Study the Daily Behavior of Rainfall over Iraq

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Abstract. Through statistical analysis and determine the date and place of daily rainfall for the study area, which included ten stations from Iraq (2007-2016) It turned out that the behavior of daily rainfall varied significantly from Extreme values reached (89 mm) in Baghdad to min. (0.2mm) in Samawah. Although most of the months of rainy season did not record any rain. Baghdad, Mosul, Khankan and Kirkuk are most variable stations of rain with SD (4). The reason for the change in the amount of daily rain and the difference in distribution between the months of the rainy season is due to the nature of the atmospheric depression where very severe cases it results from the deepening of the atmospheric low surface pressure In this study, it was found that the daily rains of Iraq are not only varying in amount but also a different in Persisting with (1-4and more) days where In March all stations have max. Frequency persisting one day but persisting two days was in January while December persisting three days but persisting four days and more recorded in December. This is due to the nature of the atmospheric depression where very severe cases it results from the Atmospheric depression deepened from the upper atmosphere.

Keywords. rainy season, Persisting, Statistical Analysis and sever rain.

1. Introduction
Rainfall is one of the most important types of precipitation that is directly related to human life. The daily rainfall beaver is fairly crucial for water use practices and future planning in agriculture: planting, irrigation and drainage [1]. The heavy rainfall events may take place over most of world and last for days, resulting in widespread flooding and disruption of infrastructure and even loss of life [2]. Rainfall comprise the main source of water for the terrestrial hydrological processes, exact measurement and prediction of the spatial and temporal distribution of rainfall is a basic goal in hydrology [3]. The characteristics of rain depend on many factors, including it is shown that the horizontal distributions of climatological rainfall patterns for different rainfall regimes are strongly dependent on the direction of the low-level prevailing flow with much higher rainfall on the windward side. Furthermore, the seasonal variations in rainfall amount and type (light precipitation versus convective precipitation) are also dependent on the thermodynamic stratification and the availability of moisture [4].

climate change is occurring globally where the trend and magnitude of change on rainfall is not conclusive, it may vary by regions and seasons [5]. The Iraqi climate is classified as the dry and semi-dry region, the variance of rainfall amount is very high from year to another, the amount of annual
rainfall mainly depends on the type of the Pressure system (cyclone), location of the region and its intensity and speed and period of continuity and the amount of moisture loaded [6] for the important of there were many studies, Slar Ali et al [7] studying the relationship nature between falling rain quantities and the number of raining days at 30-year period for selected stations in Iraq.

It is obvious, through the research, that the increase in the number of annually raining days does not necessarily mean an increase in the annually falling rain quantities since the relationship nature between the two variables is not strong [7], Asraa Khtan et al. [8] estimate the maximum possible rainfall in selected stations of Iraq using two models (meteorology and statistical) where it was found that the values of the meteorology model to predict the maximum rainfall within 24 hours gave higher accuracy than the statistical model because of the different rainfall nature of the study area [8]. AL-Rijabo et al [9] studied variation of rainfall in Iraq for the period (1980-2010) using 22 meteorological stations, Winter months represent about (42-56) % of total annual rainfall. The annual variability of rainfall in all these stations is high [9]. Sulaiman Ismael (2016) the patterns of daily rainfall intensity with its trend and classification in Sulaimania city between (1992 –2015), where the repetition rate of trace precipitation pattern reached to (0.1 –0.9) mm for 15.1 day (%8.72 from the days of the rainy season), and the very light rainfall pattern is 1-2.49 mm for 12.2 day (.4.4%from the days of the rainy season) and the light rainfall (2.50 –7.49) mm for 18.1 day (6.62%from the days of the rainy season) and the moderate rainfall is (7.50 –35.49) mm for 24.57 day (%9 From the days of the rainy season) and the heavy rainfall is (35.50 –65.49) mm for 2.39 day (%0.87 from the days of the rainy season) and the very heavy rainfall exceptionally is more than 65.50 mm for 0.39 day (%0.14 from the days of the rainy season [10], Abd-Alhasan and Razaq Hussein (2017) Study the intensity and persisting in Iraq for period (1980-2011) conclude it varies the geographical distribution of rain in Iraq depending on the factors causing the rainfall, which affects the type of rain and then the intensity of most cases of heavy rain occur by the impact of terrain factor either light rain and medium intensity will be affected by the depressions of the Mediterranean Sea Red Sea and the Arabian Gulf causes light rainfall [11].

