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STATISTICAL ANALYSIS OF RAINFALL AND TEMPERATURE: A CASE STUDY OF AMRELI DISTRICT, GUJARAT

[1]Zarna J Chovatiya, [2]Dr.Gargi Rajpara, [3]Dr.Mohdzuned .M. Shaikh

[1]Assitant Professor, [2]Principal, [3]Assistant Professor
[1] Department of Civil Engineering, L.D. College of Engineering, Ahmedabad, India,
[2] Civil Department, L.D.R.P. Institute of Technology & Research, Gandhinagar, Gujarat, India

[3] Department of Civil Engineering, L.D. College of Engineering, Ahmedabad, India,

Abstract: The significance of the trend in rainfall and temperature in Amreli district of Gujarat, India has been analysed in the present study. Rainfall is scares and erratic in Gujarat especially in Saurashtra region of Amreli district. So, its preservation and conservation has become one of the most important aspects in accordance to the water resources planning. Trend analysis has been carried out on monthly, seasonal and annual basis for the period 1979 to 2019 for rainfall and temperature. Linear trend analysis has been used to assess the variation in rainfall and temperature. The highest trend of total monthly rainfall has been observed in the month of July. The seasonal trend analysis indicates a positive rainfall trend in Pre-Monsoon, Monsoon, and Winter seasons while Post-Monsoon indicates a negative trend. The annual rainfall in the Amreli district indicates a positive trend with slope of regression line 7.2203. The trend analysis of average maximum temperature indicates a significant rise in winter season whereas falling trend in monsoon, Pre-Monsoon and Post-Monsoon season. The average annual maximum temperature indicates a negative trend with slope of regression line -0.021. The average minimum temperature trend analysis indicates a rising trend for all months except January and December month and seasons. The average annual minimum temperature showed a positive trend with slope of regression line 0.0194.

Index Terms **- Trend Analysis, Climate change, Linear regression, Amreli**

I. INTRODUCTION

Water resource has the prime concern for any future planning and development including flood control, flood protection and sustainable watershed management. The rainfall available in the watershed is key factor for determining the availability of water to fulfil the different demand mainly for agriculture, hydropower water supply, industry, etc. The timely availability of water influences the agriculture sector, food security and energy sector. Global climate changes affect the long-term rainfall pattern causes availability of water and may danger of occurrence of serious drought and flood. The high instantaneous rainfall in monsoon (June-Sept) may have shortage of water availability in non-monsoon period. Due to uneven distribution of rainfall and mismatch between demand and water availability requires large storage structures to control the natural flow according to the requirement of the region (S Kundu, D Khare et al, 2015). Generally, the hydro-structures are designed assuming the stationary climate. Global warming affects the rainfall change which influence the stream flow rate, hydrologic cycle, water demand (specially in agriculture) requires review in planning, design and management of hydraulic structures (Deasy Nalley,2012) . Changes in run-off and its distribution will depend on likely future climate scenarios. The trend analysis of rainfall, temperature and other climatic variables on different spatial scales will help in the construction of future climate scenarios (Arijit Ganguly, Ranjana Ray Chaudhuri et al, 2015). Since average annual precipitation in the area is lesser than the overall country precipitation, so any rise or fall in trend will have significant impact on watershed management (Agnieszka Rutkowska, 2013). Any rise or fall in annual rainfall in the area leads to stress on annual average stream flow with consequent implications in planning and designing of water resources development projects (A. Serrano, V. L. Mateos et al,1998) In view of the above, this study has been attempted to investigate the trend of climatic variables for the study area. There are two main variables which are critical in hydrologic studies: rainfall and temperature were summarized in this article. Changes in temperature will impact the various hydrological processes such as rainfall and their sequences (Basistha A, Arya D.S. et al 2008)

II. STUDY AREA

Amreli district is one of the 33 administrative districts of the state of Gujarat in western India. The district headquarters are located at Amreli. The district occupies an area of 6,760 km² and has a population of 1,513,614 of which 22.45% were urban (as of 2011). The latitude of Amreli, Gujarat, India is 21.603176, and the longitude is 71.222084. Amreli, Gujarat, India is located at India country in the Cities place category with the GPS coordinates of 21° 36' 11.4336" N and 71° 13' 19.5024" E.

Average Annual Rainfall of Amreli district is 585 mm. Major Drainages in Amreli district is Shetrunji River. The Shetrunji is a major river basin among 71 river basins of Saurashtra region of Gujarat state, India. Which encompassing district of Junagadh, Amreli and Bhavnagar. The shetrunji river basin is the Eastern most basin of Saurashtra region and it is located approximately between 21°00' N to 21°47' N Latitude and 70°50' E to 72°10' E Longitude. The Shetrunji river originates at Chchai hills in Gir forest of Junagadh district and flows towards East direction, where it passes north of Palitana's hills called Shetrunjaya, then flow towards south easterly direction past Talaja hill and then it confluence with the Gulf of Cambay near Sartanpar. The shetrunji river has a maximum length of 227 km and the total catchment area of the basin is 5636 sq.km.

