset.com

B. Analysis of Monsoonal Month Rainfall

In month of June periodicity of rainfall in decade VI show 4-8 years in CWT analysis. In XWT analysis same periodicity found with ENSO as shown in figure 4. The significant 3–8-year periodicities may be attributed to El Niño Southern Oscillation (ENSO) (Trenberth, 1976; Philander, 1983; Webster et al., 1998). In 2008 extreme rainfall in month of June due to ENSO (La-Nina). Cyclone Nargis is formed 2008 in Bay of Bengal during April to December, maximum wind speed 165Km/h(105mph) and lowest pressure is 92 hPa (mbar). In month of July high power spectra is showed in decade V to VI and periodicity of rainfall is here 8-11 years as shown in CWT analysis in figure 3.

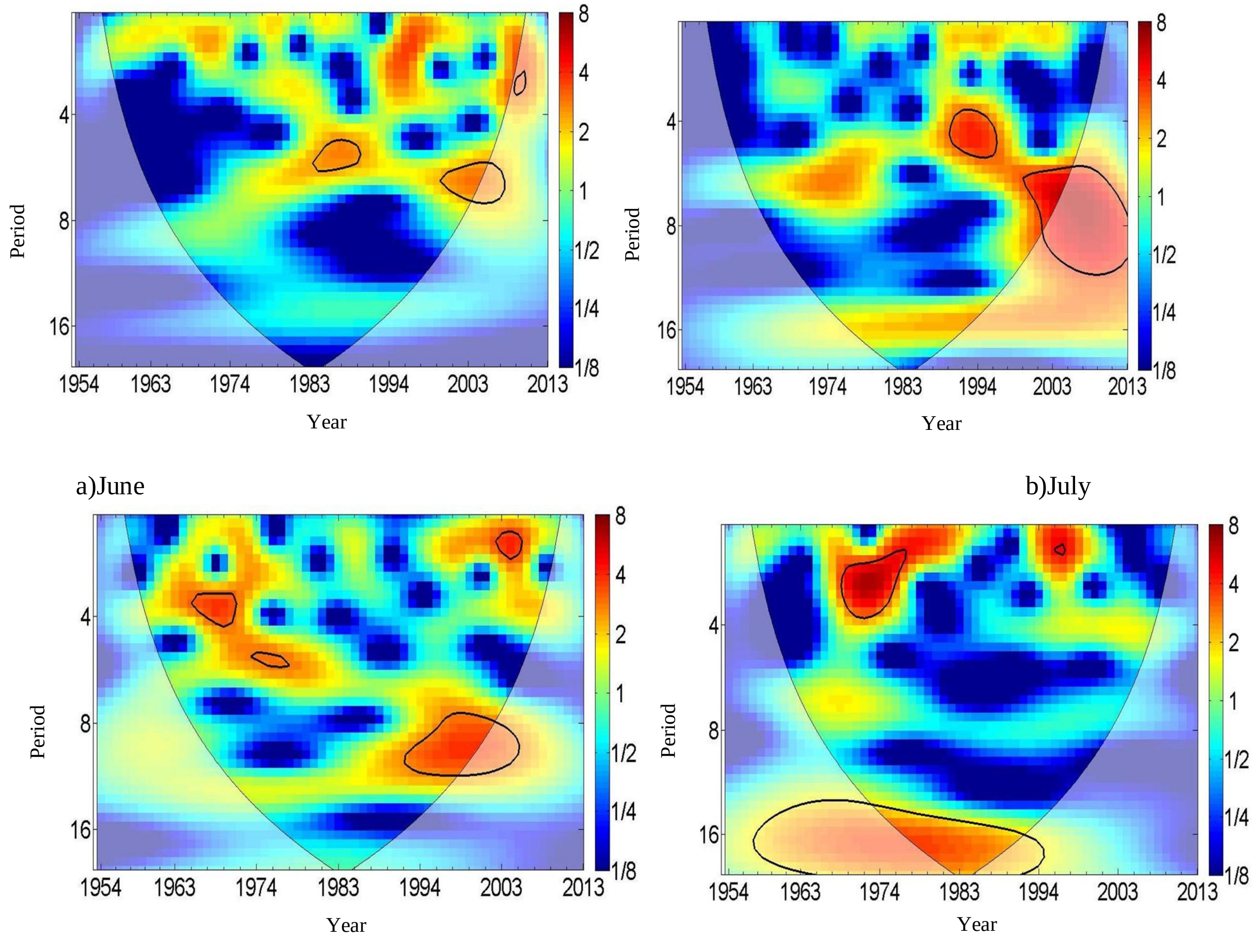
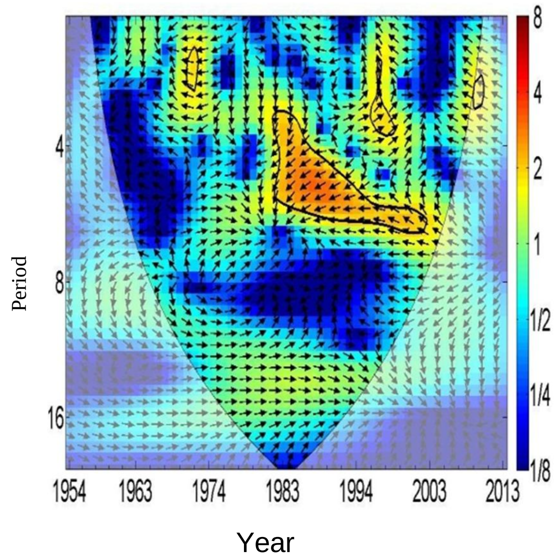


