Volume : 4 | Issue : 6 | June 2015 • ISSN No 2277 - 8179

Research Paper

Perturbation of Solar Activity on The Indian Rainfall Pre-Industrilisation Era (1900-50)

Meteorology

KEYWORDS :

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ABSTRACT

We have used 50 Years (1900 AD to 1950 AD pre-industrialization era) data for studying the relationship amongst the rain showers and sunspots over the north-western part of India as a case study. The rainfall data of city Ahmadabad, state Gujarat, India, have been selected. We plotted the annual average sunspots verses rainfall and examined the perturbation of solar activity on rainfall. The systematic relationship exhibited the dependence of average rain on Solar Sunspots Number (SSN).It is observed that Maximum is the SSN, more is the rainfall and also minimum is the SSN, again more is the rainfall. These results are consistent within statistical error and much justifiable for the pre-industrialization era.

Introduction:

India is predominantly an agricultural country. Indian agriculture has about 25% contribution towards the national economy which is more dependent on rainfall but least on technically based resources of irrigation. The agricultural economy is badly hit by the irregularity in rainfall either by draught or heavy flooded or hailstorm. Success or failure of crops in any year is always crucial for the development of Indian economy, which in turn controls 25% of the GDP of the country. In 1950s and 1960s, Indian budget was regarded as a gamble on the monsoon rains (Lean (2006), Faukal (2006)). This holds good even now. On 1st April 2015 government of Rajasthan reported that, hailstorm has created a gross loss of 8, 574 crore rupees to the farmers, which has directly affected 2.31 crores of population in the state (Frohlich 2010).

The cause for the abnormal variability of the Monsoon rainfall such as occurring of floods and droughts is not yet completely understood. It is believed that the main causes is due to the localized anthropogenic activity which influences over the climate and environment, viz., degradation of forest coverage, silting of dams and other unknown causes (Parthasarathy et al., 1993, and references there in; Rapa Kumar et al., 2002; Gadgil, 2003).

Thus it is very important to study the influence of the solar cycle activity phenomena on the climate of the earth, in general, and the monsoon rainfall variability in particular (Feuluer 2010)

The Aim of the present study is to search for a possible affiliation between the sunspot activity and the Indian Monsoon rainfall variability.

Data Analysis:

For the first half twentieth century we consider 50 years (1900-1950) data of the Sunspots numbers and Indian monsoon rainfall and determine occurrence of variability through correlative and periodic analysis. We have taken the Sunspot number data from (Physics Research Laboratory, Ahmadabad) have compiled a homogeneous set of rainfall data for the Northwestern part of India., The rainfall data (in mm) for the years 1900-1950 is available in monthly and annual series. . In the present analysis, we use the annual (averaged for the period of 12 months) rainfall data. The extra terrestrial effect on rainfall is global and its signature can be identified on long range time scale. The 11years sun spots activity cycle is effective for five and half year's periods for its maxima and minima. Once either of the maxima or minima of solar activity occur than there would be more genuine good effect on the annual rainfall comprising of both seasonal and non-seasonal rainfall. In order to understand the solar and Galactic Cosmic radiation effect on rainfall we synoptically combine the annual rainfall data including winter, summer and rainy season. For a Particular year rainfall data we compute the total rainfall known as annual rainfall data. For similar years we take the mean sunspots data of 12 months. In table 1 the data computed for Sunspots and rainfall activity are shown.

The first column represents Solar year for first half twentieth century and second column average annual solar Sun Spot number (SSN) where as third column shows total annual rainfall. The data of the table-1 is plotted for the industrialization years 1900-1950 sometimes called Pre-industrialization era as shown in fig-1 which corresponds to least pollution period. The data points have been plotted and the trend in the figures exhibits the attribution of Galactic and Cosmic perturbation over the annual rainfall. The relationship between Sunspots and annual rainfall has been examined and has come up with the clear indication for half of the 20th century. It has been observed that annual rainfall is always above average (as shown by horizontal pink line produce by the data taken from Aires Nanital) which is referred as access rain during the maximum of the solar activities. This reveals that during solar maxima the solar cosmic flux with Galactic Cosmic flux enhance the Ionization in the atmosphere of the earth in the form of secondary cosmic radiation. This cosmic radiation is in form of shower extending up to lower part of troposphere where mostly monsoon prevails.

