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Erraticness of the rainfalls in different regions of India

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सार – भारत के विभिन्न क्षेत्रों में, हाल के कुछ वर्षों के अधिक अनियंत्रित (अधिक मानक विचलन) होने का कोई प्रमाण नहीं मिला है। इससे पहले, कुछ क्षेत्रों में अधिकतम अनियंत्रित वर्षा 1880–1890 और 1950–1960 के दौरान, ~ 70 वर्षों के अंतराल में हुई। यदि यह अर्थपूर्ण है तो, यह 2020–2030 के दौरान वर्षा के अधिकतम अनियंत्रित होने की संभावना का संकेत हो सकता है।

ABSTRACT. In the different regions of India, there is no evidence of rainfalls being more erratic (larger standard deviations) in more recent years. In the past, the peaks seem to have occurred during 1880-1890 and 1950-1960 in some regions, a separation of ~70 years. If meaningful, it could be indicative of a likely peak during 2020-2030.

Key words – Rainfall, Indian regions, Erraticness.

1. Introduction

Presently, there is considerable discussion about climate change, global warming, polar ice melting and possible increase in sea level, etc. [The International Panel on Climate Change (Report) http://www.ipcc.ch/, http://www.climate-change.me.uk/html/what_is_climate_change.html, http://www.euronet.nl:80/users/e_wesker/climate.html http://www.state.gov/g/oes/rls/remarks/2009/ 119983.htm; http://livinggreen.info/LvGnGlblWarmgIPCCRpt.pdf; Kumar *et al*., 1999; Timmermann *et al*. 1999; Crowley 2000].

Rainfall variations are an important part of climatic changes. In this short note, the monthly rainfall variations in the Indian region during the last 136 years are examined.

2. Data

Data for the monthly values of rainfall in different regions of India were obtained from the website http://www.imdpune.gov.in/research/ndc/ndc_index.html.

3. Methodology

Table 1 gives the average rainfall characteristics in different regions (average of 136 years). As can be seen, large rainfall is concentrated in the summer months June, July, August and September. For every year, there are 12 monthly values. Their *mean* and *standard deviation* were calculated.

The mean is the average monthly value, one value per year. It may change from one year to the next and may show periodicities of a few years (notably, QBO, Quasi-biennial oscillation or QTO, Quasi-triennial oscillation, see Kane 1995 and references therein), and even long-term trends.

The actual 12 monthly values are of course, different from the average, some above, some below. The erraticness can be judged by the *standard deviation* of this series of 12 values (calculated from the 12 deviations from the mean). Thus, July is generally the highest rainfall month and January is generally a low rainfall month. So every yearly set of 12 monthly values will have a certain SD (standard deviation of the series of 12 monthly values). If the rainfalls are erratic, namely, large rainfalls in some months, low rainfalls in some others, even during the successive monsoon months, (what is generally termed as vagaries of monsoon), the deviations from mean would be larger and so, the yearly standard deviation (SD, one value per year) would also be larger. Thus, SD (one value for every year) would be a good indicator of the vagaries of the monsoon. Here, we would be examining whether the SDs were larger during some intervals of years, indicating stretches of years of larger monsoon vagaries.

TABLE 1

Rainfall (mm) characteristics of different regions in Índia (average of 136 years, 1871-2006), ALL = All India, HOM = Homogeneous, COR = Core monsoon, NW = North-west, WC = West central, CNE = Central northeast, NE = Northeast, PENIN = Peninsular

	ALL	HOM	COR	NW	WC	CNE	NE	PENIN
Jan	109	85	87	72	94	158	143	114
Feb	127	87	78	73	97	186	293	93
Mar	151	78	66	55	94	150	625	129
Apr	266	90	63	39	124	167	1325	385
May	530	174	151	112	216	423	2347	857
Jun	1641	1284	1521	654	1699	1624	3786	1654
Jul	2723	2579	3054	1875	3043	3181	3985	1890
Aug	2422	2226	2601	1552	2671	3106	3550	1560
Sep	1700	1434	1654	813	1844	2083	2837	1476
Oct	783	411	415	122	601	719	1413	1823
Nov	310	126	135	43	180	142	289	1205
Dec	118	60	69	41	73	66	87	412
Mean	907	720	824	454	895	1000	1723	967
Std. Dev SD	959	922	1096	645	1110	1189	1510	712