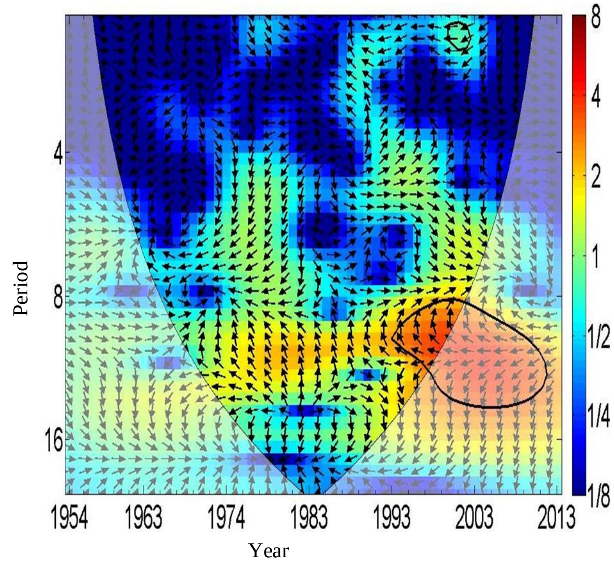
Fig. 3 Continuous wavelet transform of Jharkhand Rainfall time series (1954-2013). The 5% significance level against red noise is shown as a thick contour.

This type of periodicity is due SSN so this relation established in XWT analysis .Antiphase relation showed with SSN in figure 4..Increase in solar activity decreases the intensity of galactic cosmic rays flux which consequently results in high rainfall [Sun et al. 2002 and Svensmark 1997], correlation with Indian rainfall occurrences (Hiremath,2006; Jagannathan and Bhalme, 1973; Bhattacharya and Narasimha, 2005), the rainfall activity is high for low sunspot activity and low rainfall activity for higher sunspot occurrences (R. Samuel Selvaraj et al 2013). In month of August periodicity of rainfall is 8-16 years showed in CWT analysis. SSN is responsible of this type of periodicity this relation established in XWT analysis, antiphase relation during that period as shown in figure 4. In month of September periodicity of rainfall showed 2.5 years in decade V, QBO is responsible of this type of periodicity. The period 2.5-5 years in the power spectrum of rainfall variability may be due to well-known QBO (Quasi-biennial oscillation) phenomenon in the earth’s atmosphere which in turn might have been influenced by the solar activity (Elias and Marta, 2003, and references there in). This relation established in XWT analysis, in-phase relation show in figure 4.

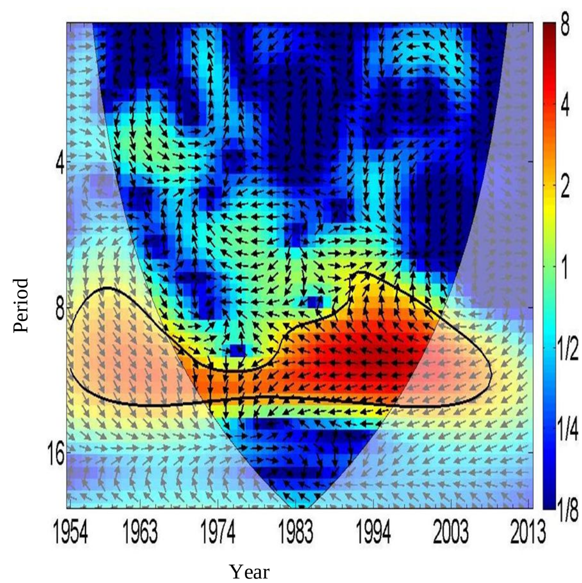
International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue XII Dec 2021- Available at www.ijraset.com



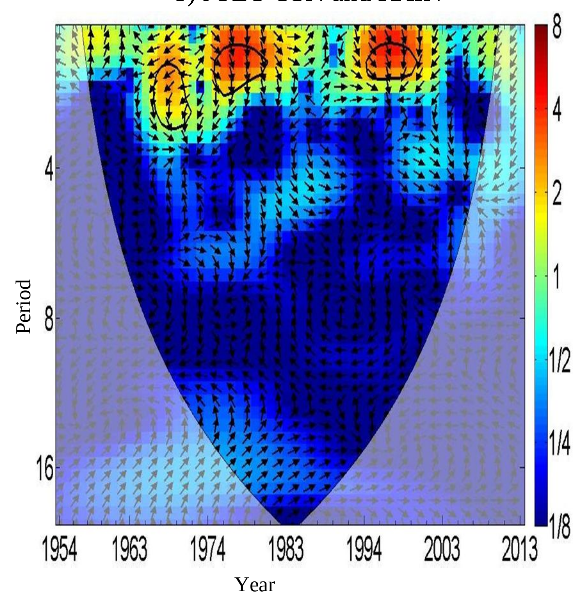
a) JUNE-RAIN and ENSO



b) JULY-SSN and RAIN



c) AUGUST -RAIN and SSN



d) SEPTEMBER -RAIN and QBO

Fig. 4 Cross wavelet transform of the Jharkhand a) June- rainfall and ENSO b) July rainfall and SSN c) August rainfall and SSN d) September QBO and Rainfall time series (1954-2013). The 5% significance level against red noise is shown as a thick contour. The relative phase relationship is shown as arrows (with in-phase pointing right, anti-phase pointing left).

