Journal of Education for Pure Science- University of Thi-Qar
Vol.9, No.2 (June, 2019)
Website: jceps.utq.edu.iq Email: jceps@eps.utq.edu.iq

DOI: http://doi.org/10.32792/utq.jceps.09.02.27

Trend Analysis for Some Climate Variables of Selected Stations in Iraq

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Received 02/10/2018, Accepted 23/12/2019, Published 02/06/2019

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Abstract:

This search deal with the effect of worldwide global warming on surface air temperature, relativity humidity and rainfall for selected stations in Iraq. Monthly surface air temperature, relativity humidity and rainfall were analysed to get temporal trends variation with the period (1984-1999) by using Mann-Kendall test to detect the significant trend. The test showed that surface air temperature and relativity humidity had a positive trend at all station with a highest value in Basrah station (0.085) and (0.344) respectively, while the test for rainfall showed a negative trend at all stations with a highest decreasing value (-1.606) in Basrah station too.

Keyword: Trend analysis, Climate, Variables, Iraq.

I. Introduction

Different investigations have been done in various parts of the world for distinguishing conceivable atmosphere patterns and changes. A portion of these have demonstrated noteworthy patterns, particularly amid the most recent four decades (Karl et al., 1993) [1]. For instance, Kadiolgu, 1997 in Turkey [2], El-Azraq, 1999 in Egypt [3], however there are not kidding issues in water assets, horticulture and condition in these nations. Ebb and flow worldwide environmental change impacts incorporate expanded worldwide surface temperatures, an ascent in worldwide ocean levels, adjusted precipitation examples, and defrosting of ocean ice and icy masses. Evaluations of environmental change are most solid for as long as fifty years amid which exact information has been deliberately assembled everywhere throughout the globe and all through the upper climate [1]. While temperatures around the globe have risen, observe that temperature changes have not been uniform. A few zones will and are getting colder, yet slants in the mean land and mean sea temperature have expanded by 1°c in the previous hundred years. Locales, for example, the Middle East and Northern Africa are anticipated to see their temperatures increment by more than 14.4 c° before the finish of the present century [4]. These expanded temperatures will influence everything from ocean levels, to new water accessibility sanitation to the spread of ailment. Every single past investigation with respect to patterns in surface climatic factors in Turkey focused on temperature, precipitation and relativity designs for instance, Tu¨rkes et al. (1995) [5] utilized different non-parametric tests to distinguish sudden changes and patterns in the long haul mean temperature of both individual stations and land locales

in Turkey amid the period (1930– 1992). They observed that atmosphere had a tendency to be hotter in the eastern Anatolia and to be cooler especially in the Marmara and Mediterranean areas utilizing local mean temperature arrangement. Tu¨rkes (1996) [6] worked with the territory found the middle value of yearly precipitation arrangement amid the period (1930– 1993) and called attention to that marginally immaterial declines were by and large seen over Turkey, especially operating at a profit Sea and Mediterranean districts. Kadıog˘lu (1997) [7] analyzed patterns in the mean yearly temperature records amid the period (1939– 1989) in the eighteen stations crosswise over Turkey and discovered irrelevant expanding patterns in the mean yearly temperatures, precipitation and relativity. He additionally showed that a territorial increment in mean least temperatures, which could be ascribed to the urban warmth island impact, showed up around 1955. His outcomes are uncertain for the presence of long haul patterns. Interestingly, Tayanc [8]. The study aimed to examine the temporal trend in annual temperature, relativity humidity and rainfall in Iraq for 16-year time period (1984-1999) by using Mann-Kendall test.

II. Study area

The geographical Iraq is located in semitropical latitude in the northern hemisphere between (22.5^0-37.5^0) north ,the equator and between longitudes (38.45^0 -48.45^0) east of Greenwich live , data were recorded in four stations from the Iraqi Meteorological Organization and Seismology [9] (Baghdad, Basrah, Mosul, Rutba) and for the period (1984-1999), which represent most of the climate in Iraq to detect the presence of heterogeneity trends in the average of both temperature, relative humidity and rainfall by using test Mann-Kendall. Table 1 shows the names, numbers and altitude of the study station above sea level and geographical location. Figure 1 shows the distribution of these climatic station.