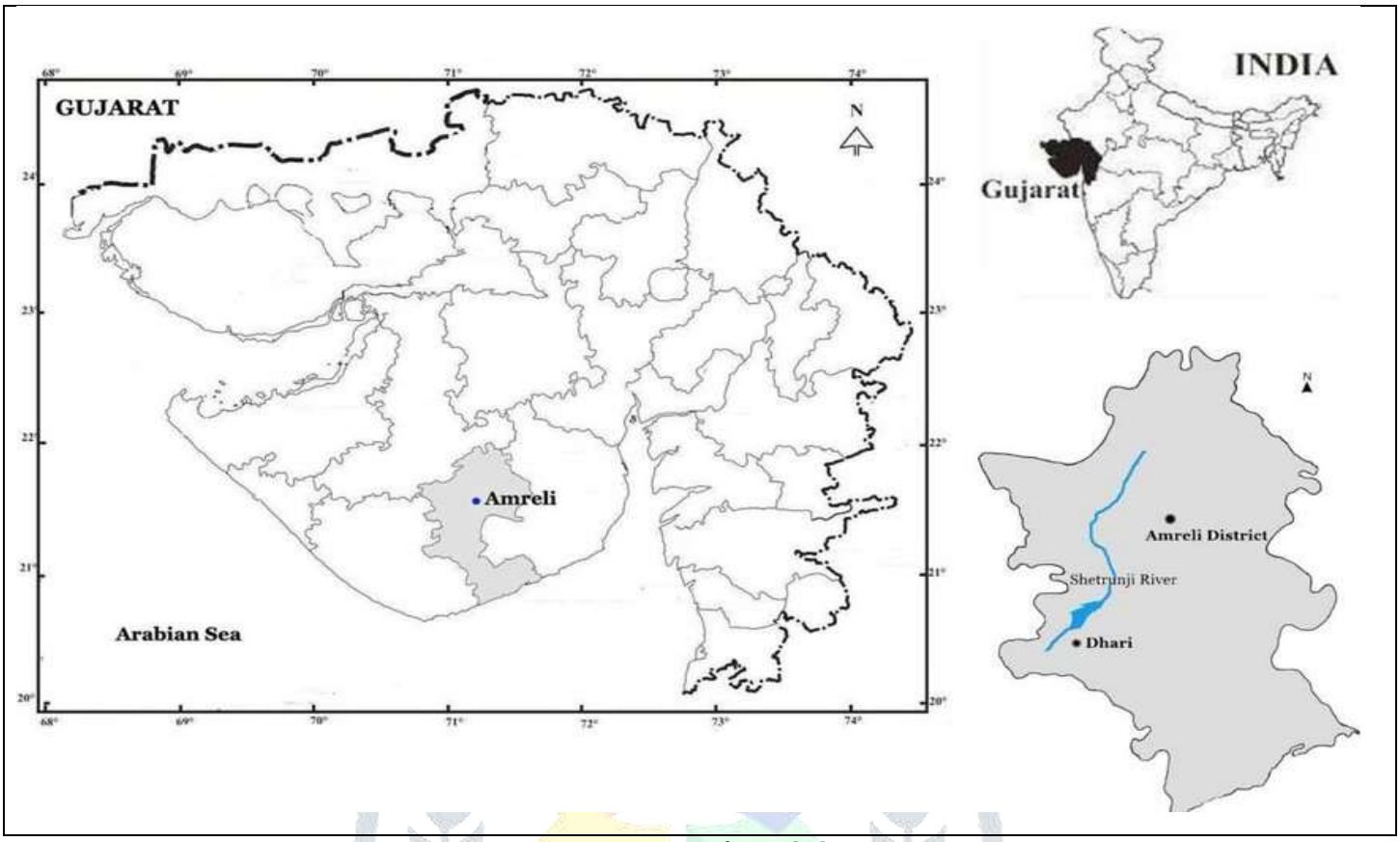


Fig.1 Location map of Amreli district

III. RESEARCH METHODOLOGY

The daily precipitation, maximum and minimum temperature data for the years 1979-2019 was extracted from [8] **for 21.3877 Latitude and 70.9375 Longitude to 22.0121 Latitude and 70.93 Longitude.** The 41 years data analysis was carried out and the monthly precipitation, average maximum and average minimum temperature for each year was obtained. From the monthly precipitation; the annual and seasonal precipitation (Winter, summer, Monsoon, Post-Monsoon) precipitation was found. From the average monthly maximum temperature and average monthly minimum temperature; the average annual maximum temperature and average annual minimum temperature was found.

Trend is defined as the general movement of a series over an extended period of time or it is the long-term change in the dependent variable over a long period of time (Webber et.al. 1980, Panda A. et.al. 2019). Linear Regression Method was used for trend analysis to detect the monthly, seasonal and annual rainfall trend monthly and annual temperature trend.

The equation of a linear regression line given as:

$$y = ax + b \qquad (3.1)$$

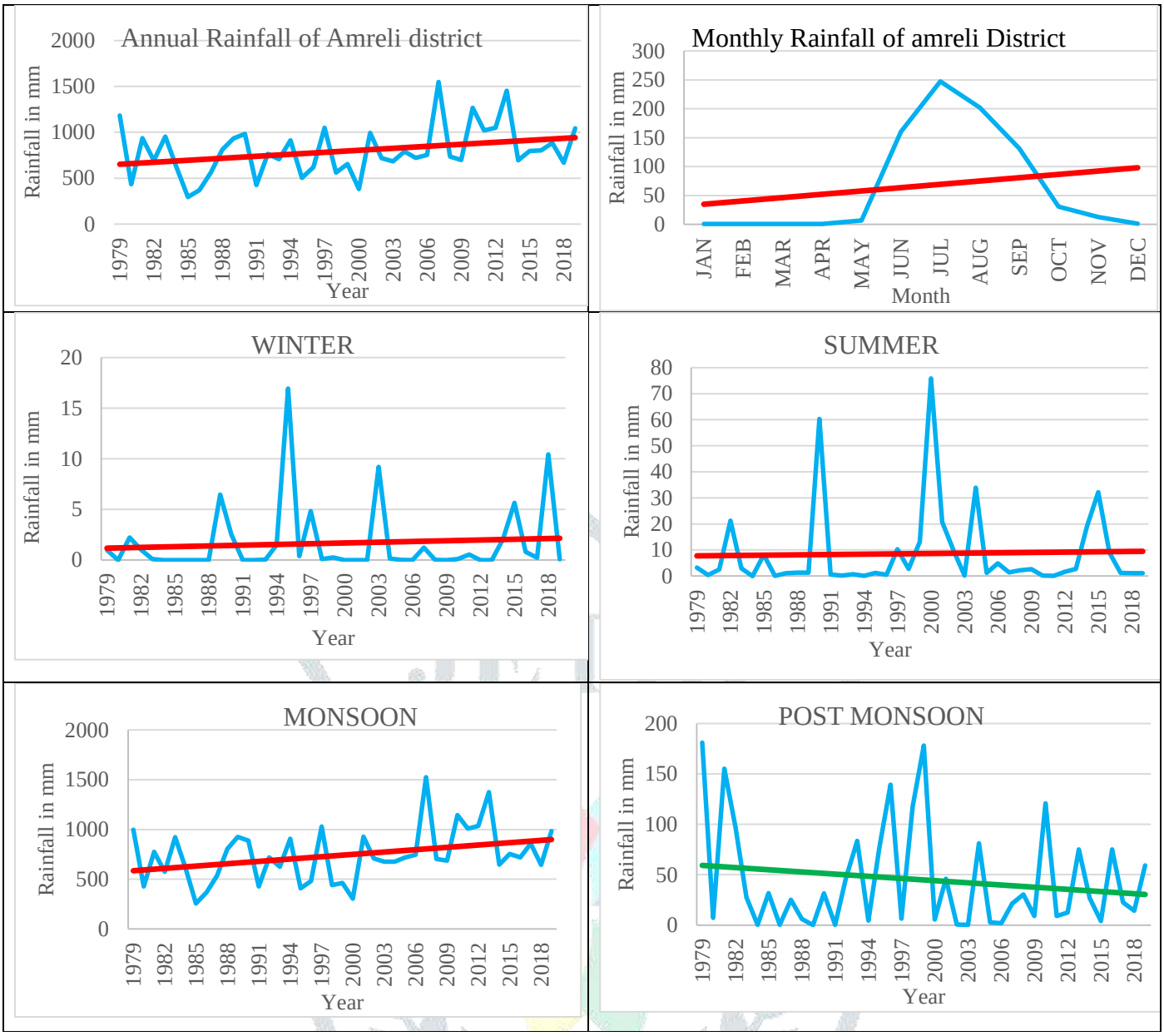
Where, y is the observation on the dependent variable, x is the observation on the independent variable, a is the slope of the line and b is an intercept of the vertical axis.