C. Analysis of Active and break days

The present rainfall dataset has been used to identify the active–break periods during the southwest monsoon season. In the present analysis, the active and break periods during the southwest monsoon season have been identified in the following way. The area-averaged daily rainfall time series for each year from 1954 to 2013 has been prepared by simply taking the arithmetic mean of all rainfall at all grid points over the Jharkhand region.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue XII Dec 2021- Available at www.ijraset.com

Table 1. Active and Break days identified in the present analysis (1954–2013) Active and Break days – July and August (Jharkhand)

Jharkhand	break (-1)	No. of days	Active (+1)	No. of days
1954	1-11J,17-20J,22-27J,30-8A,17-19A,23-27A	39	14-16J,14-16A	6
1955	12-14J,21-24J,28-30J,1-6A,21-27A,	23	5-7J,25-27J	6
1956	1-3J,17-20J,29-1A,9-13A,18-20A,28-31A	23	4-8J,14-16J,5-8A	12
1957	5-11J,14-18J,26-7A,11-24A,26-28A,	40	20-22J	3
1958	1-10J,13-16A,18-28A	25	20-24J,5-7A	8
1959	13-19J,23-26J,6-10A,21-26A	22	9-12J,20-22J,27-29J	10
1960	7-9J,12-19J,22-26J,6-9A	20		
1961	7-10J,17-19J,23-28J,17-19A,	16	3-6J,2-5A	8
1962	8-16J,23-27A	14	19-21A,28-30A	7
1963	2-4J,8-13J,16-19J,27-29J,1-7A,12-14A,16-24A,28-31A	40	25-27A	3
1964	1-5J,12-14A,16-20A,27-30A	17	15-17J,28-31J,21-24A	11
1965	11-17J,21-23J,6-12A,19-22A,26-31A	27	1-3J,8-10J,1-3A	9
1966	2-9J,14-31J,3-5A,13-17A,19-31A	47		
1967	10-12J,20-26J,12-14A	13	16-19J	4
1968	1-3J,19-22J,25-27J,5-8A,16-18A,24-31A	25	9-11J,16-18J,30-4A,9-12A	16
1969	5-15J,23-29J,1-5A,23-27A,29-31A	31	18-20J,13-15A	6
1970	10-20J,25-30J,5-12A,14-26A,28-31A	42	1-3J	3
1971	8-10J,23-25J,28-30J,4-6A,21-27A	19	1-5J,11-13J,15-17A,28-31A	15
1972	3-5J,20-31J,1-3A,16-22A,29-31A	29		
1973	1-8J,11-20J,28-31J,2-10A,13-18A,21-26A,28-30A,	46		
1974	30-9A,11-15A,18-21A,23-26A	24	7-9J,12-15J	7
1975	4-6J,23-26J,1-3A,24-28A	15	1-3J,7-9A,13-15A,18-20A	12
1976	1-5J,13-17J,20-25J,10-15A,19-28A	32	8-11J	4
1977	20-24J,10-12A,15-26A	20	9-11J,26-6A	15
1978	2-11J,13-17J,29-2A,6-8A,26-30A	28	14-16A	3
1979	2-11J,15-17J,23-25J,30-2A,13-18A,20-23A,25-31A	37	26-29A	4
1980	17-19J,24-26J,6-8A,16-20A,28-31A	18		
1981	9-11J,21-24J,6-8A,10-13A,16-18A,25-30A	23	6-8J,17-20J,30-1A,22-24A	13
1982	1-8J,11-15J,17-20J,25-28J,3-5A,10-12A	27	22-24J	3
1983	1-4J,7-16J,1-4A,11-14A,16-22A	29	26-28J,23-26A	7
1984	2-4J,6-8J,19-21J,3-5A,23-25A	15	22-24J,13-15A	6
1985	19-23J,8-19A	17	13-15A	3
1986	2-5J,14-19J,27-2A,8-14A,17-19A,26-31A	33	6-9J,3-5A	7
1987	29-31J,9-11A,15-18A	10	24-27J,21-24A,26-29A	12
1988	14-16J,19-25J,29-1A,7-9A,20-22A,24-26A	23	10-12A,27-30A	7

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue XII Dec 2021- Available at www.ijraset.com

