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A Study of Change in Rainfall Pattern in Anand (middle Gujarat) in the last 60 years (1958-2017)

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Abstract

The analysis of rainfall records for long period provides information about rainfall pattern and variability. The long term monthly rainfall data for the period 1958-2017 (60 years) was studied. And also rainfall studies are utmost utility for understanding nature and behavior of climate change. In this study, trends in rainfall, maximum rainfall intensity and rainy day for 1958-2017 were examined. Long term data analysed for 60 years (1958-2017) annual data suggest that there is a significantly change in rainfall over last decade. It observed that total mean rainfall June to october but in by 50.04mm last 60 years and annual rainy days decreased by 0.017 mm per year. From the average monthly rainfall analysis, it is observed that rainfall variation for first 20 years (1958-1978) and second 20 years (1979-1999) are similar rainfall pattern whereas it differs for last decade (2000-2017) because of the change in magnitude however the overall trend is similar. Average monthly rainfall analysis indicates there is maximum rainfall in month of June and minimum rainfall in month of October.

Article History

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Keywords

Climate Change;
Linear Regression;
Rainfall Pattern;
Rainy Days;
Trend;
Rainfall Variation.

Introduction

India's economy is dependent on the agricultural production, which in turn is dependent one of the monsoon rainfall and its distribution. The year to year fluctuation in rainfall as well as the fluctuation within the monsoon season governs the crop growth, development and yield. Earlier studies on rainfall probability in India have been carried by many workers (Singh *et al*., 2009; IMD, 2010 and Halikatti *et al*., 2010). Rainfall, the main driver of the hydrological cycle, has been varying in part of the world in various ways. Rainfall is the main source of water. But rainfall is scares and erratic in Gujarat especially in Saurashtra region. So, its preservation and conservation has become the most important aspect in relation to the water resources

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development planning. Its magnitude, variation and distribution plays important role in hydrological response of the area. The analysis of rainfall records for long period provides information about rainfall pattern and variability. And also rainfall studies are utmost utility for understanding nature and behavior of climate change. (Solanki *et al.*)

Climate change is one of the main challenges in the world that is being studied by scientists and researchers. Rainfall is a key input in management of agriculture and irrigation projects and any change in this variable can influence on sustainable management of western resources, agriculture and ecosystems. Mainly, studies of climate change science are focused on the probable changes in the annual series of a variable such as rainfall and variability of this is important for crop planning. Globally the averaged precipitation is projected to increase; both increases and decreases are expected at the regional scale.

Table 1: Monthly rainfall variation for 1958-1978, 1979-1999 and 2000-2017

Month	Monthly Average Rainfall(mm)		
	1958-1978	1979-1999	2000-2017
June	128.2	107.3	98.5
July	283.9	274.3	324.9
August	250.3	262.1	290.7
September	177.5	106.5	163.3
October	12.7	27.3	6.5

The impact change on water resources has received much attention globally. The analysis of rainfall records for long period provides information about rainfall pattern and variability (Lazaro *et al.*). The main objective of this paper is to analyses the rainfall data to study variation in rainfall pattern.

