Erraticness of the rainfalls in different regions of India

R. P. KANE

Instituto Nacional de Pesquisas Espaciais – INPE
C. P. 515, 12245-970 – São José dos Campos, SP, BRAZIL

(Received 17 July 2009, Modified 26 August 2009)
e mail : kane@dge.inpe.br

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/education/climate.html http://www.state.gov/g/oess/rls/remarks/2009/119983.htm; http://livinggreen.info/LvGnGlblWarmingIPCCRpt.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 India (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  | 156 | 150 | 625   |
| Apr   | 266 | 90  | 63   | 59  | 124 | 167 | 172 | 385   |
| May   | 530 | 174 | 151  | 112 | 216 | 423 | 234 | 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|1,00 |1,00  |     |     |     |     |       |
| HOM   | 0,96|1,00 |0,97  |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.

Acknowledgements

This work was partially supported by FNDCT, Brazil, under contract FINEP-537/CT.

References

Crowley, T. J., 2000 “Causes of Climate Change Over the Past 1000 Years”, Science, 289, 270-277.

Kane, R. P., 1995, “Quasi-biennial and quasi-triennial oscillations in the summer monsoon rainfall of the meteorological subdivisions of India”, Mon. Wea. Rev., 123, 1178-1184.

Kumar, K. K., Rajagopalan, B. and Cane, M. A., 1999, “On the weakening relationship between the Indian monsoon and ENSO”, Science, 284, 2156-2159.

Timmermann, A., Ohberhuber, J., Bacher, A., Esch, M., Latif, M. and Roeckner, E., 1999, “Increased El Niño frequency in a climate model forced by future greenhouse warming”, Nature, 398, 694-696.