1989	3-12J,16-18J,6-12A,14-16A,18-22A,28-30A	31	13-15J,27-5A	13
1990	11-13J,17-19J,5-7A,14-21A,23-31A	26	7-10J,14-16J,22-24J	10
1991	9-16J,31-5JA,7-11A,24-26A,29-31A	25	20-23J	4
1992	1-8J,10-15A,21-25A,29-31A	22	9-13J,16-19J,23-25J,27-31J,7-9A,18-20A	23
1993	10-14J,19-23J,29-31J,3-5A,7-10A,16-19A,25-28A	28		
1994	22-25J,4-8A,12-14A,20-22A	15	23-25A	3
1995	4-6J,25-27J,12-14A,25-31A	16		
1996	2-4J,13-22J,27-31J,9-15A,29-31A	28	5-7J,1-4A,6-8A	10
1997	5-7J,14-17J,7-11A,25-28A	16	21-25J,12-15A,29-31A	12
1998	1-3J,23-29J,6-12A,20-31A	29	4-6J,14-16J,13-19A	13
1999	1-4J,6-10J,9-12A,20-22A	16	11-15J,18-21J,27-31J,4-8A,26-30A	24
2000	1-10J,14-16J,27-31J,4-6A,12-14A,17-30A	38	21-26J	6
2001	4-9J,13-15J,2-9A,20-23A	21	29-31J,24-26A,28-31A	10
2002	5-13J,24-28J,1-9A,19-21A,25-27A	29	1-3J,12-17A	9
2003	3-4J,16-23J,4-10A,25-30A	23	13-15J,24-28J,30-3A,12-16A,18-20A	21
2004	9-12J,17-21J,25-27J,30-2A,16-19A,25-29A,	25	5-7A,9-14A,20-22A	12
2005	15-18J,24-26J,30-1A,8-13A,19-21A,25-31A	26	3-5J,2-4A,22-24A	9
2006	5-7J,22-25J,1-9A,24-26A	19	8-11J,13-17J,15-18A,21-23A	16
2007	9-12J,4-11A,21-24A,29-31A	19	3-8J,15-17J,28-31J,1-3A,12-14A,17-20A	23
2008	11-13J,4-10A,23-28A	16		
2009	1-3J,16-18J,24-28J,5-8A,23-25A,29-31A	21	2-4A	3
2010	1-10J,16-18J,19-24J,29-31J,4-19A,26-31A	44		
2011	6-11J,13-19J,23-30J,19-22A,27-31A	30	20-22J,4-10A,14-18A	15
2012	1-3J,7-9A,18-26A,28-31A	19	16-18J	3
2013	1-12J,14-16J,18-20J,13-15A,23-26A,29-31A	28	7-9A,20-22A	6

For the year 2008 the active and break periods have been identified. We have listed the active and break days during July and August only, provided they last consecutively for three days or more. The results giving the active and break periods during the period 1954–2013 are shown in tables 1.

In the present analysis, we have considered standardized rainfall anomalies to identify the active and breaks days of monsoonal extreme rainfall showing in year 2008. The standardized rainfall anomaly time series for the year 2008 an excess monsoon year as shown in Figure 5.

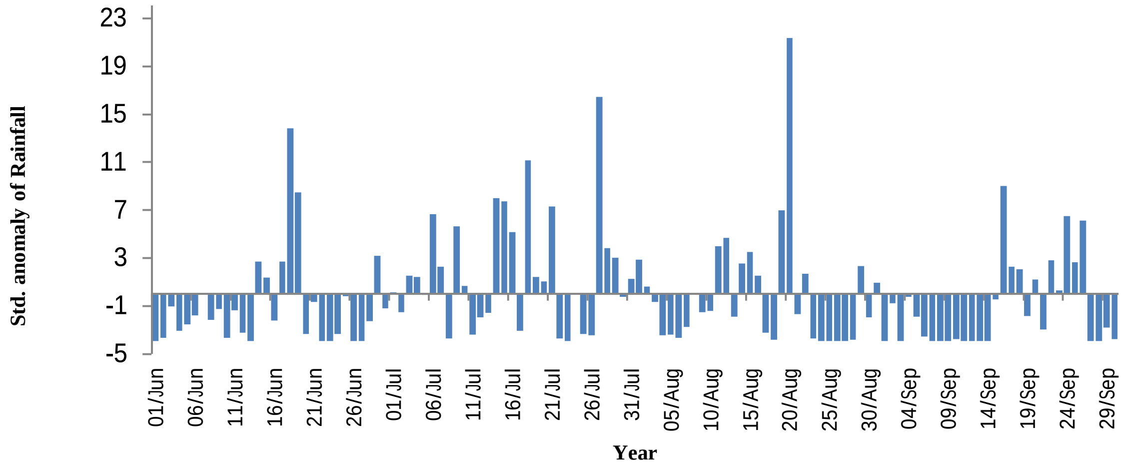
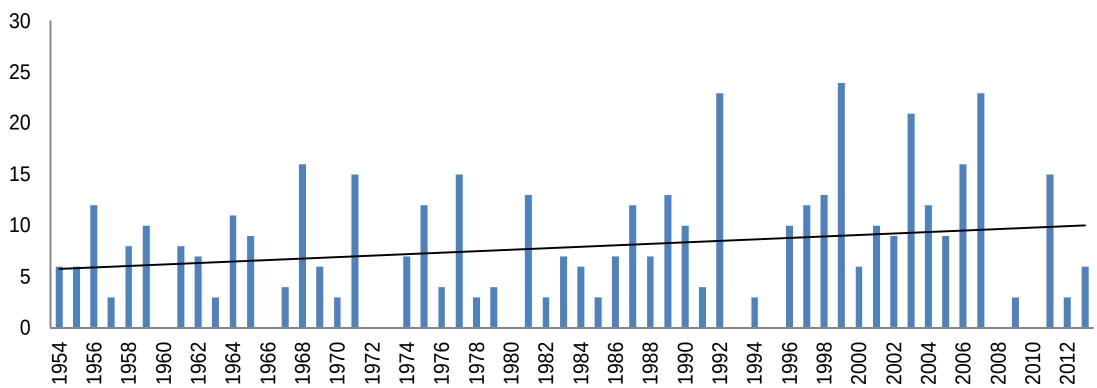
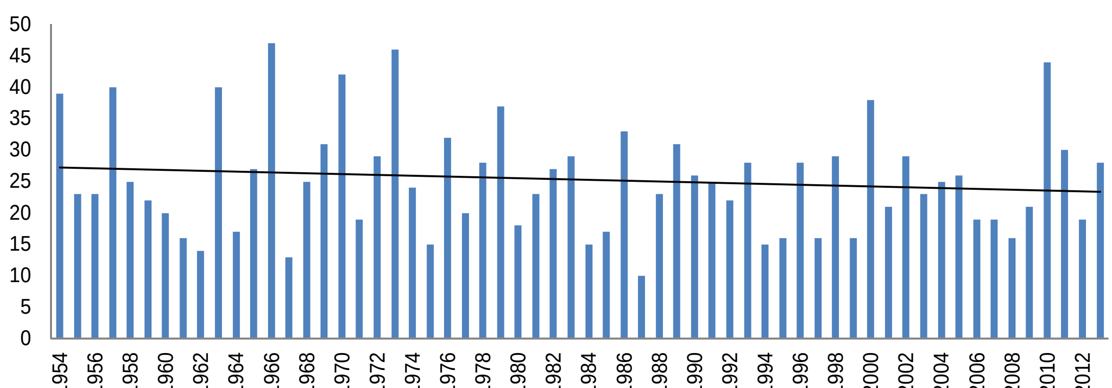