Material and Methods

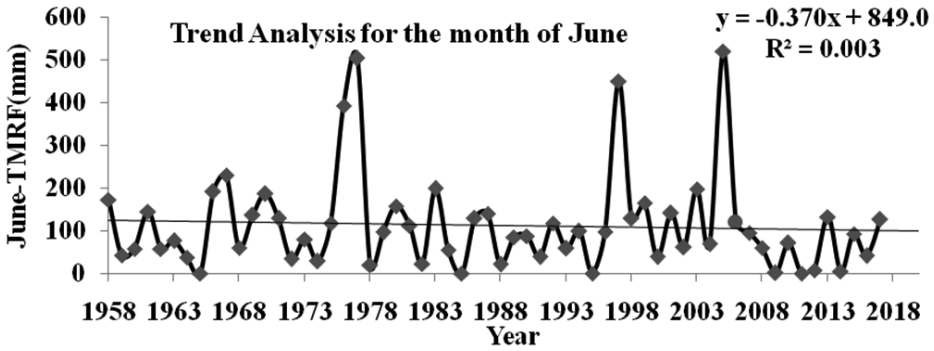
Study Area

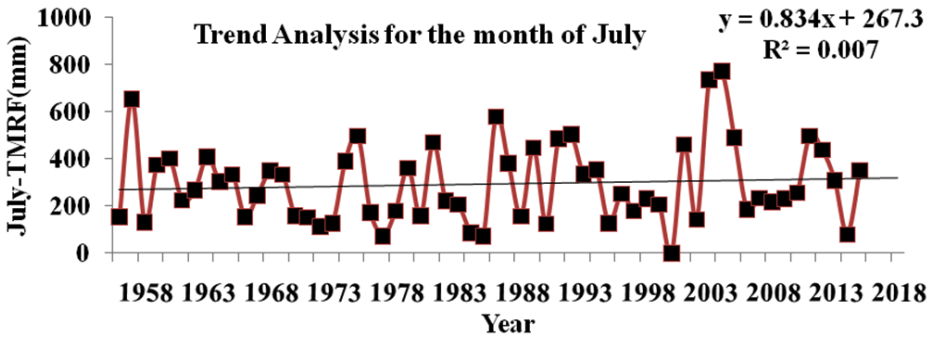
The rainfall at Anand (Middle Gujarat Agro-ClimaticZone-3) ranged between 286.9 mm to 1693.4 mm. The Rainfall variability (Annual and Seasonal) in Anand for the period 1958-2017 (60 years) were studied for their variability. The Anand (Middle Gujarat Agro-Climatic Zone-3)located (latitude - 220 35' N, longitude- 720 58' E) in Fig 1.

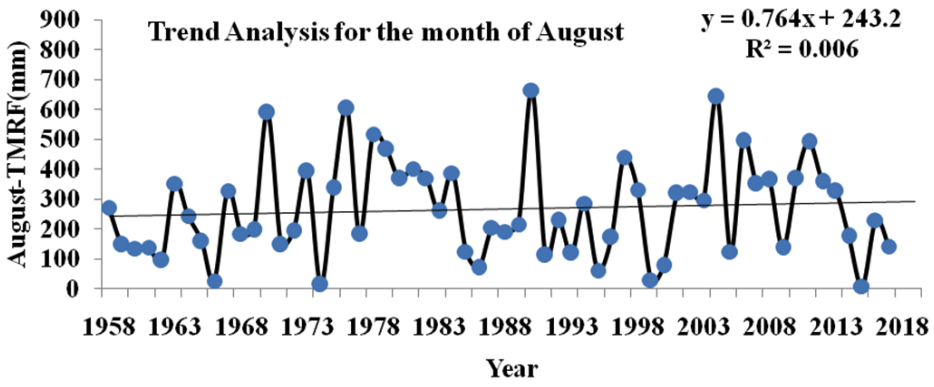
Data and Methodology

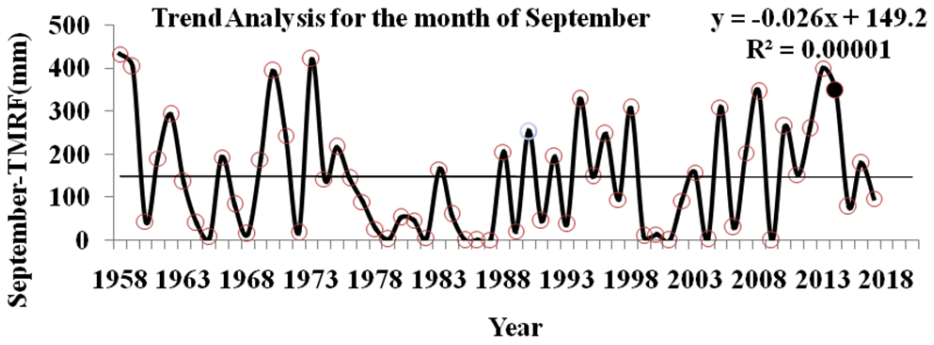
In this paper average of total mean rainfall (mm), maximum rainfall intensity of the month (mm/day) and rainy days data was used during 1958 – 2017 (60 years). The trend is determined by the relationship between the two variables as rainfall and time. The statistical method such as linear regression analysis and coefficient of determination R^2 are used.