IV. TREND ANALYSIS

4.1 Trend analysis of rainfall

Table 1: Results of Rainfall Trend analysis using Linear Regression Method

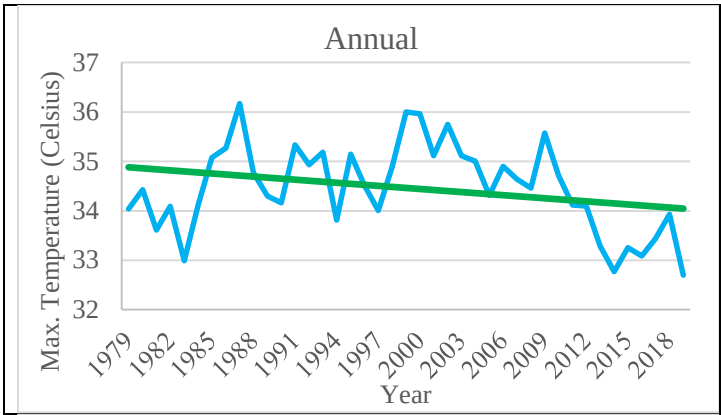
Time series	Regression line slope
Annual	7.2203
Monthly	5.7625
Winter	0.0247
Summer	0.0416
Monsoon	7.8742
Post monsoon	-0.72071

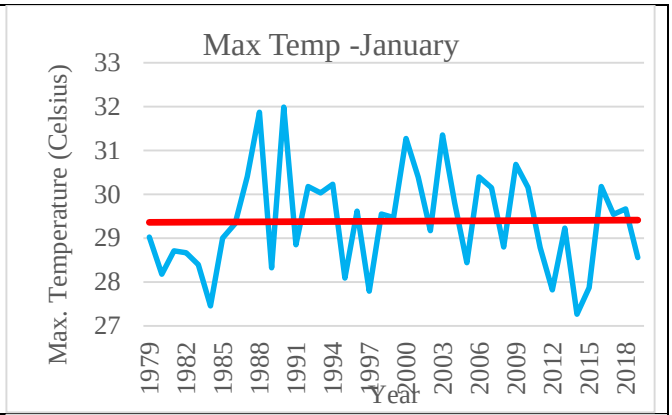


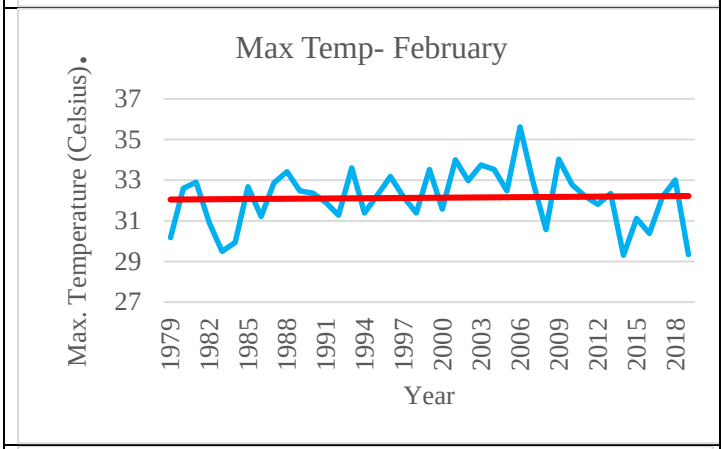
4.2 Trend analysis of Temperature

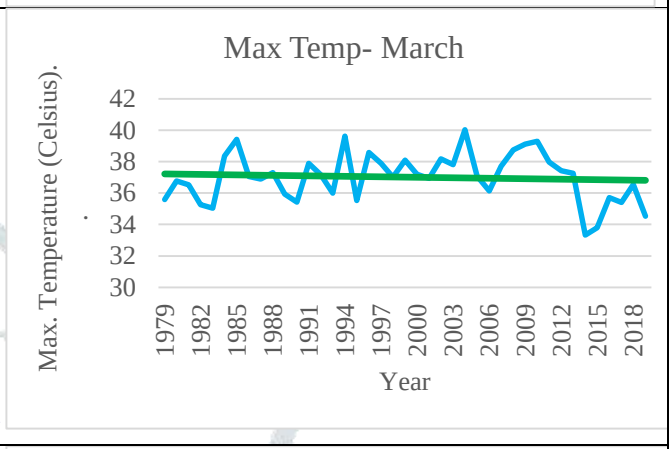
Table 2: Results of Average Maximum Temperature Trend analysis using Linear Regression Method

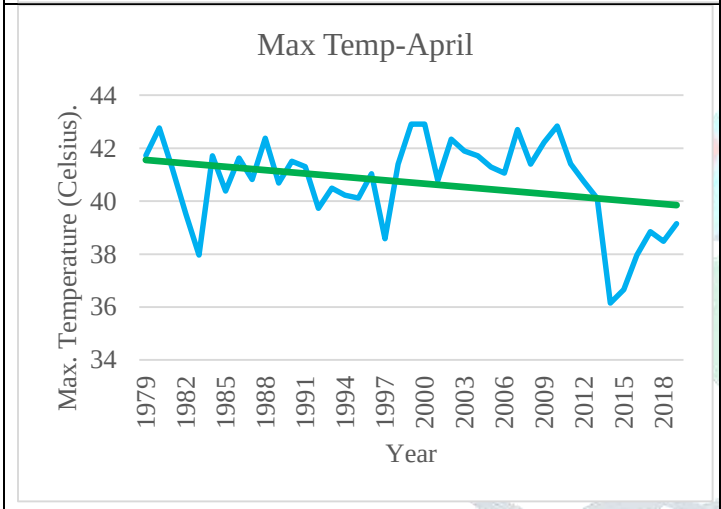
Time series	Regression line slope
Jan	0.0013
Feb	0.0044
March	-0.0099
April	-0.0428
May	-0.0737
June	-0.0805
July	-0.0085
August	0.0184
Sept	-0.0381
Oct	-0.0367
Nov	0.0191
Dec	-0.0046
Annual	-0.021
Winter	0.0028
Summer	-0.0421
Monsoon	-0.0272
Post monsoon	-0.0074