Fig. 5 Standardized rainfall anomaly time series for Jharkhand 2008 during the period 1 June to 30 September

Using the standardized daily rainfall anomaly averaged over Jharkhand the number of break and active days during the period June–September was calculated for each year for the period 1954–2013. The criterion followed to identify the breaks was the same as that discussed above. The time series of the number of active and break days for the period 1954–2013 derived from the present analysis is shown in Figure 6 a, b respectively. Increasing trend show in active days and decreasing trend show in break days period shown in figure below 6.



a)



b)

Fig. 6 Time series of a) Active b) Break days of Jharkhand during the July-August (1954–20013).

Trend of active days increases with time series and break days decreases with time. Maximum number of active days occurred in 2007 (23days) while maximum number of break days occurred in 2010 (44days), as shown in figure 6. In the study by Rajeevan et.al (2006), the number of break or weak monsoon days was identified earlier for the period of 1951-2003 for the Central India region.

Define break days as days with large positive outgoing longwave radiation (OLR) anomalies for at least four consecutive days or more over a wide region covering the northwest and central India (Krishnan et al., 2000). The objective criterion that the OLR anomaly averaged over the region (18°-28°N; 73°-82°E) should exceed 10 WM^{-2} during all the days of the break period. Further, the active period in July-August month 2008 and breaks days in the period July-August month 2007and 2010 were considered as shown in figure 7. OLR positive anomaly increases then rainfall is decreases (Break days) in 2010 and when OLR negative anomaly is increase then increases (Active days) rainfall in 2007 as shown in figure 7.

