Trend and Variability of Rainfall: A Case Study of Shillong City

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Abstract: ***This study aims to investigate and analyze the trends and variability of rainfall in Shillong and its nearby areas, located in Meghalaya hills of North-east India; which is geographically a neighbouring area to the wettest places of the Earth, i.e., Cherrapunji and Mawsynram. The analysis of variability and trends to annual, seasonal, monthly and daily rainfall was carried out, using the data collected from the IMD station at Shillong; thereby attempting to highlight whether rainfall in Shillong area has been increasing or decreasing over the years. Rainfall variability coefficient is utilized to compare the current rainfall trend of the area with its past rainfall trends. The present study also aims to analyse the frequency of occurrence of extreme rainfall events over the region. These studies will help us to establish a correlation between the current rainfall trend and climate change scenario of the study area.***

Keywords: Trends and variability of rainfall; annual, seasonal, monthly and daily rainfall; rainfall variability coefficient; extreme rainfall events; climate change; Shillong, Cherrapunji, Mawsynram

1. Introduction

The North-east region of India (NEI), which covers an area of 0.26 million square km, is one of the highest rainfall-receiving regions of our planet earth. By virtue of receipt of heavy amount rainfall, NEI falls in low rainfall variability category and it ranges from 8-15%. For the North Eastern states of India, the normal annual rainfall ranges from 2000-3000 mm [1]. In high rainfall areas distribution of rainfall is of more concern as compared to its amount received.

The northeast Indian region of India is expected to be highly prone to the consequences to climate change because of its geo-ecological fragility, strategic location vis-à-vis the eastern Himalayan landscape and international borders, its trans-boundary river basins and its inherent socio-economic instabilities [1]. The impacts of climate change on regions like northeast India are less explored and less known till now making the future scenarios more uncertain for vulnerability assessment and risk management. However, certain indicators point to impacts being already visible in the region. Studies on rainfall and the temperature regimes of northeast India indicate that there is no significant trend in rainfall for the region as a whole i.e. rainfall is neither increasing nor decreasing appreciably for the region as a whole [1]. The summer monsoon rainfall is found to be decreasing over this region significantly during the last century at an approximate rate of 11 mm per decade [1,2].

Shillong is the capital city of Meghalaya, one of the smallest states of India. This city is significant because the world's highest rainfall area, Mawsinram/Cherrapunjee also falls within the region. But, Shillong receives far less precipitation due to the orographic effect. Under Köppen's climate classification, the city features a subtropical highland climate (Cwb). Its summers are warm and very rainy, while its winters are cool and dry. Shillong is subject to vagaries of the monsoon. The monsoons arrive in June and it rains almost until the end of August. October–November and March–April are the best months to visit Shillong.

The present study attempts to highlight the following goals:

- To study the periodic variability and comparative trends of rainfall pattern in Shillong.
- It will also highlight the increasing/decreasing trend of rainfall in Shillong, through an analysis of rainfall trends in the area over the years (1975-2014).

- To analyze the seasonal and monthly variation of rainfall (mm) in Shillong, during 1901-2014.

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2. Study Area

Shillong city is located at 25.57°N 91.88°E. It is on the Shillong Plateau, the only major uplifted structure in the northern Indian shield. The city lies in the centre of the plateau and is surrounded by hills, three of which are revered in Khasi tradition: Lum Sohpetbneng, Lum Diengiei and Lum Shillong. The weather conditions are pleasant and pollution-free over the year. In summer, the temperature varies from 23 °C (73 °F) to 4 °C (39 °F) in the winter.

Shillong city has abracing climate, throughout the year, which is influenced by the North-East winter winds. There are four main seasons in city, viz. (i) Spring: March and April (ii) Summer (Monsoon): May to September (iii) Autumn: October and November and (iv) Winter: December to February. The maximum and minimum temperatures attained during summer are 20°C and 15°C while during winter these are 16°C and 4°C respectively. In October and November months the climate is cool. After November, the winter sets in and continues upto the end of February. Rainfall starts by the third week of May and continues up to September end and sometimes up till middle of October.

3. Materials and Methods

The present study is based on the primary daily rainfall data collected from Indian Meteorological Department, Guwahati, and secondary rainfall data collected from Indian Meteorological Department, Pune. This study is an attempt to highlight whether rainfall in Shillong City has been increasing or decreasing over the years (1975-2014), through an analysis of rainfall trends in the area. Also, analyses have been done to study the seasonal and monthly variation of rainfall (mm) in Shillong, during 1901-2014, by using both primary and secondary rainfall data.

4. Results and Discussion

We investigated the current trends and variability of Rainfall in Shillong City. The results from our analysis are discussed below:

(a) Total Annual Rainfall Variability: By using the daily rainfall data collected from IMD-Guwahati, we analyzed the total annual rainfall (in mm) recorded in Shillong city during 1975-2014. As shown in Fig. 1, the linear trend-analysis indicates a slight decrease in the amount of total annual rainfall in Shillong city over the last four decades.