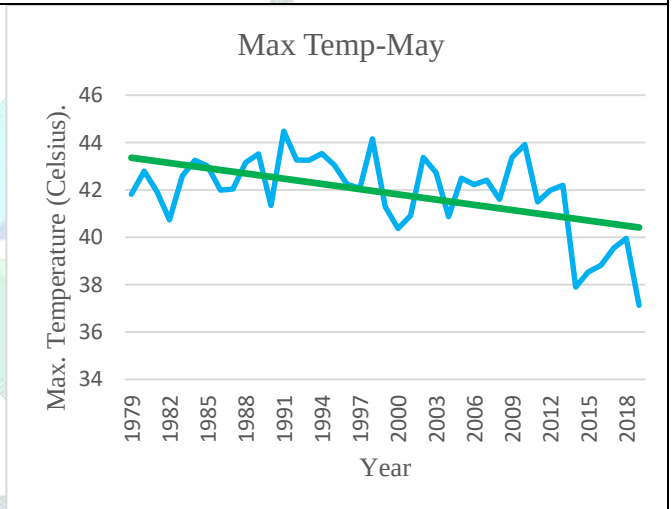

Annual
Max. Temperature (Celsius)
Year

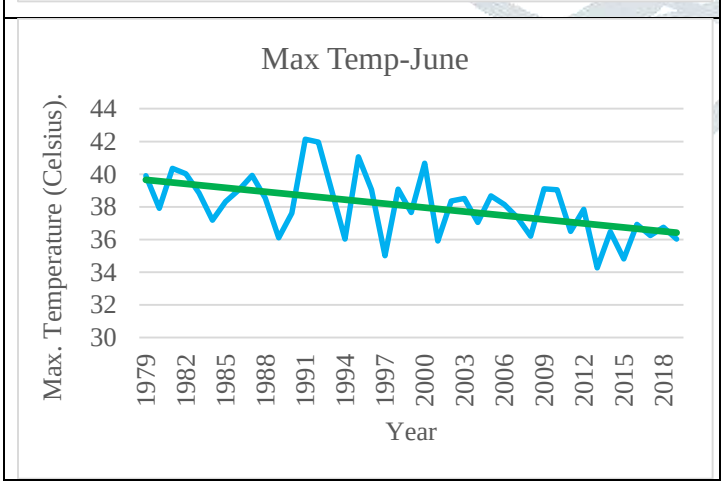

Max Temp -January
Max. Temperature (Celsius)
Year

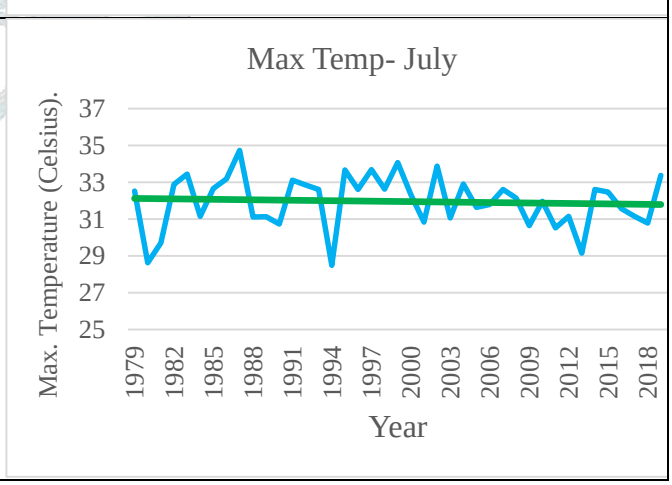

Max Temp- February
Max. Temperature (Celsius).
Year

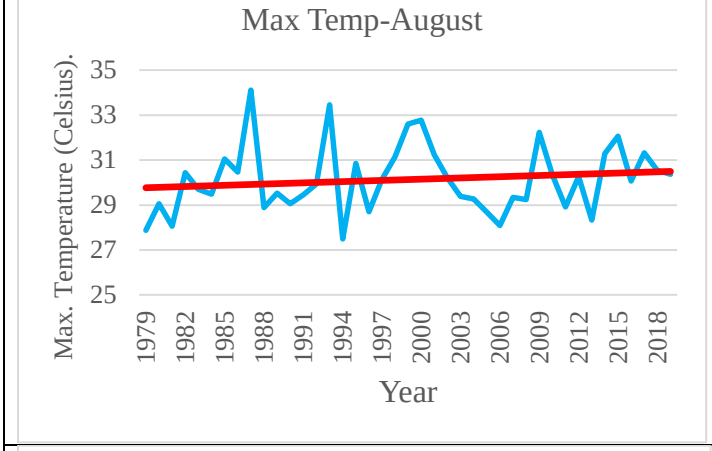

Max Temp- March
Max. Temperature (Celsius).
Year

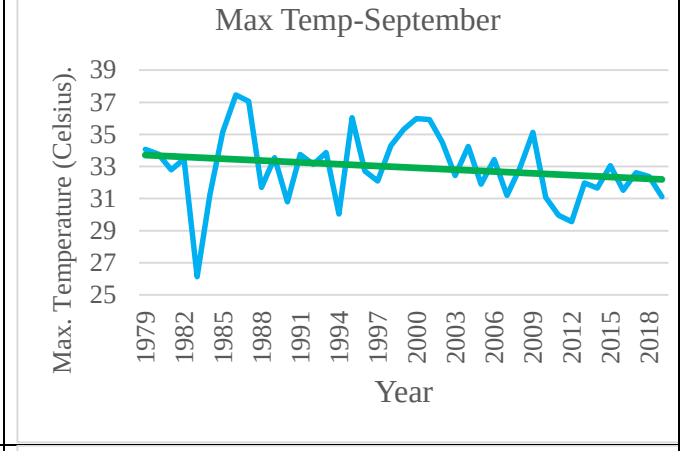

Max Temp-April
Max. Temperature (Celsius).
Year


Max Temp-May
Max. Temperature (Celsius).
Year


Max Temp-June
Max. Temperature (Celsius).
Year


Max Temp- July
Max. Temperature (Celsius).
Year


Max Temp-August
Max. Temperature (Celsius).
35
33
31
29
27
25
1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009 2012 2015 2018
Year


Max Temp-September
Max. Temperature (Celsius).
39
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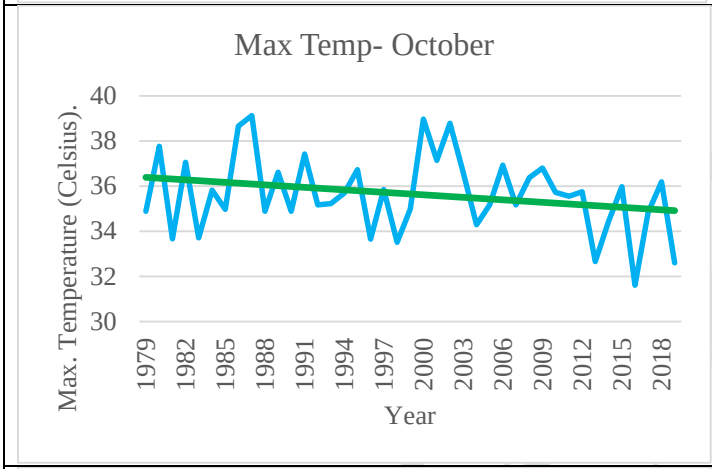
1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009 2012 2015 2018
Year


Max Temp- October
Max. Temperature (Celsius).
40
38
36
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32
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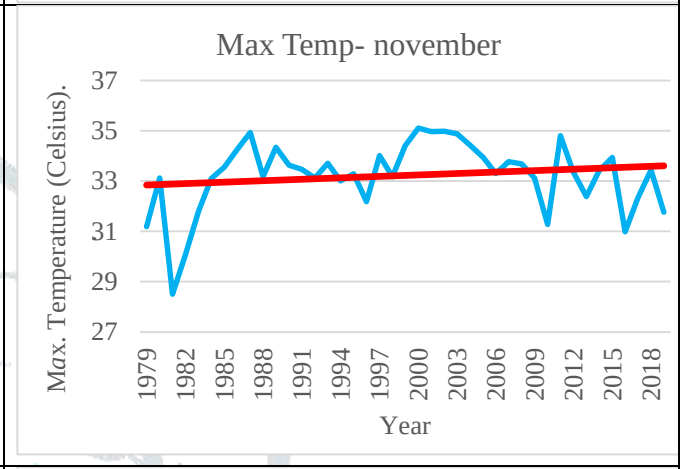
1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009 2012 2015 2018
Year