Baldawi et al (2017) input rain as one of the main factors estimate the response function of wheat yield in Iraq using the ARDL for the evaluation of joint integration and the estimation of the short and long term equilibrium relationship the results showed a lack of stability of rain [12]. Pankaj Dey et al (2018) show that the state of persistence of cross-correlation structure between rainfall and streamflow across the different time scales as well as spatial scales are not controlled by the amount of rainfall observed in MOPEX basins [13]. Jawad et al (2018) applied Statistical methods to compute the probability of drought events at every zone. The results showed the drier year is 2008, the wetter years are 2001 in Desert zone and 2003 in steppes and Arid and Semi-Arid Zone zones. The results also showed a significant fluctuation in precipitation from the average, especially at Arid and Semi-Arid Zone when compared with other zones. The values of standard deviation of precipitation were compared with precipitation anomalies for each zone, Arid and Semi-Arid is the drier zone in 2007-2008, the wetter zone is also Arid and Semi-Arid in 2002-2003. Using run theory, the drier Zone is Arid and Semi-Arid and the wetter Zone is steppes during study period [14]. S. Foued et al (2019) used the empirical formulas and models of the HEC-RAS software. These models were calibrated to actual data obtained during the observation period from 2017 to 2018 for the various rain events to quantify and estimate morphological evolution in the medium term, the model results give good criteria [15]. The objective of the study is to know the daily behavior of rain and its duration to benefit from it in administrative and economic planning, especially in the agricultural field.

2. Materials and Methods

2.1. Study Area and data

The observed daily rainfall data of ten rain gauge stations, see fig (1) (including: Baghdad, Mosul, Rutba, Khankeen, Kirkuk, Hay, Dewaniya, Basra, Karblaa and Nasriya) in Iraq of rainy seasons for (2007-2016) where taken from Iraqi Meteorological Organization and Seismology (IMOS).
2.2. The Statistical Analysis of Rainfall

The basic statistical analyses, see table (1) estimated for data to determine the behavior of daily rainfall for each month of rainy season. The daily rainfall values fluctuated unevenly for the months of the rainy season where it was noted that the highest stations oscillatory rain are (Baghdad, Mosul, Khanken and Kirkuk) with the standard deviation values are greater than 3 this means that the daily rainfall values of those stations in the normal state are more or less than the mean of 3 mm, especially in (January, March, October, November and December). The rest of the stations had SD (2) for most months of the rainy season. Note that the mean daily rainfall for all months of study areas was in the range of (1.7).