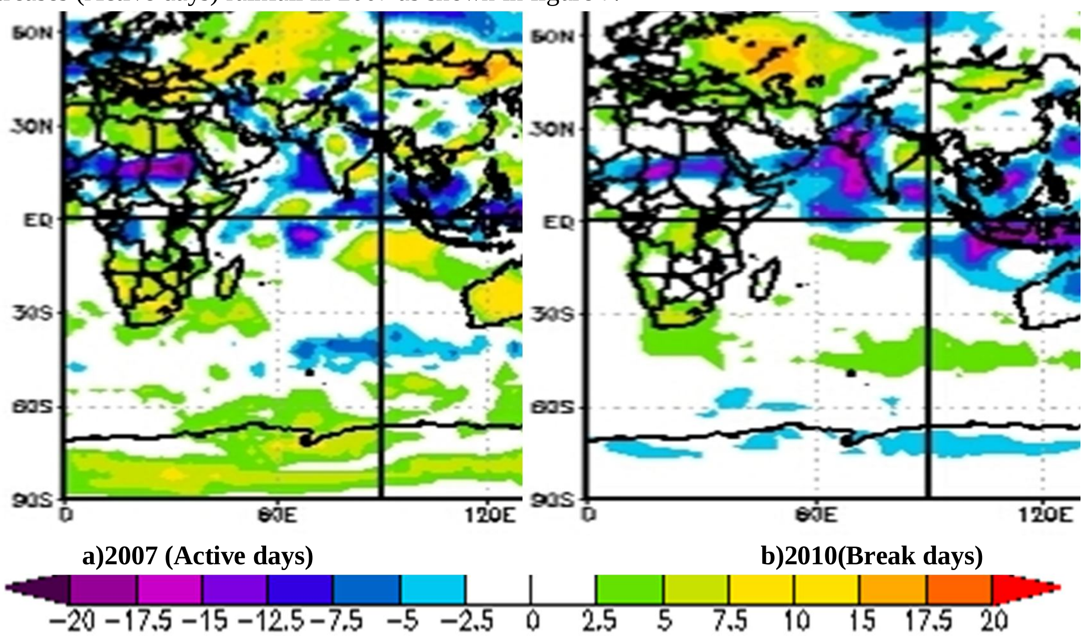
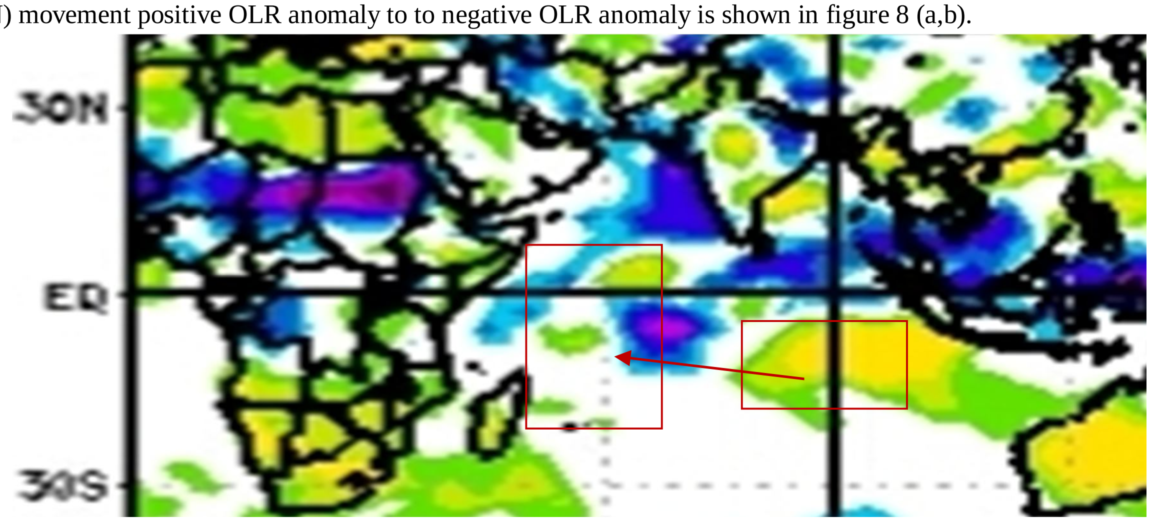
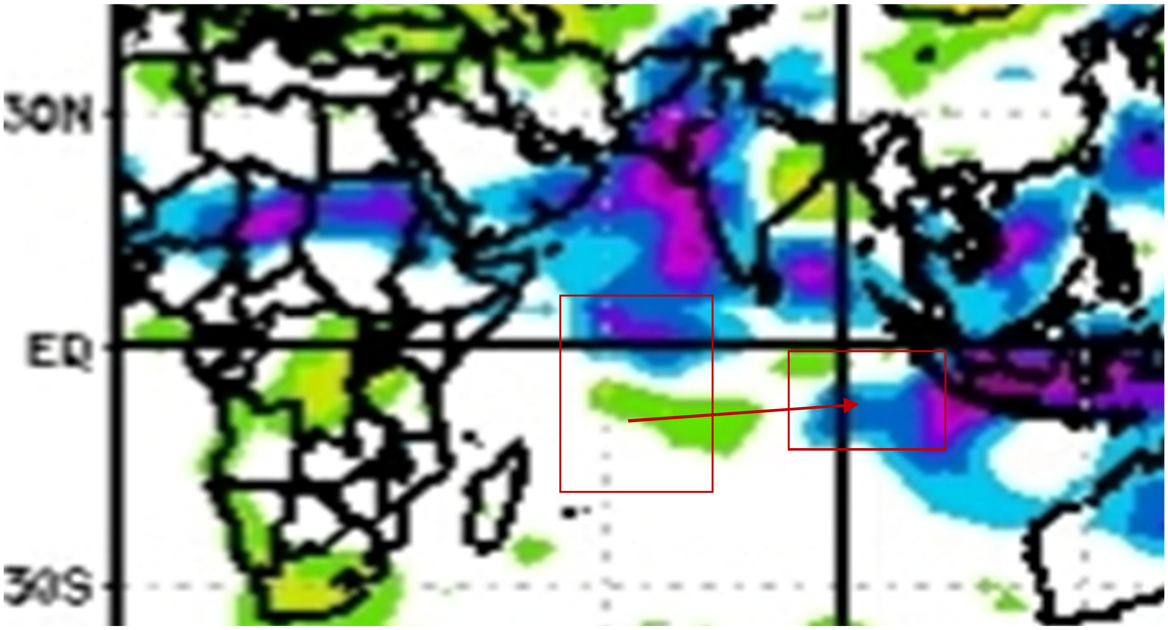