Max Temp- november
Max. Temperature (Celsius).
37
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31
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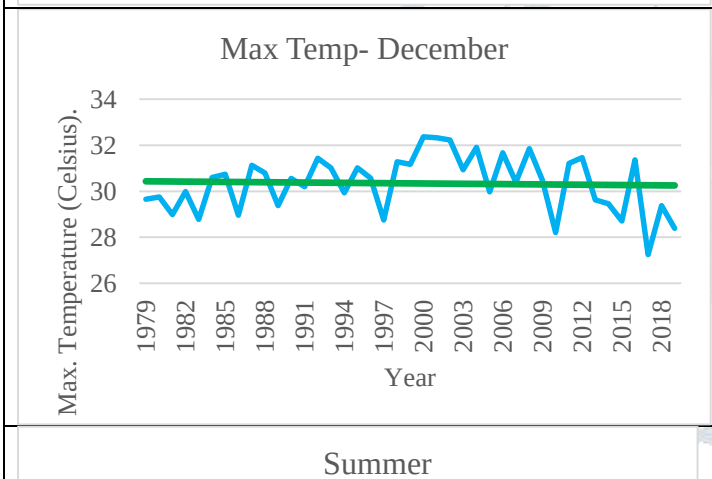
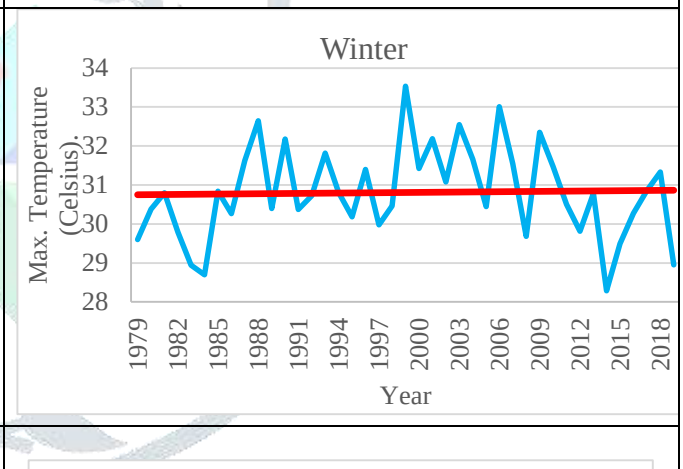
1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009 2012 2015 2018
Year


Max Temp- December
Max. Temperature (Celsius).
34
32
30
28
26
1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009 2012 2015 2018
Year


Winter
Max. Temperature (Celsius).
34
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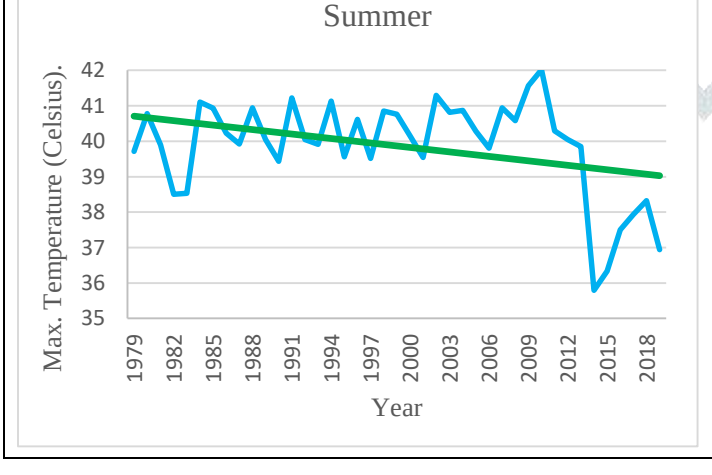
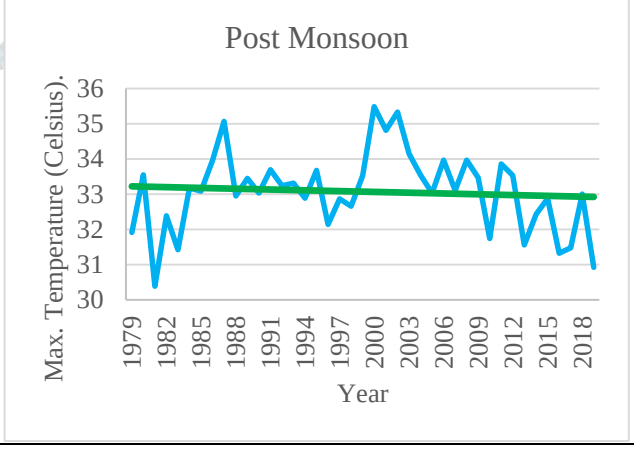
1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009 2012 2015 2018
Year


Summer
Max. Temperature (Celsius).
42
41
40
39
38
37
36
35
1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009 2012 2015 2018
Year


Post Monsoon
Max. Temperature (Celsius).
36
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1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009 2012 2015 2018
Year

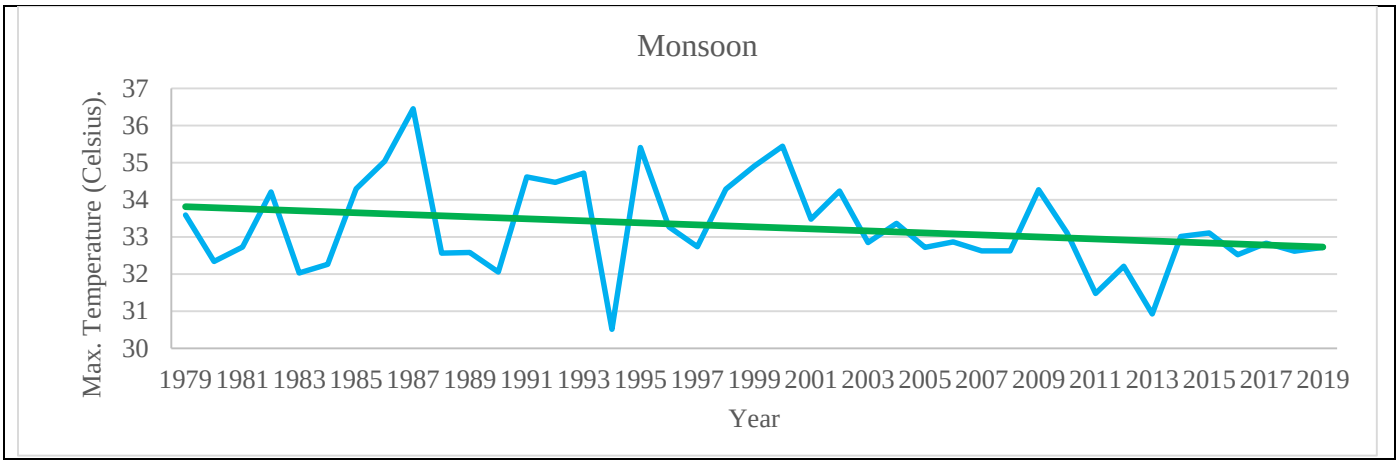
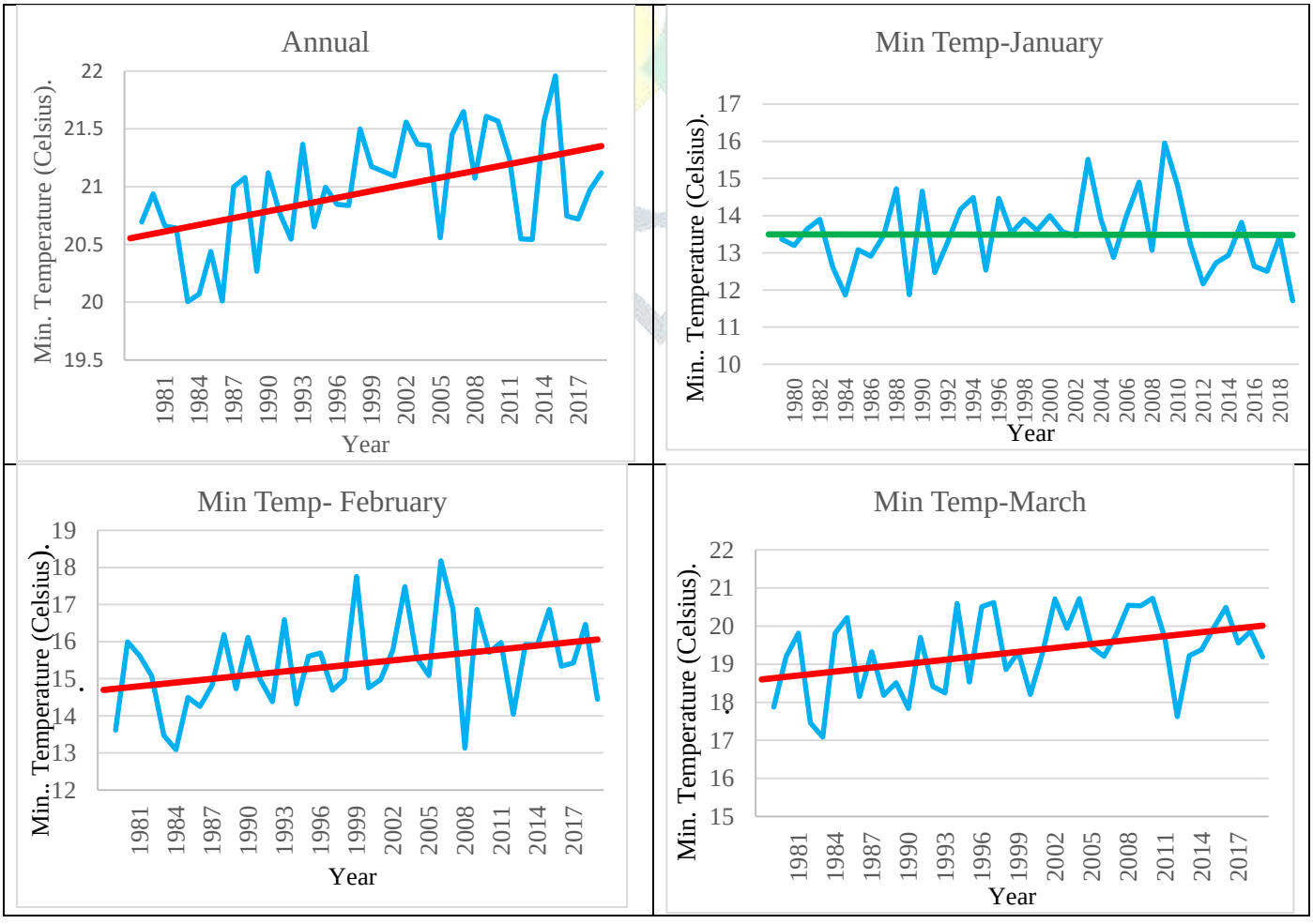
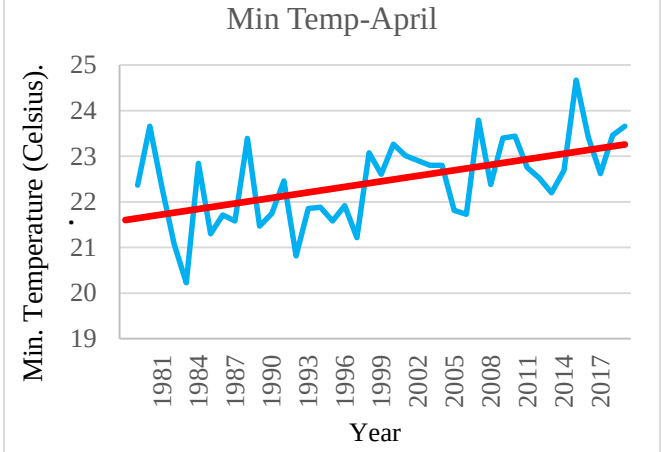
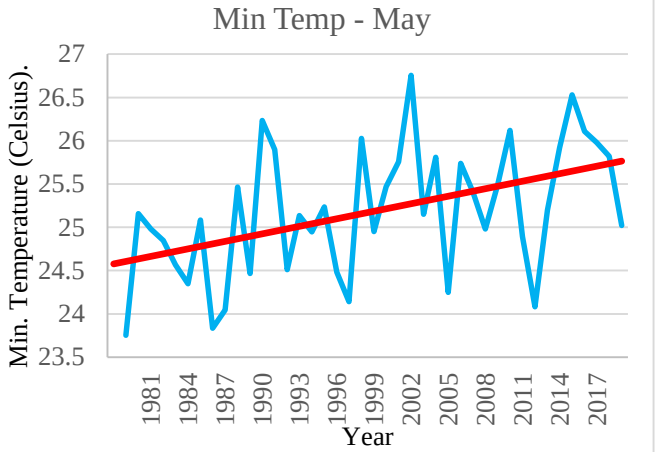


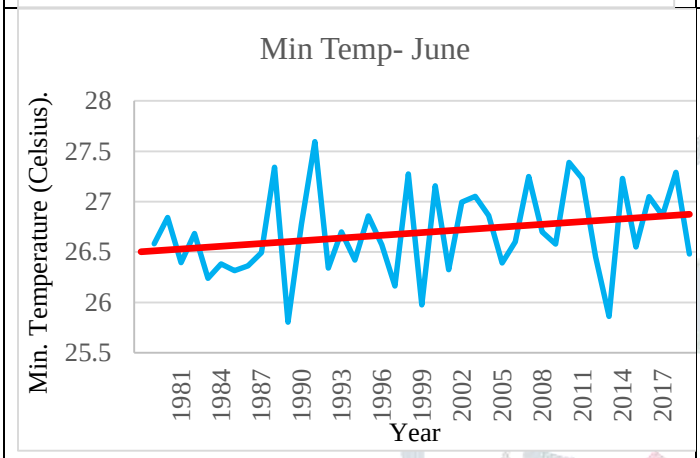
Table: 3 Results of Average Minimum Temperature Trend analysis using Linear Regression Method

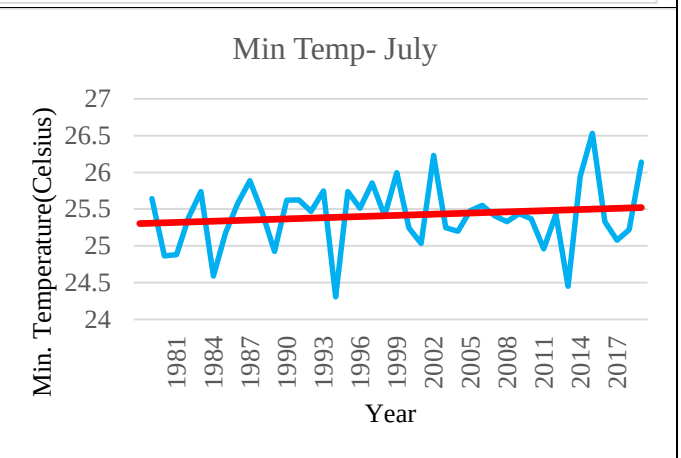
Time series	Regression line slope
Jan	-0.0005
Feb	0.0333
March	0.0345
April	0.0404
May	0.029
June	0.009
July	0.0053
August	0.0181
Sept	0.0226
Oct	0.0259
Nov	0.0204
Dec	-0.0052
Annual	0.0194
Winter	0.0164
Summer	0.0346
Monsoon	0.0138
Post monsoon	0.0137