Fig. 1: Location of map


Trend Analysis for the month of June
y = -0.370x + 849.0
R² = 0.003
June-TMRF(mm)
600
500
400
300
200
100
0
1958 1963 1968 1973 1978 1983 1988 1993 1998 2003 2008 2013 2018
Year


Trend Analysis for the month of July
y = 0.834x + 267.3
R² = 0.007
July-TMRF(mm)
1000
800
600
400
200
0
1958 1963 1968 1973 1978 1983 1988 1993 1998 2003 2008 2013 2018
Year


Trend Analysis for the month of August
y = 0.764x + 243.2
R² = 0.006
August-TMRF(mm)
900
800
700
600
500
400
300
200
100
0
1958 1963 1968 1973 1978 1983 1988 1993 1998 2003 2008 2013 2018
Year


Trend Analysis for the month of September
y = -0.026x + 149.2
R² = 0.00001
September-TMRF(mm)
500
400
300
200
100
0
1958 1963 1968 1973 1978 1983 1988 1993 1998 2003 2008 2013 2018
Year

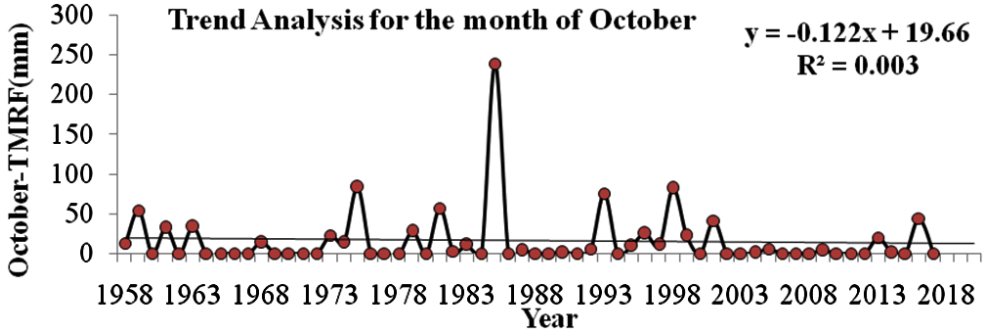


Fig. 2: Linear regression trends of monthly mean of total mean rainfall.