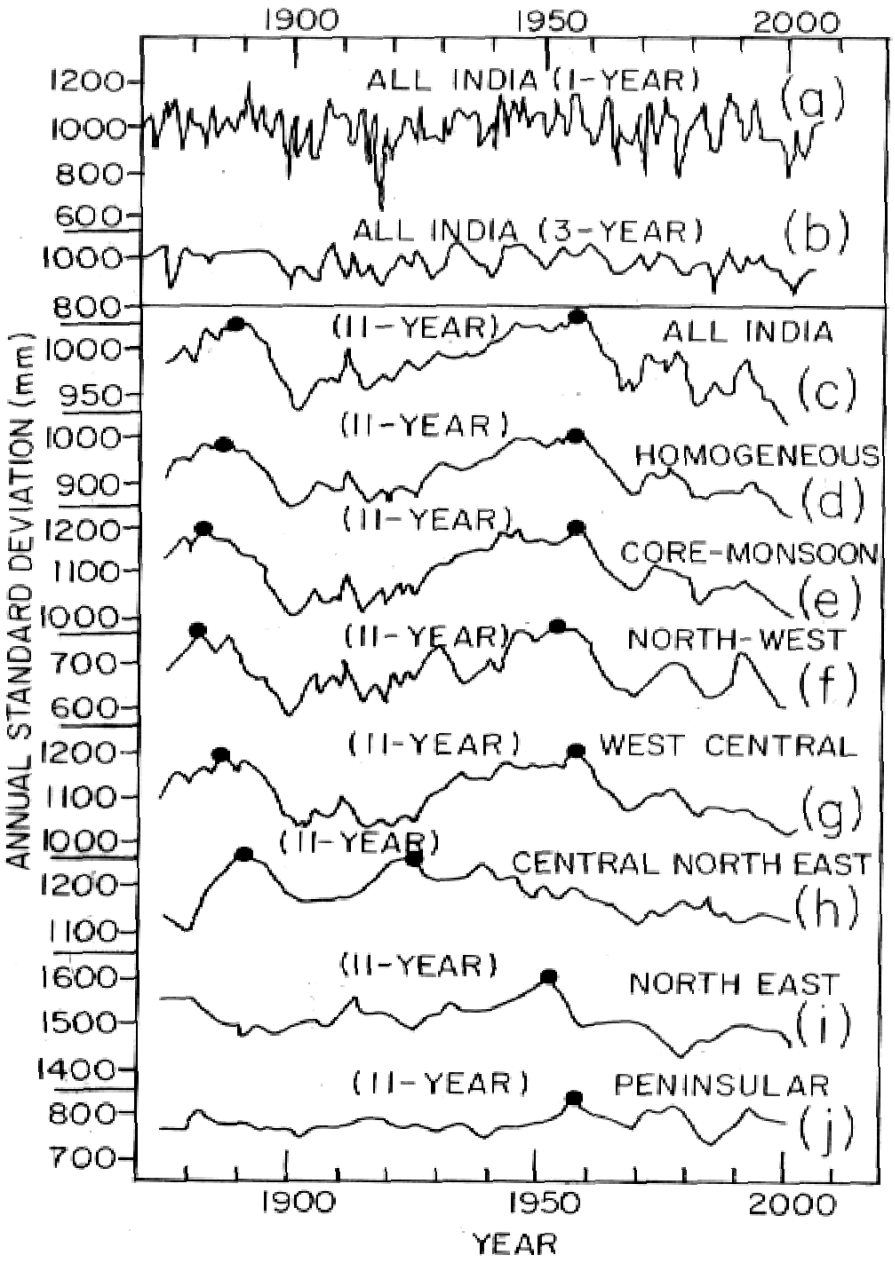
TABLE 2

Inter-correlations between the standard deviations of the rainfalls in different regions of India. ALL = All India, HOM = Homogeneous, COR = Core monsoon, NW = North-west, WC = West central, CNE = Central northeast, NE = Northeast, PENIN = Peninsular

	ALL	HOM	COR	NW	WC	CNE	NE	PENIN
ALL	1,00							
HOM	0,96	1,00						
COR	0,92	0,97	1,00					
NW	0,86	0,91	0,87	1,00				
WC	0,94	0,97	0,95	0,78	1,00			
CNE	0,47	0,27	0,27	0,15	0,34	1,00		
NE	0,41	0,40	0,44	0,42	0,36	0,12	1,00	
PENIN	0,38	0,35	0,29	0,42	0,26	-0,13	0,01	1,00

4. Results

For each region for every year during 1871-2006, the standard deviations (SDs, one value per year) were examined. Fig. 1 (a) shows a plot of the standard deviation (one value per year) for All India rainfall. There is considerable scatter, with values changing largely from year-to-year, illustrating the well known fact that rainfall pattern (rainfall distribution in the various months) may differ widely from one year to the next. To reduce the scatter, running means were obtained for 3 successive years. These are shown in Fig. 1 (b). The scatter got reduced but was still appreciable. Hence, running means were obtained for 11 successive years (solar cycle). These are shown in Fig. 1 (c). Now, some long-term patterns are seen. After decreasing from 1890 to 1900, there was an almost monotonic increase in the smoothed SD values from 1900 to about 1960, followed by an oscillatory



Figs. 1(a-j). Plots of the standard deviations of the 12-month data series (SD, one value per year) for 1871-2006 for All India rainfall (a) one year values, (b) 3-year running means, (c) 11-year running means. Further plots are for Indian regions (d) Homogeneous, (e) Core monsoon, (f) Northwest, (g) West central, (h) Central northeast, (i) Northeast, (j) Peninsular. Peaks are marked with big dots

decrease up to 2006. The standard deviation (a measure of erraticness of rainfall) was maximum near about 1880-1890 and then again near about 1950-1960 (peaks marked by two big dots). Thus, the erraticness has been certainly not larger in recent years. Further plots are for individual regions, Fig. 1(d) for Homogenous India, Fig. 1(e) for Core-monsoon region, Fig. 1(f) for North-west, Fig. 1(g) for West-central. All these show the same feature, namely, an increase from 1900 to ~1960. For other regions Fig. 1(h) for Central northeast, Fig. 1(i) for North-east and Fig. 1(j) for peninsular India, the patterns seem to be different, dissimilar between themselves and different

from those of [Figs. 1(c, d, e, f, g)]. Table 2 shows the intercorrelations. These are large between ALL, HOM, COR, NW, WC and poor with CNE, NE, PENIN.

5. Conclusion

There is no evidence of rainfalls being more erratic (larger SDs) in more recent years. In the past, the peaks seem to have occurred during 1880-1890 and 1950-1960 in some regions, a separation of ~70 years.

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