### Table 1. Standard deviations and Mean for all Rainy months season

| Months | Baghdad | Mosul | Rutba | Basra | Dewania | Hay | Karbla | Nasriya | Khanken | Kirkuk |
|--------|---------|-------|-------|-------|---------|-----|--------|---------|-----------|--------|
| Jan    | Mean 0.65 | 1.61  | 0.36  | 0.73  | 0.50    | 0.64| 0.56   | 0.42    | 1.22      | 1.49    |
|        | S.D 3.57 | 5.02  | 1.75  | 2.89 | 3.14    | 3.03| 2.77   | 0.15    | 4.29      | 5.37    |
| Feb    | Mean 0.71 | 1.39  | 0.37  | 0.31  | 0.23    | 0.37| 0.38   | 0.29    | 0.90      | 1.07    |
|        | S.D 2.74 | 4.39  | 1.90  | 1.38  | 0.99    | 2.02| 1.88   | 1.46    | 3.47      | 0.20    |
| Mar    | Mean 1.21 | 1.21  | 0.36  | 0.39  | 0.22    | 0.37| 0.68   | 0.68    | 0.77      | 1.41    |
|        | S.D 3.41 | 2.41  | 2.18  | 1.97  | 1.42    | 0.11| 4.88   | 4.97    | 2.27      | 4.52    |
| Apr    | Mean 1.04 | 1.03  | 0.21  | 0.26  | 0.28    | 0.53| 0.23   | 0.30    | 0.78      | 0.91    |
|        | S.D 4.60 | 4.59  | 1.21  | 1.74  | 1.44    | 3.18| 1.21   | 1.32    | 3.02      | 3.03    |
| May    | Mean 0.18 | 0.34  | 0.19  | 0.11  | 0.15    | 0.30| 0.11   | 0.20    | 0.23      | 0.42    |
|        | S.D 1.11 | 1.62  | 1.21  | 0.97  | 1.33    | 2.13| 0.85   | 1.50    | 1.31      | 2.96    |
| Sep    | Mean 0.04 | 0.04  | 0     | 0     | 0       | 0   | 0      | 0       | 0         | 0.01    |
|        | S.D 0.44 | 0.44  | 0.09  | 0.02  | 0       | 0.26| 0.02   | 0.04    | 0.01      | 0.11    |
| Oct    | Mean 0.52 | 0.52  | 0.27  | 0.07  | 0.07    | 0.16| 0.18   | 0.27    | 1.05      | 0.53    |
|        | S.D 2.97 | 2.96  | 1.52  | 0.59  | 0.52    | 1.04| 1.37   | 1.82    | 5.57      | 2.71    |
| Nov    | Mean 1.35 | 1.30  | 0.34  | 0.57  | 0.71    | 0.78| 0.61   | 0.80    | 2.12      | 1.29    |
|        | S.D 7.83 | 5.82  | 1.95  | 2.87  | 3.38    | 3.67| 4.30   | 4.43    | 7.73      | 5.43    |
| Dec    | Mean 1.60 | 1.61  | 0.33  | 0.64  | 0.40    | 0.67| 0.43   | 0.37    | 0.96      | 1.45    |
|        | S.D 4.55 | 4.558 | 2.667 | 0.174 | 2.413   | 3.187| 3.192  | 1.802   | 4.209     | 4.486   |
3. Results and Discussions
The maximum daily rain was calculated during the study period for each month of the rainy season to locate them, as shown in figure (2). Most of the maximum daily rainfall was recorded in January for all stations with (≥ 30) mm while March, November and December recorded more than (20 mm) for all stations. Other months recorded the maximum daily values of rain with different amounts in different stations ranging from (0.2mm) for Nasriya in September and (89.1mm) for Baghdad in November. The reason for the change in the amount of daily rain and the difference in distribution between the months of the rainy season is due to the nature of the atmospheric depression in very severe cases it results from the fusion of atmospheric low.

![Figure 2.](Image)

Figure 2. Maximum daily rainfall for period (2007-2017).
Persisting of daily rainfall for all stations and the duration of the study was variable from (1-4 and more) days so the number of persisting of days was divided into (1, 2, 3, ≥4) as show in fig. (3) where all stations persisting rain for one day and two days for all month except September, but three days, four days and more was some stations exist persisting while other stations did not occur.

Figure 3. Frequency of persisting rainfall days

In March all stations have max. Frequency persisting one day where Mosul has max. (31) Frequency but persisting two days was in January where Nasriya has maximum frequency (18). Mosul recorded (8) frequency in December persisting three days but persisting four days and more recorded in Baghdad December (12) frequency as show in figure 4 the continuity variation of rain is due to the depth of the atmospheric depression.

Figure 4. Max. Frq. Persisting
4. Conclusions
the behavior of daily rainfall for rainy season varying temporally and spatially with the standard deviation values are greater than 3 this means that the daily rainfall values of those stations in the normal state are more or less than the mean of 3 mm, especially in (January, March, October, November and December). All stations have persisting one day but with varying values up to an extremist (89mm) in Baghdad. In addition, the persisting of rain up to more than four days, but in some stations. This is due to the nature of the atmospheric depression where very severe cases it results from the Atmospheric depression deepened from the upper atmosphere.

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