Figure 7. OLR (W/M^2) Anomaly patterns for July-August (a) 2007 (b) 2010

ISMR is positively correlated with convection over the western equatorial Indian Ocean and negatively correlated with convection over the eastern equatorial Indian Ocean. The equatorial Indian Ocean Oscillation (EQUINOO, Gadgil et al 2004) is characterized with convection anomalies of opposite signs over the western and equatorial Indian Ocean. The correlation of OLR with the index of EQUINOO (based on zonal wind) (Gadgil et al 2004), which is again defined so that it is zonal wind (at the equator 60-–90-E, 2.5-S–2.5-N) movement positive OLR anomaly to to negative OLR anomaly is shown in figure 8 (a,b).



a)



b)

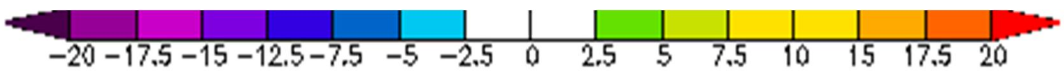


Fig. 8 OLR and Zonal Wind Anomaly patterns for July-August a.2007 b.2010

These search demonstrating the importance of EQUINOO. Comparison of figures 14(a and b) shows that the pattern of convection anomalies over the central Pacific associated with breaks and active spells. On the other hand, figures 14(a and b) show that the intra-seasonal anomaly patterns over the eastern equatorial Indian Ocean are similar to those on the interannual scale associated with the link to EQUINOO.

IV. CONCLUSIONS

Based on the findings of the current study results of the analysis that the trend in the rainfall series is decreasing in recent decade winter and post-monsoon after decade III and other seasons increasing trend after decade III. Overall shift of rainfall in this study period decreases from 1984 onwards. In monsoon season and month of June for extreme rainfall ENSO (La-Nina) effect in decade VI is noticed here. The periodicity of the rainfall identified here 2-5 years in winter (JF) season in decade V, and 8-16 years in pre-monsoon season (MAM) from decade IV to decade V and also in monsoon season (JJAS) in year 1983. Both type relation in-phase and antiphase with SSN showed. So we can say that QBO and SSN parameters involve here. Rainfall and SSN both in antiphase (JJAS 1983) relation and in-phase (MAM decade IV to V) relation showing in study. In winter season (JF) rainfall periodicity is 2.5 years, in XWT in-phase relation showed with QBO in decade V. The present rainfall dataset is used to identify the active and break periods during the southwest monsoon season using an objective criterion based on standardized daily rainfall anomaly. The active and break periods thus identified were found comparable with those identified by earlier studies. Identify the active (2007) and breaks (2010) days of monsoonal rainfall in showing extreme year. Thus the time series of break and active days prepared in this study is a more representative measure of monsoon activity during the season. OLR is show negative anomaly in 2007and positive anomaly in 2010. So in this year excessive rainfall in Jharkhand region.

REFERENCES

[1] Bhattacharyya, S., Narsimha, R. (2005), “Possible association between Indian monsoon rainfall and solar activity”, Geophysical Research Letters, 32, L05813_1 L05813_5. ISSN0094-8276.
[2] Farge, M., 1992: Wavelet transforms and their applications to turbulence. Annual Review, Fluid Mechenics, 24, pp. 395–457.
[3] Gadgil, S. and Joseph. P. V. 2003. On breaks of the Indian monsoon, Proc. Indian. Acad. Sci. (Earth Planet. Sci.), 112, 529–558.
[4] Gadgil, S., Vinayachandran P N, Francis P A and Sidharata Gadgil 2004 Extremes of the Indian summer monsoon rainfall, ENSO and the equatorial Indian Ocean Oscillation; Geophys. Res. Lett. 31(L1) 2213, doi:10.1029/2004GL019733.

[5] Gadgil, S., Rajeevan M. and Francis P. A. 2007 Monsoon variability: Links to major oscillations over the equatorial Pacific and Indian oceans; Curr. Sci. 93(2) 182.

[6] Hiremath, K. M. (2006), "The influence of solar activity on the rainfall over India: Cycle-to-cycle variations", Journal of Astrophysics and Astronomy, 27, pp. 367– 372.

[7] Jagannathan, P. and Parthasarathy, B. (1973), "Trends and periodicities of rainfall over India, Monthly Weather Review 101, pp. 371 – 375.

[8] Kalnay, E. et al. 1996 The NCEP/NCAR 40-year reanalysis project; Bull. Am. Meteorol. Soc. 2 437– 471.

[9] Krishnamurthy, V., and J. Shukla (2008), Seasonal persistence and propagation of intraseasonal patterns over the Indian monsoon region, Clim.Dyn., 30, 353–369, doi:10.1007/s00382-007-0300-7.

[10] Philander, S. G. H. (1983), "El Niño Southern Oscillation phenomena", Nature, 302, pp. 295–301.

[11] Rajeevan. et al., 2006. High resolution daily gridded rainfall data for the Indian region: Analysis of break and active monsoon spells Current Science, vol. 91, no. 3.