Table 1: Meteorological station used in the study

Station	Elevation(m)	Longitude (E^0)	Latitude(N^0)
Baghdad	31.7	44.24	33.23
Basrah	2.4	47.78	30.57
Mosul	223	43.15	36.32
Rutba	630.8	40.28	33.03

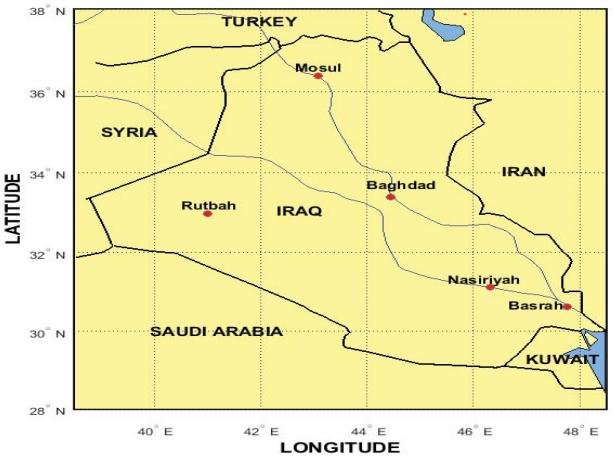


Figure 1: distribution of metrological station in Iraq

III. Methodology

The Mann-Kendall rank tests was connected for distinguishing conceivable stochastic and deterministic patterns for temperature, relativity humidity and rainfall, at (Baghdad, Basra, Mosul, AL-Rutba) stations. This test is the consequence of the improvement of the nonparametric pattern test initially proposed by Mann (1945). This test was additionally examined by Kendall (1975) and enhanced by Hirsch et al (1982, 1984) who permitted considering regularity. The Mann-Kendall test is a non-parametric test for distinguishing patterns in time arrangement information. The test looks at the relative sizes of test information as opposed to the information esteems themselves (Gilbert, 1987). One advantage of this test is that the information requires not comply with a specific appropriation. Also, information detailed as non-recognizes can be incorporated by appointing them a typical esteem that is littler than the littlest estimated an incentive in the informational index. The methodology that will be portrayed in the ensuing passages accept that there exists just a single information esteem for every day and age. At the point when numerous information focuses exist for a solitary day and age, the middle esteem is utilized. The information esteems are assessed as a requested time arrangement. Every datum esteem is contrasted with every single consequent datum esteems. The underlying estimation of the Mann-Kendall measurement, S, is thought to be 0(e.g., no pattern). In the event that an information esteem from a later day and age is higher than an information esteem from a prior day and age, S is increased by 1. Then again, if the information esteem from a later day and age is lower than an information esteem examined before, S is decremented by 1. The net consequence of every single such addition decrements yields the last estimation of S [5].Let x1, x2, … x_n speak to n information focuses where xj speaks to the information Point at time j. At that point the Mann-Kendall measurement (S) is given by

$$S = \sum_{k=1}^{n-1} \sum_{j=k+1}^{n} sign(x_j - x_k) \dots\dots (1)$$

Where

$$sing(x_j - x_i) = \left\{ \begin{matrix} 1\ if\ x_j - x_i > 0 \\ 0\ x_j - x_i = 0 \\ -1\ x_j - x_i < 0 \end{matrix} \right\} \dots\dots\dots (2)$$

A high positive estimation of S is a marker of an expanding pattern (upward pattern), and a low negative esteem shows a diminishing pattern (down ward incline). Be that as it may, it is important to register the likelihood related with S and the example estimate n, to factually evaluate the noteworthiness of the pattern [6]. The test measurement S which has mean zero and change of S; registered by

$$Var(S) = \frac{n(n-1)(2n+5)}{18} \dots\dots (3)$$

For the cases that n is bigger than 10, the standard typical difference of S is registered by utilizing the accompanying condition [7], [8].