The cosmic rays charge the lower atmosphere in the form of various secondary cosmic charges produced after the impact of protons with atmospheric gases. The secondary charges are mostly muons, pions, neutrons, electrons, positrons, light nuclei and atmospheric florescent radiation of short wave length ranges namely Gamma, x-rays and UV radiations. The charged atmosphere concurrent with monsoon undergo a typical interaction sometimes called nucleation. Water molecules in the form of vapor accumulate around the secondary charge particles with the mechanism of dipole alignment in the vicinity of electric filed around the secondary charge particles. Water molecule dipole movements polarize around the secondary charges making a macro droplet under the influence of electric field gradient of

Volume : 4 | Issue : 6 | June 2015 • ISSN No 2277 - 8179

the secondary cosmic charge. Principally when droplets condensation starts adding sufficient mass by these water droplets then under gravity, they are accelerated down towards the ground. The critical process of nucleation once started then continuously rain shower occurs. This mechanism justifies the heavy rainfall during the solar activity maxima. Fig-1 shows a plot between rainfall and sunspots number (SSN) for the year from 1901 to 1950 at Ahmadabad city of India.

The abscissa (Y-Axis) on left hand side represents the average SSN for the year 1901-50 which is pre-industrial period. Abscissa on right hand side represents the cumulative annual rainfall in millimeter with annual average rainfall indicated by horizontal pink line. The annual average line is estimated by the data taken from Aries Nainital.

Trend between maximum SSN & Rainfall

In fig-1 it is much clear that at every solar cycle maxima the rainfall is also larger than annual average. The 1st solar cycle (1901-1912) of the 20th century (1901-1950) the expected solar maxima happened on the year of 1906 showing average sunspot number between 55-60 and in the same year the rainfall occurred with the excess of rain between 160-300mm above average rainfall. Although at the year 1905 we observed maximum rainfall of access rain 300mm above the average rainfall when SSN goes to 60.

In the next cycle of solar activity between 1912-23 maxima occurs in 1917 with the maximum sunspot of about 103 and rain shower excesses up to 480mm above average.

However, in the subsequent solar cycle of 1923-33, rain shower shows extra ordinary access of about 1200mm which is above average. Although the SSN at 1928 reduced to 77 as compare to preceding cycle.

The forth solar cycle of the century happened between 1933-44 with the maxima at 1938 and SSN is about 110 but the rain shower is only 240mm excess above average.

In the last solar cycle of the pre industrial era before 1950 extended between 1944-54 with the maxima at 1949 having maximum SSN of about 140 but maximum shower in 1950 (1year latter) occurred with the excess of above 480mm above average. This was only the exception during the half of the 20th century that, maximum shower was occurring 1 year before the maxima of the solar cycle.

Trend between minimum sunspot number (SSN) & Rainfall:

The first solar minima is between 1910-15 as shown in fig-1 and excess rainfall has been observed of about 300 mm above average which is at the minima expected around 1912.

The second solar minima is between 1920-25 and excess rainfall has been observed to be again 300 mm above average.

When we examine the third solar minima between 1930-35, the excess rainfall is 320 mm above average coinciding with the expected minimum SSN at 1933.

The last solar minima have been observed between 1940-45 in which excess rainfall occurred of about 440 mm above average

Trend between draught and SSN

In fig-1 we tried to see the systematic trend between the SSN and the draught (rainfall below average) .The earlier trends in preceding sections showed that excess rainfall occurred in both the cases of maximum and minimum SSN in solar cycle. Now it is interesting to mark those data point in fig-1 where average SSN occurs for each solar cycle. These specific data points are indicated at Orange vertical lines , separated by 5 to 6 years span justifing the transition point of SSN from maximum to minimum and vice versa. The examination of rain shower data reveals that at each orange line of SSN transition there is draught without any exception during the Pre- industrial era 1900-1950 of the twentieth century.

Table 1 - Observation table at Ahmadabad city, India.