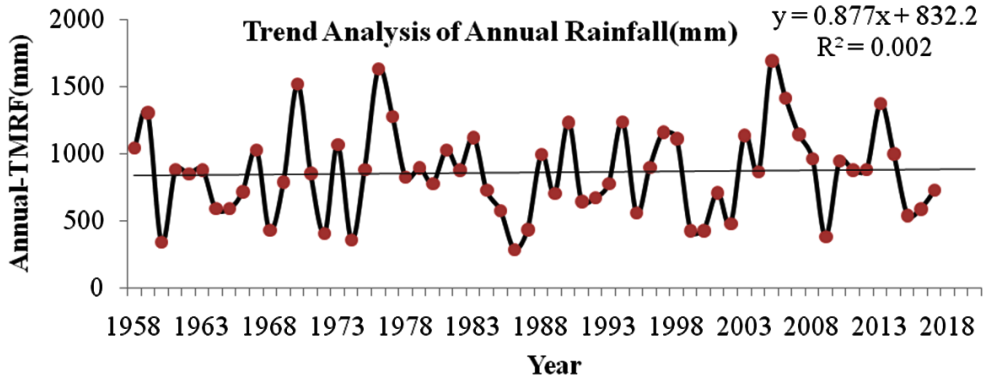


Fig. 3: Linear regression trends of annual mean of total mean rainfall

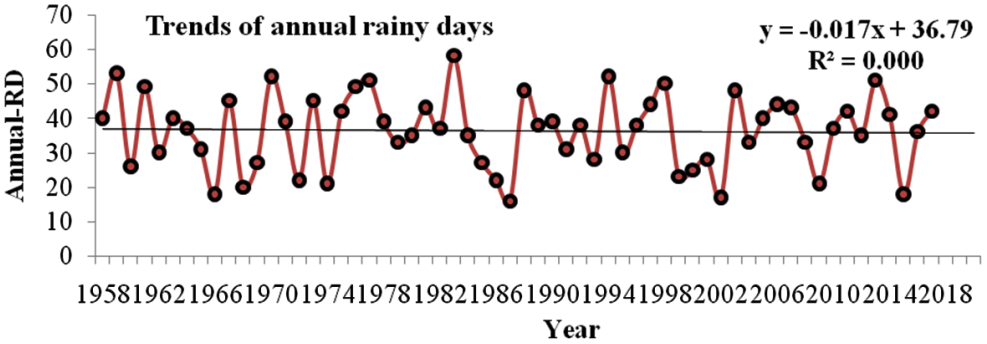


Fig. 4: Linear regression trends of annual rainy days

Result and Discussion

Trend Analysis of Monthly Mean of Total Mean Rainfall (TMRF)

The linear regression trends with their linear regression equations and coefficient of determinations for the months from June to October (Monsoon season) are represented in figure 2.

It is evident from figure 2 that monthly mean of TMRF have increased significantly for the months June to October but in July and has increased by 50.04 mm during last 60 years.

Trend Analysis of Annual Mean of total Mean Rainfall (TMRF) from the figure 3, the annual mean of total mean rainfall observed an increasing trend having an increase 0.877 mm per year. This implies that in Anand (middle Gujarat) annual rainfall has increased by 52.62 mm during last 60 years.

Trend Analysis of Annual Rainy Day

The trend for annual maximum rainfall intensity (mm/day) that Annual MRFI. Figure 4 indicate the trend for annual rainy days that Annual Rainy Day (RD) and time.

Monthly Rainfall Pattern

From table 1 and figure 5 indicate that rainfall variation for first 20 years (1958-1978) and second 20 years (1979-1999) are similar rainfall pattern whereas it differs for last decade (2000-2017) because of the change in magnitude however the overall trend is similar.

Climate change is a continuous process but it is analyzed in this study that there is a significantly change in rainfall over last decade.

Conclusion

Long term data analysed for 60 years (1958-2017) annual data suggest that there is a significantly change in rainfall over last decade. However an annual rainfall is the erratic with wide range from 1693.4 mm maximum and 286.9 mm minimum in Anand(middle Gujarat). It observed total mean rainfall June to October but in July 50.04 last 60 years and annual rainy days decreased by 0.017 mm per year. From the average monthly rainfall analysis, it is observed that rainfall variation for first 20 years (1958-1978) and second 20 years (1979-1999) are similar rainfall pattern whereas it differs for last decade (2000-2017) because of the change in magnitude however the overall trend is similar. Average monthly rainfall analysis indicates there is maximum rainfall in month of June and minimum rainfall in month of October.

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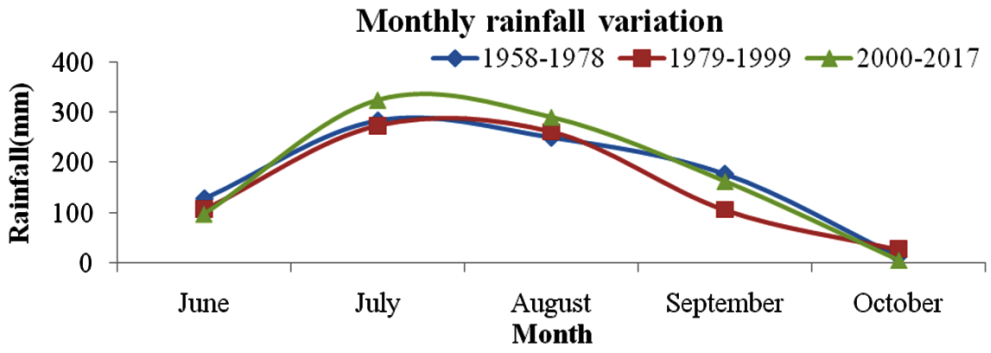

Fig. 5: Monthly rainfall variation for 1958-1978, 1979-1999 and 2000-2017

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