$$\left. \begin{matrix} Z = \frac{S-1}{\{VAR(S)\}^{\frac{1}{2}}}\ If\ S > o \\ Z=0 \qquad If\ S=0 \\ Z = \frac{S+1}{\{VAR(S)\}^{\frac{1}{2}}}\ If\ S < o \end{matrix} \right\} \dots\dots (4)$$

IIII. Result and discussion

Time series of mean yearly temperature, relative humidity and rainfall at (Baghdad, Basrah, Mosul, and Rutba) stations for the period (1984-1999) [9]. The *S* – statistic for mean yearly temperature for (Baghdad, Basrah, Mosul and Rutba) were (38, 63 ,37 ,38), for mean yearly relativity humidity were (52 ,2, -12 ,0) and for mean yearly rainfall (-16, 4, -22, 12) stations *n* (16) then compared those values by the table of null probability value for *S* we get a probability of (0.117 ,0.023 ,0.130 ,0.117), (0.049 ,0.487 ,0.362, 0.513) and (0.315, 0.462 ,0.250 ,0.362) [5].

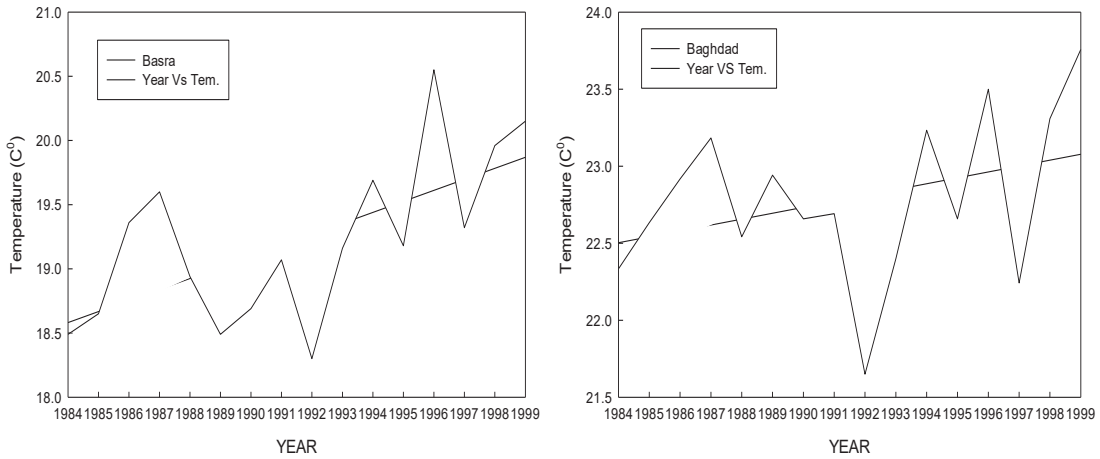
In the event that the likelihood appreciation for the figured S-measurement and the quantity of information focuses (n) is not as much as the predetermined essentialness level for the test (α for uneven; α/2 for two-sided), the outcome is huge at the 1-α certainty level and a pattern is available [5].

For an uneven test, this outcome is not exactly α for the 95% certainty level (α = 0.05) showing a critical outcome at this level of certainty. Inferred that an expanding pattern in fixation is available at the 95% certainty level. Extra to that the positive estimations of the test S-measurement show that there is an expanding pattern [10]. By utilizing conditions (3) we get

$$Var(S) = \frac{16(15)(2*16+5)}{18} = 493.33$$

The time arrangement plots of mean yearly temperature, relative humidity and precipitation are appeared in Fig. (2,3,4) for each station.

The statically significant levels ,0.05 was aced in the study. The estimate for magnitude of slop was computed for significant trend Mann-Kendall test was used to identify the analysis of mean yearly temperature, relativity humidity and rainfall figure 2, shows the trend of temperature in four stations. It can be seen that there is a slight increase in all stations, the maximum value was (0.085) in Basrah station.