[12] Ramamurthy, K. (1969), "Monsoon of India: Some aspects of 'break' in the Indian South west monsoon during July and August", India Meteorological Department, Pune, India, Forecasting Manual 1-57 No. 18.3.

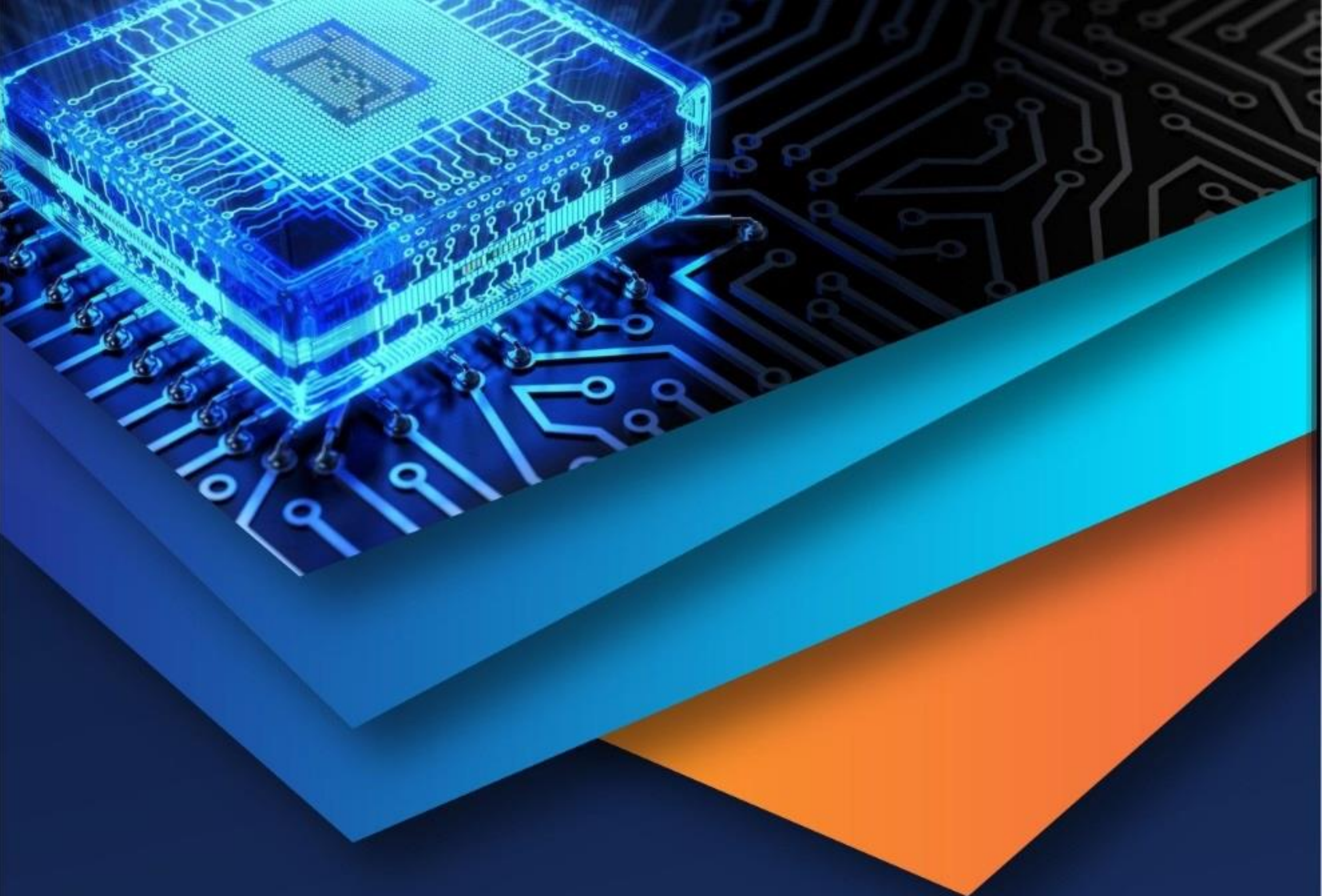
[13] Selvaraj, R. S. and Aditya, R. (2012), "The solar influence on the monsoon rainfall over Tamil Nadu", Journal of Indian Geophysical Union, Vol. 16, pp. 107-111.

[14] Sharma, S., Singh, P.K. (2017), "Long Term Spatiotemporal Variability in Rainfall Trends over the State of Jharkhand, India" Climate, 5,18, pp.2-18.

[15] Torrence C, Compo GP (1997) A practical guide to wavelet analysis. Bull Amer Meteor Soc 79(1):61-78.

[16] Trenberth, K. E. (1976), "Spatial and temporal variations of the Southern Oscillation", Quarterly Journal of the Royal Meteorological Society, 102: 639–653.

[17] Webster, P. J., Magana, V. O, Palmer, T. N., Shukla, J., Tomas, R. T., Yanai, M. and Yasunari, T. (1998), "Monsoons: Processes, predictability and the prospects of prediction", J. Geophysical Research, 103(C7), 14, pp. 451 – 14,510.



10.22214/IJRASET

INDEX COPERNICUS

45.98

IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL

IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY