International Journal of Research in Social Sciences
Vol. 6 Issue 9, Month 2016,
ISSN: 2249-2496 Impact Factor: 6.278
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gage as well as in Cabell's Directories of Publishing Opportunities, U.S.A

TRENDS OF MONTHLY AND SEASONAL TEMPERATURE OF PARBHANI

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Abstract

The trend of monthly mean of maximum, minimum, mean temperature and seasonal temperature data were analyzed for metrological data of Parbhani of Maharashtra for the year 1969-2010.Most of the months show decreasing trends by linear regression method. For Parbhanimean monthly maximum temperature of March shows highest fall in mean monthly maximum temperature and which 1.302ºC. iswinter shows highest fall in mean monthly maximum temperature and which is 0.945ºC. For monthly mean of minimum temperature February shows highest fall in monthly mean of minimum temperature (Tmin) and which is 1.856ºCand month July shows highest increase which is 0.546ºCfor the period of 42 year. March shows highest fall in mean monthlymean temperature and which 1.516ºC is and month November shows highest increase which is 0.667ºC

Keywords : Monthly temperature, maximum, minimum temperature, linear trends

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1. Introduction

Since last century changed climate adversely affect social, economic activities in developing and developed countryalike. This fact attracted attention of scientist, climatologist, and researcher on global to regional scale. On global scale most of the scientist ;Nicholl, 1996;Jones , 1999; Liu and Chen, 2000;Alina Vladut, 2001;New , 2002;Xu,2009;Mahyou, 2010;Jones P.D.,2010) and Intergovernmental panel on climate change(IPCC) concluded that there has been large scale warming of the earthsurface over the last hundred years.(IPCC,2001; IPCC2001b,).On regional scale in India many researcher (Jaswal, 2014;D.T.Deshmukh, 2013a; Karnewar and Kadam. , 2014a; Chinchorkar, 2013; Deshmukh, 2013b; Karnewar and Kadam, 2014b; Hingane , 1985, Bhutiyan, 2007; Das, 2007;Jaswal, 2010; Shrivastav, 1992;Rupa Kumar , 1994;Sahai,1998; Jaswal, 2014) studied temperature trends over India and reported increasing trendsin maximum and minimum temperature over India. Monthly mean temperature of India as awhole risen to 0.51ºC over a period of 1901-2005(Faulekar and Kale,2010,).This rate of rise may differ in different geographical regions (Deshmukh, 2013b) since this increase is linked with human emission of greenhouse gases, change in land use pattern, increasing urbanization.Much other aspect such as difference in solar radiation and pollutant aerosols also added to climate change (N.Scafetta, 2005;Brassuar, 2001).Karnewar and Kadam (2015) detected annual trends for Parbhani and found increasing trends. But according to Xuebin(2011) monthly mean provides useful and simple metrics that can be used to track relatively slow variation and trends. Taking all this fact in consideration this paper aims to study monthly and seasonal temperature trends of Parbhani

2. Study area

Parbhani city is part of Marathwada region of Maharashtra in India. Parbhani is situated approximately at the Centre of Maharashtra. Parbhani is located at 19.27 N76.78 E. It has an average elevation of 347 meters. In Parbhani district there is extension of Ajanta rages called Nirmal hills. According to 2011 census population of Parbhani city is 307191 and is officially accorded city status by establishing Municipal Corporation. Male and female are 157,628 and 149,563 respectively. The sex ratio of Parbhani city is 949 per 1000 males.

Figure: 1. Presenting Google map of Parbhani.

3 .Data and methodology

The daily temperature data recorded by IMD Pune for period 1969-2010 was collected. From daily time series data monthly maximum and monthly minimum and monthly mean temperatures were calculated. Then monthly mean of Tmax, Tmin, Tmean were averaged to calculate seasonal temperature. According to IMD, Meteorological seasons over India are: Winter Season: January – February. Summer Season: March – May. Monsoon Season: June - September. Post Monsoon Season: October – December.Later on The statistical method such as correlation analysis, regression analysis and coefficient of determination and coefficient of variation are derived.

Trend is determined by the relation between the two variables as temperature and time. Trends is the general movement of a series over an extended period of time or it is long term change in the dependant variable over a long period of time (Webber and Hawkins, 1980)the statistical methods such as regression analysis and coefficient of determination r^2(Murray R.Spiegel,LarryJ.Stephens, 2000)are used

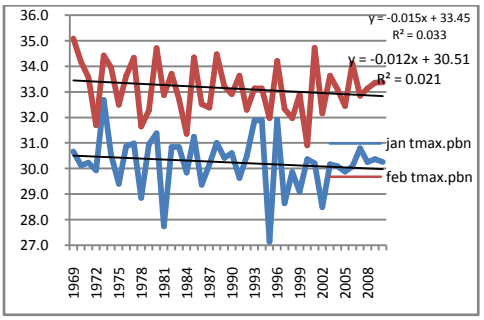
4. Result and Discussion

Table1.Statistical summary of monthly and seasonal mean of Tmax, temperature during 1969-2010.for Parbhani

Month	Mean	St.dev	c.o.v.	c.o.d. %	Y	Trends	Total. increase
Jan.	30.24 ºC	1.073	3.549	0.022	-0.0129x + 30.516	Decreasing	-0.5418 ºC
Feb.	33.13 ºC	0.998	3.012	0.034	-0.015x + 33.456	Decreasing	-0.63 ºC

Mar.	37.17 ºC	1.308	3.519	0.085	-0.031x + 37.832	Decreasing	-1.302 ºC
Apr.	40.55 ºC	1.001	2.468	0.093	-0.0252x + 41.094	Decreasing	-1.0584 ºC
May.	41.56 ºC	1.415	3.405	0.010	-0.0114x + 41.804	Decreasing	-0.4788 ºC
Jun	36.17 ºC	1.803	4.986	0.001	0.0051x + 36.062	Increasing	0.2142 ºC
Jul.	31.81 ºC	0.986	3.100	0.009	-0.0074x + 31.965	Decreasing	-0.3108 ºC
Aug.	30.57 ºC	0.927	3.031	0.010	-0.0076x + 30.73	Decreasing	-0.3192 ºC
Sep.	31.72 ºC	0.999	3.150	0.003	-0.0043x + 31.81	Decreasing	-0.1806 ºC
Oct.	32.47 ºC	1.161	3.575	0.002	0.0044x + 32.375	Increasing	0.1848 ºC
Nov.	30.68 ºC	0.776	2.529	0.225	0.03x + 30.03	Increasing	1.26 ºC
Dec.	29.22 ºC	0.937	3.209	0.159	0.0304x + 28.564	Increasing	1.2768 ºC
Winter	31.69 ºC	0.897	2.831	0.036	-0.0139x + 31.986	Decreasing	-0.5838 ºC
Summer.	39.76 ºC	0.912	2.293	0.092	-0.0225x + 40.243	Decreasing	-0.945 ºC
Monsoon.	32.57 ºC	0.768	2.357	0.003	0.0216x + 30.323	Increasing	0.9072 ºC
Post.mons	30.79 ºC	0.801	2.603	0.110	-0.0035x + 32.642	Decreasing	-0.1470 ºC

The coefficient of variation for Tmax is highest in the month of June and it is observed as 4.986% whereas it is lowest in the month of April and it is observed 2.468% for Parbhani district. This means that maximum temperature is most stable in April and least stable in June for Parbhani district.For season the coefficient of variation for Tmax is highest in the winter and it is observed as 2.831% whereas it is lowest in the summer and it is observed 2.293% for Parbhani district. This means that maximum temperature is most stable in summer and least stable in winter for Parbhani district



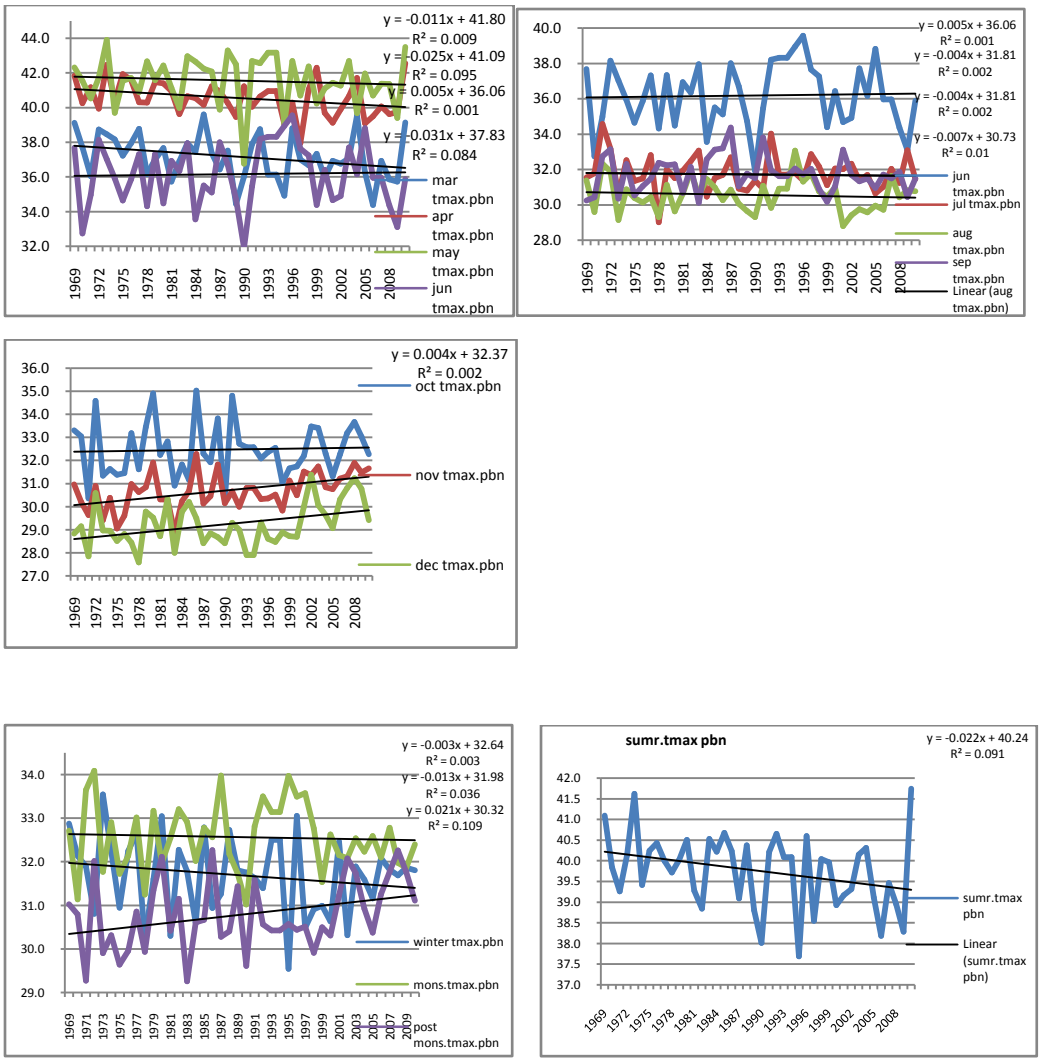


Figure 2 mean of maximum monthly and seasonal temperature of Parbhani.

2.1. **Trend Analysis of monthly and seasonal mean of Tmax of Parbhani**

The trends of monthly mean of maximum temperature (Tmax) were obtained using linear regression best fit lines. The linear regression equations and coefficient of determination for all the months from January to December and for all the season from winter to post monsoon are represented in table 1 and summarized from figure 1.It is evident from above figure 1 and table 1. That monthly mean of maximum temperature (Tmax) have decreased for the months of January, February, March, April, May, July, August, September. The total drop for Parbhani for 42 years is respectively1.491ºC, 1.856ºC ,1.801ºC,1.321ºC, 0.260ºC, 0.722ºC, 0.798ºC,1.730ºC and shows increasing trends for June, October November, December. The total increase for Parbhani for the periods of 42 years is respectively 0.214ºC, 0.184ºC, 1.26ºC, 1.276ºC.From

above figure it is clear that March shows highest fall in mean monthly maximum temperature and which 1.30ºC is and month December shows highest increase which is 1.276ºC for the period of 42 year.

The trends of mean seasonal maximum (Tmax) temperature shows decreasing trends except monsoon season of 0.907ºC for the periods of 42 years.Winter,summer,post monsoon shows falls in mean seasonal maximum temperature (Tmax) of 0.584ºC, 0.945ºC, 0.147ºC respectively for the periods of 42 years. Winter shows highest fall in mean monthly maximum temperature and which 0.945ºC is.

Table.2 Statistical summary of monthly mean of Tmin and seasonal temperature during 1969-2010.for Parbhani district

month	mean	st.dev.	c.o.v.	c.o.d.	y	trends	total increase
Jan.	14.18ºC	1.43	10.06	0.09	-0.0355x + 14.948	decreasing	-1.491 ºC
Feb.	16.62ºC	1.22	7.31	0.20	-0.0442x + 17.575	decreasing	-1.8564 ºC
Mar.	20.40ºC	1.02	5.01	0.26	-0.0429x + 21.321	decreasing	-1.8018 ºC
Apr.	24.19ºC	0.92	3.80	0.18	-0.0316x + 24.873	decreasing	-1.3272 ºC
May.	26.50ºC	0.82	3.11	0.01	-0.0062x + 26.631	decreasing	-0.2604 ºC
Jun.	24.66ºC	0.78	3.18	0.03	0.0111x + 24.421	increasing	0.4662 ºC
Jul.	23.11ºC	0.86	3.72	0.03	0.013x + 23.391	increasing	0.546 ºC
Aug.	22.48ºC	1.00	4.47	0.04	-0.0172x + 22.854	decreasing	-0.7224 ºC
Sep.	22.22ºC	1.32	5.96	0.03	-0.019x + 22.632	decreasing	-0.798 ºC
Oct.	20.13ºC	1.02	5.07	0.24	-0.0412x + 21.013	decreasing	-1.7304 ºC
Nov.	16.23ºC	1.91	11.74	0.00	0.0025x + 16.176	increasing	0.105 ºC
Dec.	13.25ºC	1.44	10.87	0.02	-0.0152x + 13.577	decreasing	-0.6384 ºC
Winter	15.40ºC	1.08	7.01	0.21	-0.0399x + 16.261	decreasing	-1.6758 ºC
Summer	23.70ºC	0.74	3.12	0.20	-0.0269x + 24.275	decreasing	-1.1298 ºC
Monsoon.	23.12ºC	0.87	3.77	0.02	-0.0095x + 23.324	decreasing	-0.399 ºC
Post.mons.	16.54ºC	0.97	5.86	0.05	-0.018x + 16.922	decreasing	-0.756 ºC

The coefficient of variation for Tmin is highest in the month of November and it is observed as 11.74% whereas it is lowest in the month of May and it is observed 3.11% for Parbhani district. This means that minimum temperature is most stable inMay and least stable in November for Parbhani district. For season the coefficient of variation of Tmin is highest in the winter and it is observed as 7.01% whereas it is lowest in the summer and it is observed 3.12 % for Parbhani district. This means that mean minimum temperature is most stable in summer and least stable in winter for Parbhani district.

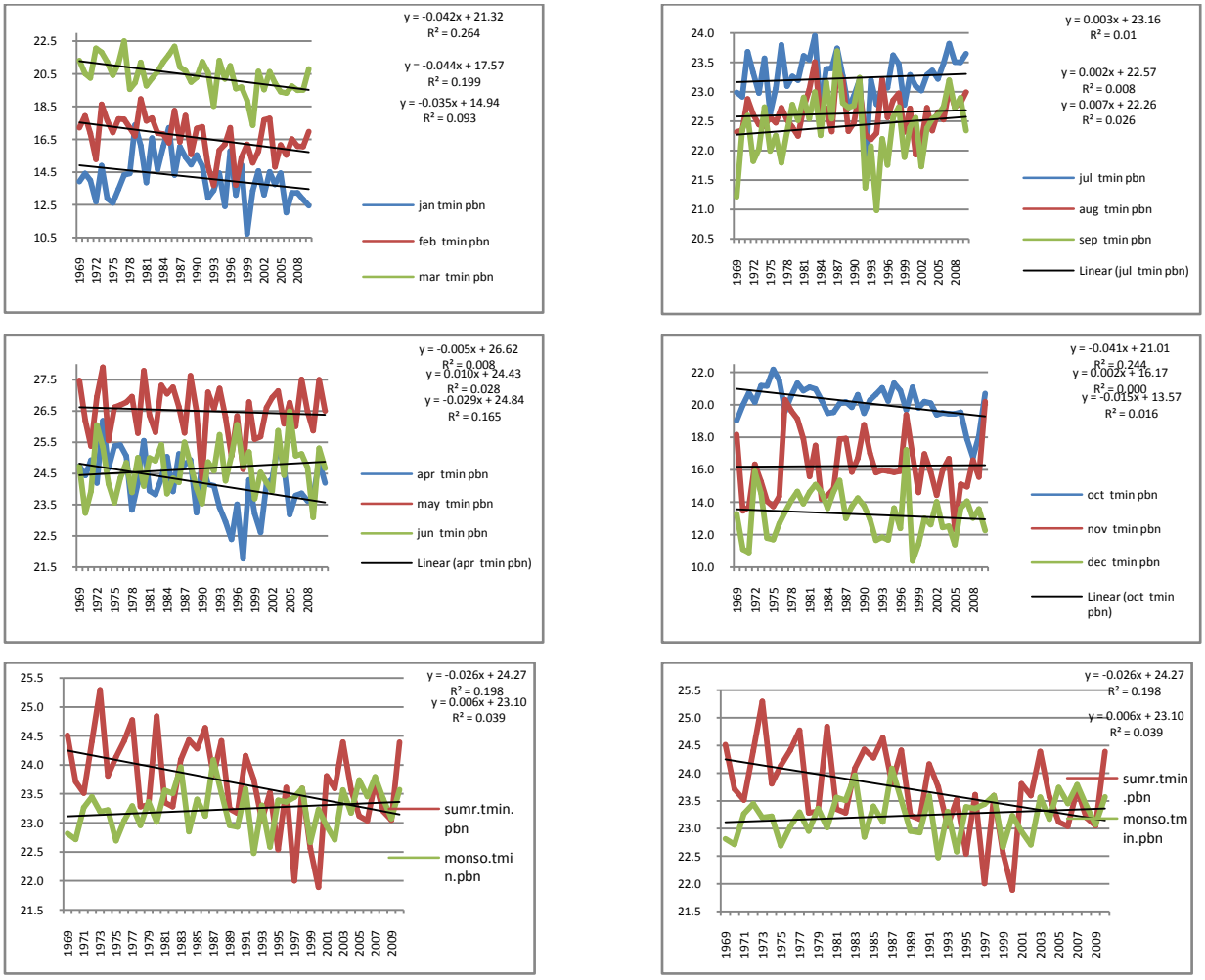


Figure 3 .mean of minimum monthly and seasonal temperature of Parbhani

"a", "b"

2. **Trend Analysis of monthly and seasonal mean of Tmin of Parbhani**

The trends of monthly mean of minimum temperature (Tmin) were obtained using linear regression best fit lines. The linear regression equations and coefficient of determination for all

the months from January to December and for all the season from Winter to post monsoon are represented in table 2 and summarized from figure 2.It is evident from above figure 2 and table 2. That monthly mean of minimum temperature (Tmin) have decreased for the months of January, February, March, April, May, August, September,October,December. The total drop for Parbhani for 42 years is 1.491ºC, 1.856ºC, 1.801ºC, 1.327ºC, 0.260ºC, 0.722ºC,0.798, 1.730ºC,0.638ºC and shows increasing trends for June, July, November and The total increase for Parbhani for the periods of 42 years is 0.4662ºC, 0.546ºC, 0.105ºC respectively .from above figure it is clear that February shows highest fall in monthly mean of minimum temperature (Tmin) and which is 1.856ºCand month July shows highest increase which is 0.546ºC for the period of 42 year.

The trends of mean minimum seasonal temperature (Tmin) temperature shows decreasing trends except for monsoon season which shows increasing trends of 0.907ºC for the periods of 42 years. winter, summer, post monsoon shows falls in mean seasonal minimum temperature (Tmin) of 0.583ºC, 0.945ºC, 0.147ºC respectively for the periods of 42 years. Summer shows highest fall of about 0.945ºC.

Table.3Statistical summary of monthly mean Tmean and seasonal temperature during 1969-2010.for Parbhani district

Month	Mean	St. dev	c.o.v.	c.o.d.	y	Trends	Total increase
Jan.	22.19ºC	1.05	4.71	0.086	-0.025x + 22.724	Decreasing.	-1.05 ºC
Feb.	24.88ºC	0.93	3.75	0.152	-0.0297x + 25.514	Decreasing.	-1.2474 ºC
Mar.	28.81ºC	1.07	3.72	0.170	-0.0361x + 29.588	Decreasing.	-1.5162 ºC
Apr.	32.35ºC	0.90	2.78	0.158	-0.0291x + 32.975	Decreasing.	-1.2222 ºC
May.	34.03ºC	1.07	3.14	0.010	-0.0088x + 34.217	Decreasing.	-0.3696 ºC
Jun.	30.37ºC	1.24	4.09	0.005	0.0069x + 30.225	Increasing.	0.2898 ºC

Jul.	27.44ºC	0.64	2.33	0.043	-0.0108x + 27.672	Decreasing.	-0.4536 ºC
Aug.	26.51ºC	0.73	2.75	0.046	-0.0127x + 26.788	Decreasing.	-0.5334 ºC
Sep.	26.97ºC	0.95	3.53	0.023	-0.0117x + 27.22	Decreasing.	-0.4914 ºC
Oct.	26.29ºC	0.68	2.60	0.099	-0.0176x + 26.669	Decreasing.	-0.7392 ºC
Nov.	23.44ºC	1.14	4.88	0.029	0.0159x + 23.099	Increasing.	0.6678 ºC
Dec.	21.24ºC	0.95	4.46	0.011	0.008x + 21.072	Increasing.	0.336 ºC
Winter.	23.53ºC	0.83	3.52	0.164	-0.0273x + 24.119	Decreasing.	-1.1466 ºC
Summer.	31.73ºC	0.77	2.43	0.154	-0.0247x + 32.26	Decreasing.	-1.0374 ºC
Monsoon	27.82	0.68	2.42	0.016	-0.0071x + 27.976	Decreasing.	-0.2982 ºC
Post.mon	23.66	0.67	2.83	0.002	0.008x + 21.072	Increasing.	0.336 ºC

The coefficient of variation for Tmean is highest in the month of November and it is observed as 4.88% whereas it is lowest in the month of July and it is observed 2.33% for Parbhanidistrict. This means that mean temperature is most stable in July and least stable in November for Parbhani district. For season, the coefficient of variation for Tmean is highest in the winter and it is observed as 3.52% whereas it is lowest in the monsoon and it is observed 2.42% for Parbhani district. This means that mean temperature is most stable in Monsoon and least stable in winter for Parbhani district

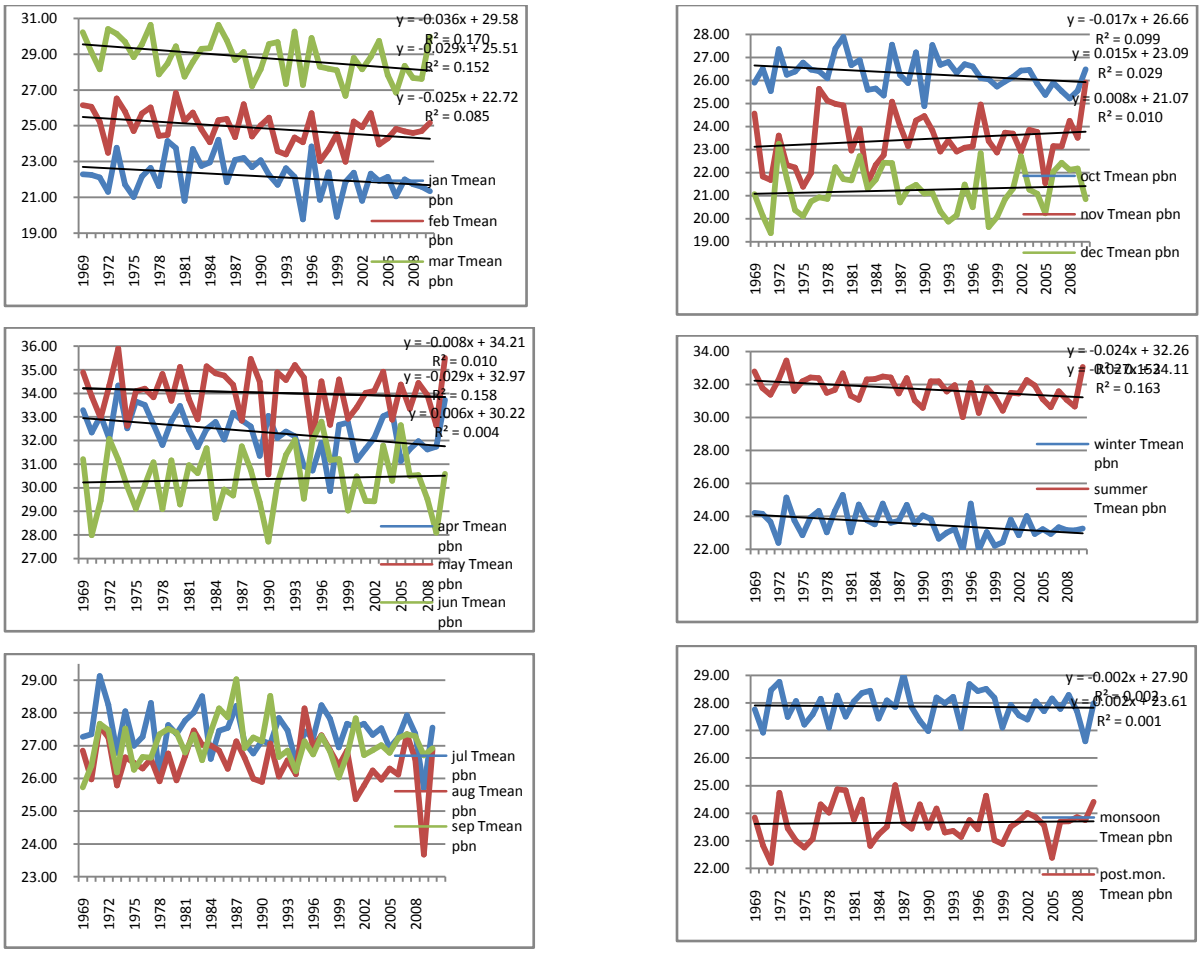


Figure 3 mean of mean monthly and seasonal temperature of Parbhani

3. **Trend Analysis of monthly and seasonal mean of Tmean of Parbhani**.

The trends of monthly mean of mean temperature (Tmean) were obtained using linear regression best fit lines. The linear regression equations and coefficient of determination for allthe months from January to December and for all the season from Winter to post monsoon are represented in table 3 and summarized from figure 3.It is evident from above figure 3 and table 3. That monthly mean of mean temperature (Tmean) have decreased for the months of January, February, March, April, May, July, August, September,October. The total drop for Parbhani for 42 years is 1.05ºC, 1.247ºC, 1.516ºC, 1.222ºC, 0.369ºC, 0.453ºC, 0.533ºC, 0.491ºC, 0.739ºCrespectively and shows increasing trends for June, November, December. The total increase for Parbhani for the periods of 42 years is respectively 0.289ºC,0.667ºC,0.336ºC.From above figure 3 it is clear that March shows highest fall in mean monthlymean temperature and which 1.516 º C isand monthNovember shows highest increase which is 0.667ºC for the period of 42 year.

The trends of mean seasonal mean (Tmean) temperature shows decreasing trends forwinter, summer, and monsoon season. Winter, summer,monsoon shows falls in mean seasonal meantemperature (Tmean) of 1.146ºC,1.037ºC, 0.298ºC respectively for the periods of 42 years. Winter shows highest fall of about 1.146ºCand post monsoon season shows increasing trends of about 0.336 ºC for the total periods of 42 years.

5. Conclusion

It is detected that most of the trends of mean monthly maximum temperature (Tmax), monthly mean of minimum temperature(Tmin), monthly mean of mean temperature (Tmean) were obtained using linear regression best fit lines For Parbhani shows decreasing trends. For mean monthly maximum temperature March shows highest fall in mean monthly maximum temperature and which is 1.302ºC and month December shows highest increase which is 1.276ºC .Winter shows highest decrease in mean monthly maximum temperature and which 0.945ºC is. For monthly mean of minimum temperature(Tmin) February shows highest drop inTmin and which is 1.856ºCand July Tmin shows highest growth which is 0.546ºCfor the period of 42 year. Monsoon Tmin season shows increasing trends of 0.907ºC.Summer Tmin shows highest fall of about 0.945ºC.For monthly mean of mean temperature March shows highest fall in mean monthlymean temperature and which is 1.516ºC and month November shows highest increase which is 0.667ºC. Winter Tmean shows highest fall of about 1.146ºC and Post monsoonTmean shows increasing trends of about 0.336 ºC.

Reference

1. .BrasseurG.P. and E. Roeckner, "Impact of Improved Airquality on the Future Evolution of Climate,"*GeophysicalResearch Letters* Vol. 32, No. L23704, 2005, p. 4.

2. Chinchorkar S.S.,VaidyaVB,Vyas,andPande, 2013:Monthly,seasonal and Annual Air Temperature Variability and trends-a case study to assess climate change on Anand (Gujarat state), spring, and volume 1 no.1 pp.20-25.

3. D. E. Parker and E. B. Horton, "Global and Regional Climatein 1998," *Weather*, Vol. 54, 1999, pp. 173-184.

4. DeshmukhD.T.,LungeH.S., 2013.Trend assessment in climatic variables by MannKendall and t-test: a case study of Yevatmal District in Vidharbha,India International Journal Of Scientific Research,volume:2,issue 5,pp 597-600.