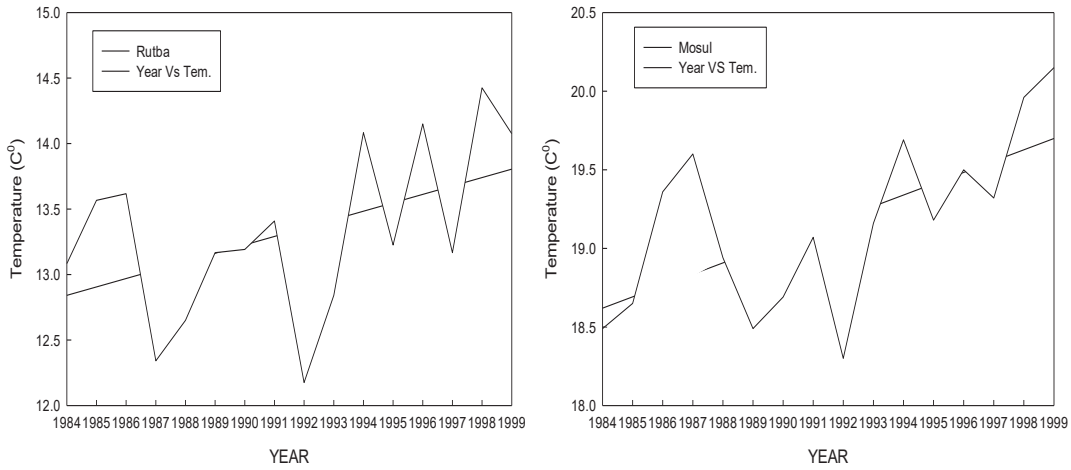


Figure (2) Time series of mean yearly temperature for (Baghdad, Basrah, Mosul, Rutba) stations

Figures 3 shows the trend of mean yearly relativity humidity in four stations. It can be seen that there is a slight increase in all stations, the maximum value was (0.344) in Basrah station.