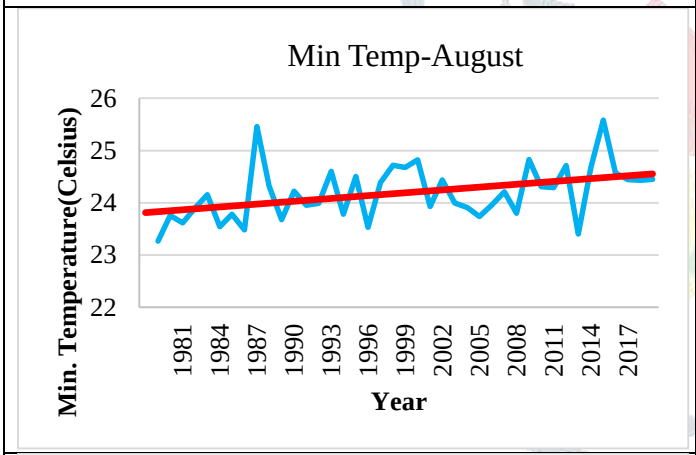


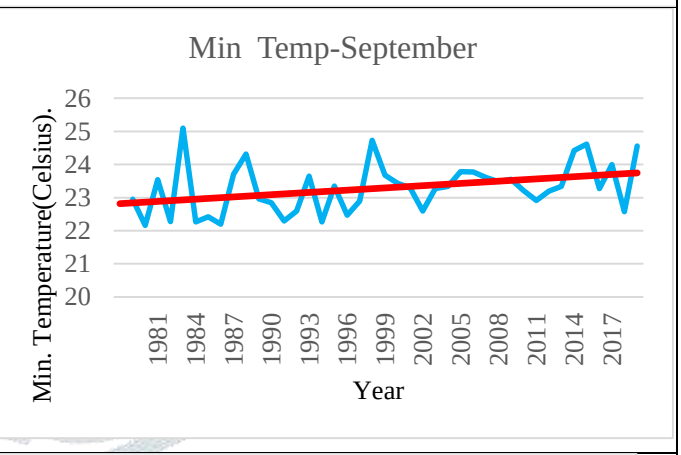

Min Temp-April
Min. Temperature (Celsius).
Year

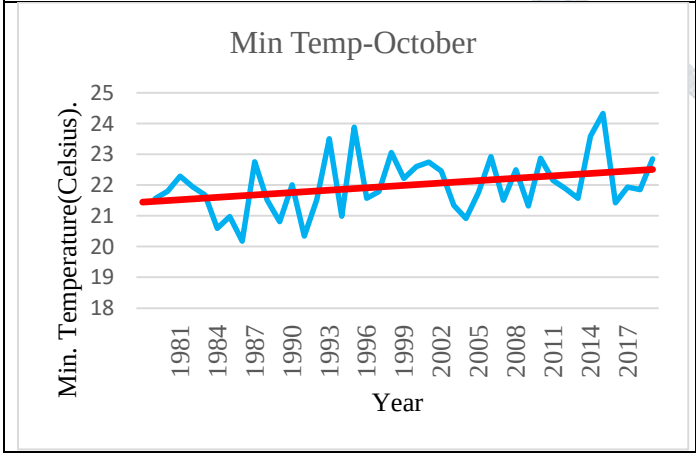

Min Temp - May
Min. Temperature (Celsius).
Year

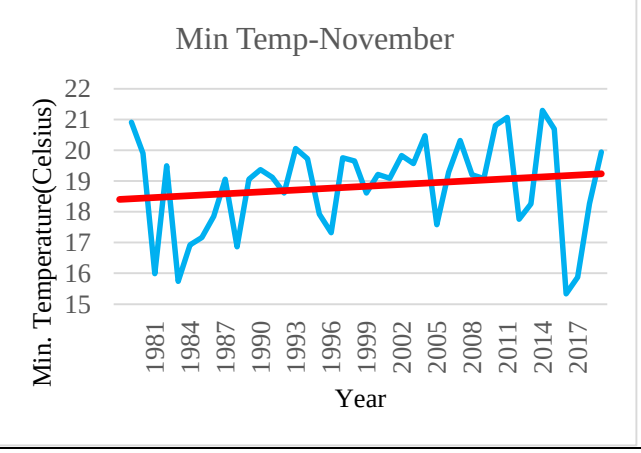

Min Temp- June
Min. Temperature (Celsius).
Year

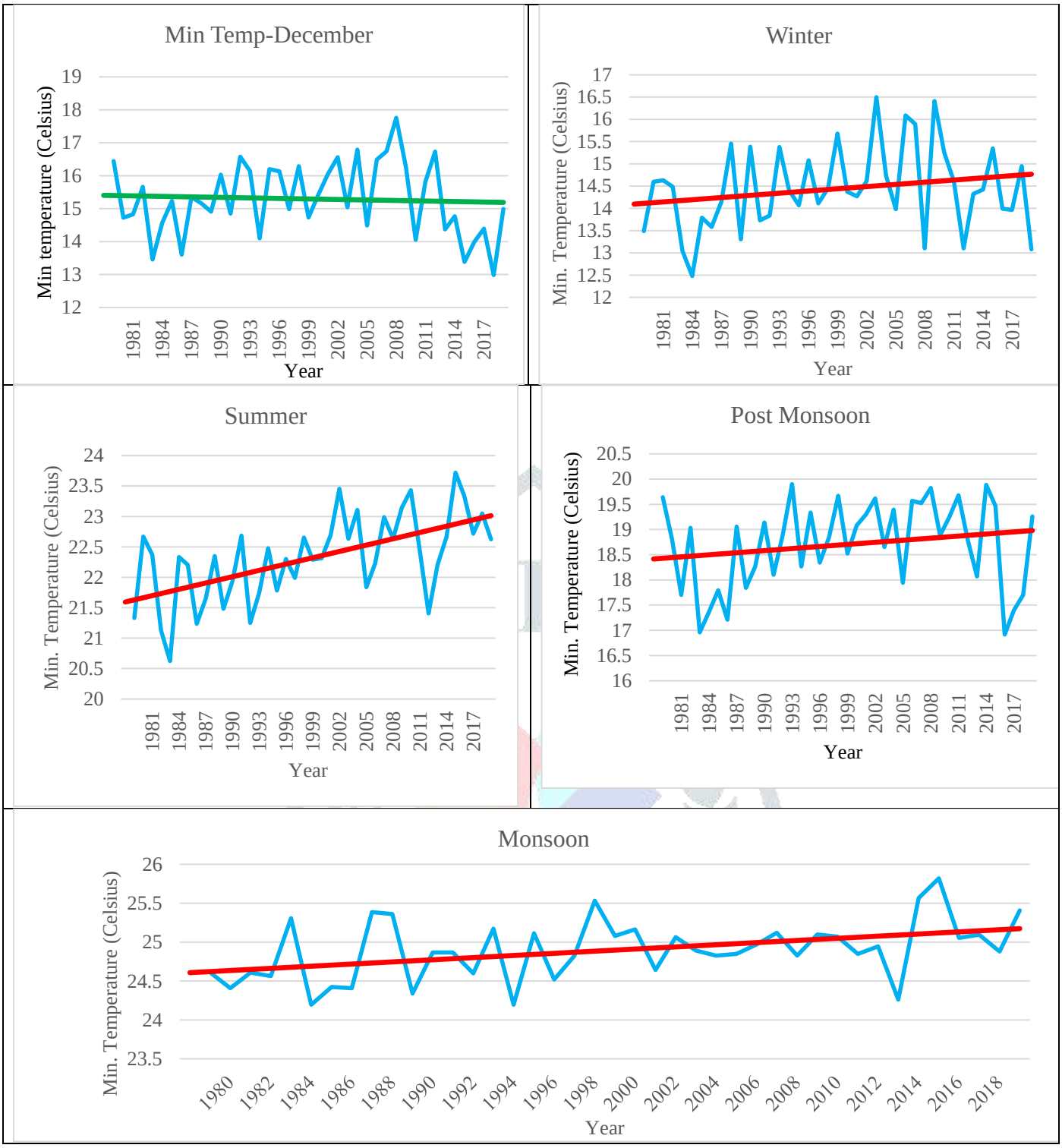

Min Temp- July
Min. Temperature(Celsius
Year


Min Temp-August
Min. Temperature(Celsius)
Year


Min Temp-September
Min. Temperature(Celsius).
Year


Min Temp-October
Min. Temperature(Celsius).
Year


Min Temp-November
Min. Temperature(Celsius)
Year



V.RESULTS AND DISCUSSION:

Table 1 shows the preliminary data analysis of total monthly, annual and seasonal rainfall for the period 1979-2019. The trends of total rainfall for 1979-2019 were obtained using linear regression best fit lines. The results shown in Table 1 shows falling trend of rainfall is observed in Post-Monsoon Season. An increasing trend of rainfall in summer, winter and monsoon season. Annual rainfall in Amreli district showed an increasing trend. The trends of average maximum temperature for 1979-2019 were obtained using linear regression best fit lines. The results shown in Table 2 indicated a falling trend in March, April, May, June, July, September, October and December months. An increasing trend in average maximum temperature is observed in January, February, August and November months. An increasing trend in average maximum temperature is observed in winter season while falling trend is observed in summer, Monsoon and Post-Monsoon Season. The results shown in Table 3 indicated an increasing trend in average minimum temperature for all the months except January and December and all the seasons. Annual Average Minimum Temperature in Amreli District showed an increasing trend.

VI.CONCLUSION:

The meteorological data is taken from 1979-2019 for rainfall and temperature trend analysis of the study area. The annual rainfall data series shows rising trend with significant increase in rainfall. The seasonal rainfall trend analysis shows rising trend in monsoon season with significant increase of rainfall. The annual average maximum temperature trend analysis shows falling trend. This work can be helpful to the water resources managers to mitigate the extreme events.

References

[1] S Kundu, D Khare, A Mondal, PK Mishra, March 2014, Long term raingall trend analysis (1871-2011) for whole India, Climate Change and Bio-diversity, 45-60.
[2] PK Meena, D Khare, S Kundu, PK Mishra, February 2015, Long term trend analysis of mega cities in Northern India using rainfall data, Indian Journal of Science and Technology 8(3), 247-253. https://doi.org/10.17485/ijst/2015/v8i3/59580
[3]S Kundu, D Khare, A Mondal, PK Mishra, January 2015, Analysis of spatial and temporal variation in rainfall trend of Madhya Pradesh India (1901-2011), Environmental Earth Sciences 73(12), 8197-8216. https://doi.org/10.1007/s12665-014-3978-y
[4] Duhan D, Pandey A., 2013, Statistical analysis of long term spatial and temporal trends of precipitation during 1901-2002 at Madhya Pradesh, India, Atmospheric Research, Elsevier, 122:136-149. https://doi.org/10.1016/j.atmosres.2012.10.010
[5] Deasy Nalley,November 2012, Analyzing trends in temperature, precipitation and streamflow data over Southern Ontario and Quebec using the discrete wavelet transform, Department of Bioresource Engineering, McGill University, Montreal
[6] Arijit Ganguly, Ranjana Ray Chaudhuri, Prateek Sharma, September 2015, Analysis of trend of the precipitation data: A case study of Kangra district, Himanchal Pradesh, International research of Granthalaya.
[7] Solanki, P. N., N. J. Shrimali, and K. B. Gohil. "A Study of Change in Rainfall Pattern in Dhatarwadi Reservoir Catchment, Amreli, Gujarat." IJSRD-International Journal for Scientific Research & Development 1.11 (2014).
[8] https://swat.tamu.edu
[9] Meshwa Shah, M.M.Shaikh, December 2021, Trend analysis of rainfall and Temperature: A case study of Bhogavo River Watershed, Gujarat, JETIR, Volume 8 Issue 12(ISSN-2349-5162)