5. DeshmukhD.T.,LungeH.S., 2013.Trend detection of rainfall, rainy days and temperature data of Akola district in Vidharbha,India.IJSR,volume:2,issue 2,pp. 404-407.

6. FulekarM.H.,KaleR.K., (2010).Impact of climate change: Indianscenario, University News,volume l48no 24, pp15-23.

7. *Houghton JT*, Filho LGM, Callander BA, Harris N, Kattenberg A, Maskell K (eds.).Cambridge University Press: Cambridge; 133–192.

8. Inter-Governmental Panel on Climate Change (IPCC),"Climate Change 2001: Synthesis ReportContribution of Working Groups I and III to the ThirdAssessment of the (IPCC*)*," Cambridge University Press,Cambridge, 2001.

9. JaswalA.K.,Naresh Kumar andKhareP., 2014,Climate Variability in Dharmasala a hill Station in westernHimalayas, J. ind. Geophysics. Union, 2014v.18,no.3,pp.336-355.

10. Jones P. D., New M., Parker D. E., Martin, S., & Rigor, I. G. (1999), Surface Air Temperatureand Its Changes over the Past 150 Years. *Reviews of Geophysics* 37:173-199.

11. Karnewar Kailas and KadamAvinash (2015)"a", Rising temperature trends of Parbhani, Maharashtra, India. Researcher Vol.7 No.2 pp. 60-63.

12. Karnewar Kailas and Avinash Kadam, 2015"b", study of temperature trends of Nanded , Maharashtra, India, world Rural Organization volume 7 pp.1-6

13. Liu Xu and Chen B., 2000. Climate warming in the Tibetan Plateau during recent decades, Int. J. Climatology, v. 20, pp: 1729-1742.

14. Mahyoub H. Al Buhairi," Analysis of Monthly, Seasonal andAnnual Air Temperature Variability and Trends in Taiz City -Republic of Yemen. *Journal of Environmental Protection*,2010, 1, 401-409, doi:10.4236/jep.2010.14046 publishedOnline December 2010 (http://www.SciRP.org/journal/jep).

15. Murray R.Spigel,Larry J.Stephens,SCHAUM'S outlines STATISTICS" third edition,TATAMcGRAW-HILL EDITION,2000.

16. N.Scafetta and B. J. West, "Estimated Solar Contribution tothe Global Surface Warming Using the ACRIM TSI SatelliteComposite," *Geophysical Research Letters*, Vol.32, 2005, p.L18713.

17. New M., Lister D., Hulme M., and Makin I., 2002. A high resolution data set of surface climate over global land areas, Climate Research, v. 21, pp: 1-25.

18. Nicholls N., Gruza, G.V., Jouzel, J., Karl T.R., Ogallo, L.A., & Parker, D.E. (1996). Observedclimate variability and change. In *Climate Change 1995: The Science of Climate Change.*

19. P. D. Jones, E. B. Horton, C. K. Folland, M. Hulme, D. E.Parker and T. A. Basnett, "The Use of Indices to IdentifyChanges in Climatic Extremes," *Climatic Change*, Vol.42,No. 1, 1999, pp. 131-149.

20. Sahai A.K., 1998. Climate change: a case study over India, Theoretical and Applied Climatology, v. 61,pp., 9-18.

21. Shrestha, A.B., Wake, C.P., Mayewski, P.A. and Dibb, J.E., 1999. Maximum temperature and trends in the Himalaya and its vicinity: An analysis based on temperature records from Nepal from period 1971-94, Journal of Climate, v. 12, pp: 2775-2787.

22. Vlăduţ, A. (2013), Evaluarea riscurilor climatice in Câmpia Olteniei în contextul schimbărilor,climatice globale, Edit. Universitaria, Craiova, 163.

23. Webber J., and Hawkins C., statistical analysis application to business and economics, Harper and Newyork,1980.

24. XuJ., Grumbine E.R., Shrestha A., Eriksson M., Yang X., Wang Y., Wilkes, A., 2009. The melting Himalayas: Cascading effects of climate change on water, biodiversity, and livelihoods, Conservation Biology, v. 23, vo. 3, pp: 520-530.

25. Xuebin Zhang,Lisa Alexander, Gabriele C.Hegerl,Philip Jones Albert KleeinTank,Thomas C.Peterson,Blair Tremin and Francis W.Zwiers, 2011 Indices for monitoring changes in extremes based on daily temperature and precipitation data Wires Climate Change,Advanced review.