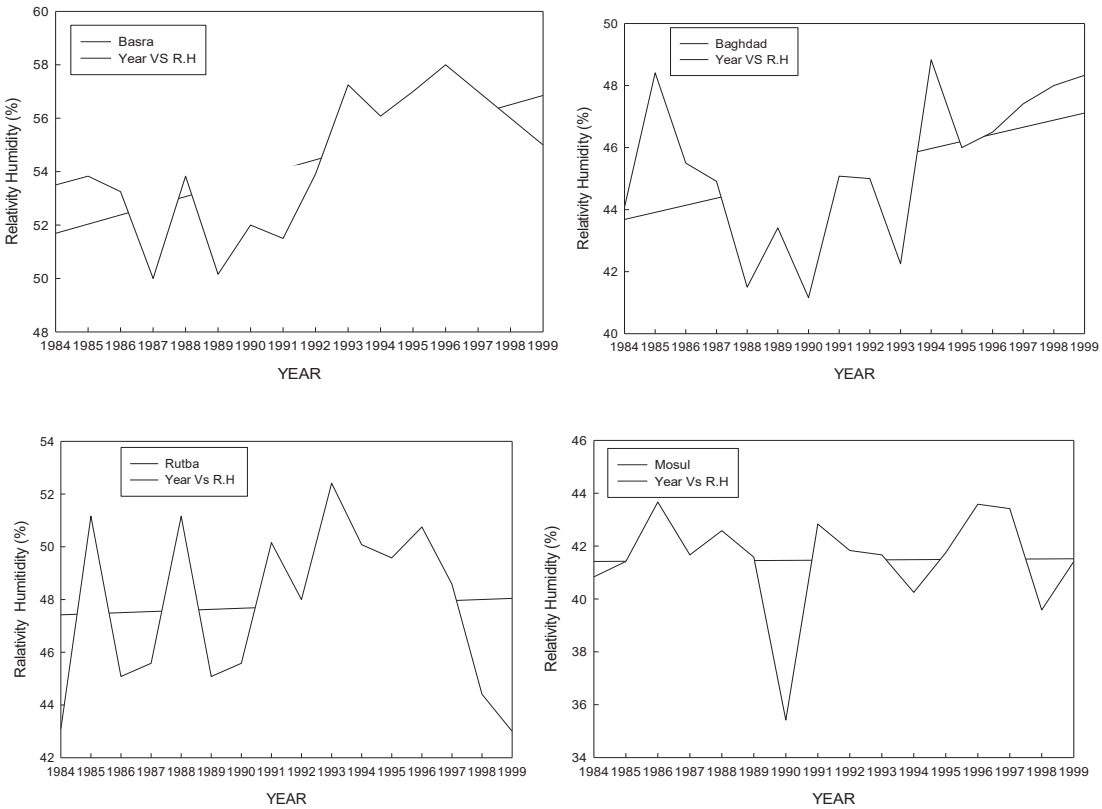


Figure (3) Time series mean yearly Relativity Humidity for (Baghdad, Basrah, Mosul, Rutba) stations
Figures 4, shows the trend of rainfall in four station it can be note that there is a slight decrease in all stations, the maximum value was (-1.606) in Basrah station.

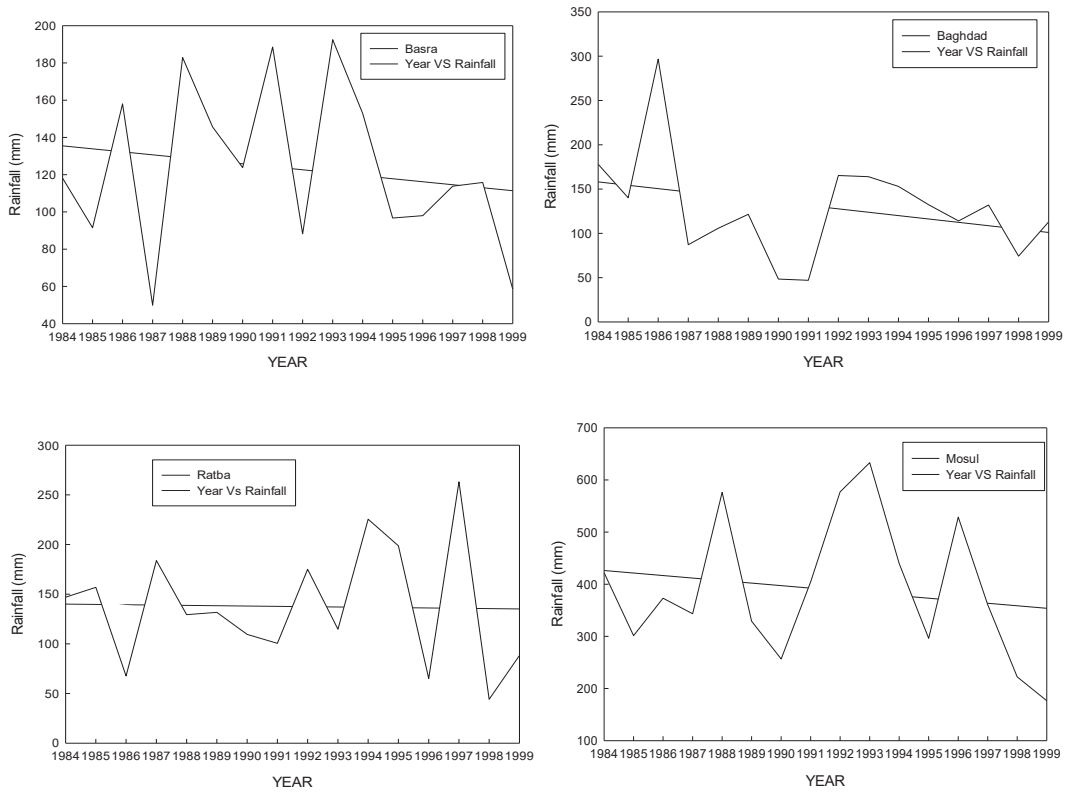


Figure (4) Time series of mean yearly Rainfall for (Baghdad, Basrah, Mosul, Rutba) stations

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