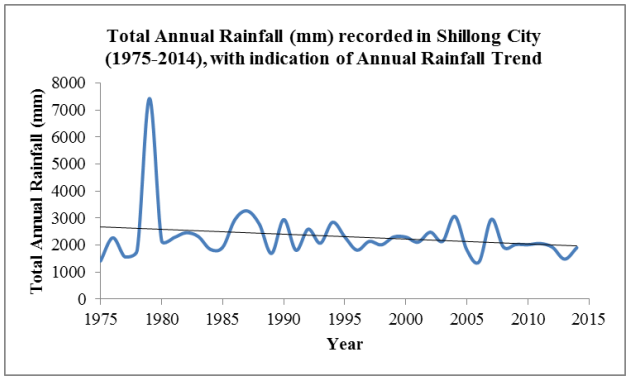

Figure. 1. Trends of Mean Annual Rainfall (mm) of Shillong city during 1973-2014

(b) Seasonal and Monthly Rainfall Variability: Shillong city experiences the south-west tropical monsoon and as such it follows the rhythm of monsoon characteristics by concentration of rainfall during summer season and decreasing the trend in winter season. Rainfall starts by the third week of May and continues up to September end and sometimes up till middle of October.

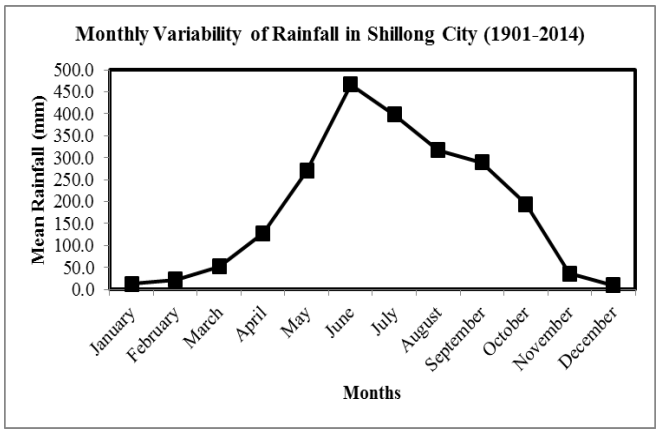

Figure. 2. Monthly Variability of Rainfall (mm) in Shillong City (1901-2014)

The details of seasonal and monthly variability of Rainfall (mm) in Shillong during 1901-2014, are tabulated in Table 1. Fig. 2 and 3 shows the monthly and seasonal variability of rainfall (mm) in Shillong city during 1901-2014. From these analyses, we have

shown that-

(a) The amount of monthly rainfall (mm) is highest in the month of June and lowest in the month of December respectively.

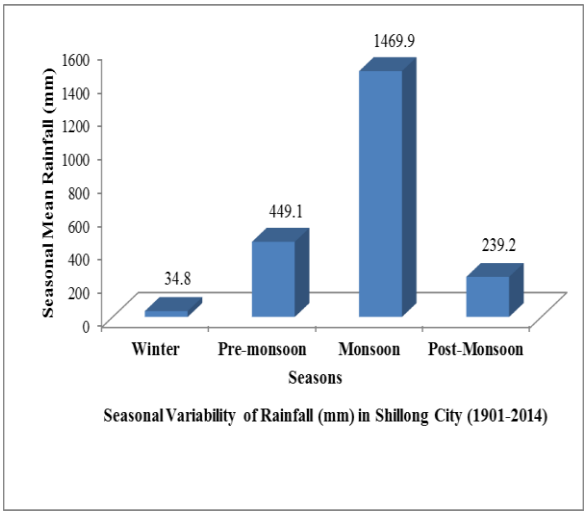

Figure. 3: Seasonal Variability of Rainfall (mm) in Shillong City (1901-2014)

(b) The amount of rainfall (mm) is highest in the monsoon season and lowest in the winter season. Also, 67% of total mean annual rainfall is recorded in the monsoon season, which is 1.6% in the winter season.

(c) The rainfall variation is high in post-monsoon and pre-monsoon seasons as compared to the winter and monsoon seasons.

I. **TABLE I** Seasonal and Monthly Variability of Rainfall (mm) in Shillong (1901-2014)

Months	Total Rainfall (mm)	Mean Rainfall (mm)	Seasons	Seasonal Mean Rainfall (mm)	24-Hour Heaviest Rainfall (mm)	
	(during 1901-2014)	(during 1901-2014)			Rainfall (mm)	Date & Year
January	1456.3	12.9	Winter (JF)	34.8	28.8	9/1/1993
February	2481.4	22.0			48	28/02/1973
March	5881.1	52.0	Pre-monsoon	449.1	44.3	29/03/2005
April	14394.1	127.4	(MAM)		57	3/4/1971
May	30475.1	269.7			227	22/05/1988
June	52659.2	466.0	Monsoon (JJAS)	1469.9	273.2	25/06/1988
July	44935.8	397.7			223.4	29/07/2001
August	35807.1	316.9			180	23/08/1966
September	32695.1	289.3			244	4/9/1979
October	21909.2	193.9	Post-Monsoon	239.2	262	8/10/2004
November	4113.6	36.4	(OND)		138.2	16/11/2007
December	1002.6	8.9			71	10/12/1973

Table I also shows the 24-hour heaviest rainfall (mm), recorded in a particular month, along with particular date and year. Accordingly, the highest record of 24-hour heaviest rainfall of 273.2 mm had been recorded on 25th June, 1988, in the history of Shillong city.

5. Conclusion

The purpose of the present study is to investigate and analyze the variability in rainfall occurred over the years. The current analysis of rainfall data has shown a slightly decreasing trend of rainfall variability in Shillong city.

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