Table-1 **Table-1**

Years	Average annual SSN	Total annual Rainfall (mm)
1901	2.74	485.5
1902	5.05	711.6
1903	24.38	668.2
1904	41.95	243.6
1905	63.47	1075.7
1906	53.86	963.5
1907	62.03	845.8
1908	48.54	820.4
1909	43.88	757.2
1910	18.58	646.5
1911	5.70	249.4
1912	3.59	983.2
1913	1.44	910.5
1914	9.59	1032.6
1915	47.37	306.5
1916	57.07	640.8
1917	103.89	1251.8
1918	80.57	213.8
1919	63.61	743.1
1920	37.64	619
1921	26.13	034.9
1922	14.24	957.1
1923	5.77	358.8
1924	16.72	657.5
1925	44.31	582.5
1926	63.88	1260.4
1927	69.04	1997.1
1928	77.81	888.7
1929	64.86	624.1
1930	35.73	698.9
1931	21.23	816.6
1932	11.14	796.5
1933	5.66	1091.6
1934	8.72	725.9
1935	36.03	583.1
1936	79.73	562.8
1937	114.40	1005.8
1938	109.55	524.4
1939	88.75	505
1940	67.78	457.9
1941	47.48	1129.9
1942	30.60	1211.7
1943	16.33	857.7
1944	9.59	1012.7
1945	33.09	933.3
1946	92.51	705
1947	151.51	649.3
1948	136.20	306.9
1949	136.57	628.7
1950	83.93	1237.1

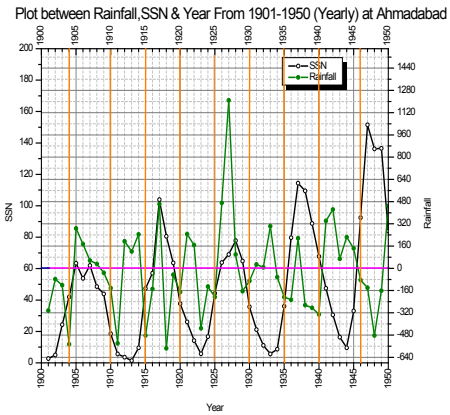

Fig-1 Plot between Rainfall, SSN & Year From 1900-1950 (yearly) at Ahmadabad. Black line represents the connecting point of average annual SSN and green line for the total annual rainfall. The horizontal pink line indicates the average annual rainfall and vertical orange line for average of maximum SSN occurring in each solar cycle.

Conclusion and Discussion

Twentieth century is regarded as the transition of world into industrialization era after 1950. The first half of it (1901-1950) was unpolluted because of absence of anthropogenic activities but next half became polluted due to eruption of several dimensional industrialization with modern ingenious technologies. Without any dispute high technology development made the planet comfortable to live in but at the same time destroyed the purity of atmosphere by pouring large amount of pollutants. The percentage of intruded pollutants disturbed the entire cycle of seasons over the g lobe changing extreme condition of all types of weather and climate. This led us to divide the study into pre (1900-1950) and post (1950-2012) industrialization era and we confined our investigation for period (1900-1950) in the present study. The extensive data analysis of SSN and total annual rainfall were computed and the fundamental conclusions drawn are as under:-

We clearly observed that high rainfall above average occurred during the maximum and minima SSN of each solar activity cycle over the first half of twentieth century.

We also found that at an average SSN in each solar activity cycle (shown by vertical orange line in fig-1) invariable draught happened with rainfall below average (shown by a horizontal pink line).

These finding from the data at Ahmadabad city can be understood as the basis of interaction phenomenon between monsoon clouds and secondary charged particles produced by primary Solar and galactic cosmic radiation impacting in the gas molecules of atmosphere as discussed in last paragraph of data analysis section. During solar maxima, solar cosmic radiation dominantly take part in nucleation of droplets in clouds for excess rainfall above the average and similarly during solar minima, galactic cosmic radiation do. At time of draught (rainfall below average) neither the maximum nor the minima SSN but average SSN of all solar cycle after each period of 5 years have been found responsible. Convincingly how does it happen is not clear but leave behind a query for proper explanation.

Acknowledgement

The authors are thankful to the unknown referee for useful suggestions and comments. We are also thankful of IMD Ahmadabad, India to provide the rainfall data for the present study and PRL for Sun Spot Number data and Airies Nainital for average rainfall data.

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