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DETECTION OF THE CHANGE OF METEOROLOGICAL SEASON IN MIDDLE AND SOUTHERN IRAQ

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Abstract

This study aimed to detection of the change of meteorological season in middle and southern Iraq by using mean seasonal temperature for long period (1981-2017) and comparing this mean for two periods: The first period A (1981-2000) and second period B (2001-2017). These results of analyses the mean monthly and seasonally temperatures indicate There is no overlap in moth or season for two periods (A and B) but there is increase in mean temperature for all months and seasons of B period because of global climate change. the increase on spring and summer more than (1^{o}C) while winter and autumn less than (1 ^{o}C) for middle and southern Iraq. Nasiriyah, Najaf, Basra, Amarah and Khanaqin have maximum increase more than (1.5 ^{o}C) on summer.
Keywords: Iraq, meteorological season, detection change and mean temperature.

Introduction

Climate change has a clear impact on most countries in the world in terms of changing of air temperature and since this change is an important impact on human activity Where the observed difference in meteorological seasons "meteorological seasons are, by convention, defined (in the Northern Hemisphere) as December–February for winter, March–May for spring, June–August for summer, and September–November for autumn. Summer and winter coincide with what are respectively the warmest and coldest three months of the year" temperatures and astronomical seasons" astronomical seasons depend solely on the earth's axial tilt and its orbit around the sun, and are demarcated by the equinoxes and the solstices temperature" (Cannon 2005). Annual changes in surface temperature associated with the seasons are much larger over land than over the oceans. Surface temperatures lag the solar cycle by 27^2 days over the United States, compared with 32^2 days in mid-latitudes over the Northern Hemisphere as a whole, and 44 days in mid-latitudes of the Southern (Trenberth 1983). Surface-temperature trends in the Northern Hemisphere (NH) reveal a rise from about 1890 to 1940 of a few tenths of a degree Celsius, a slight downward trend until the early 1970s, and a further increase into the 1980s. The largest increases in surface temperatures over the Northern Hemisphere in the decade prior to 1988 were in Alaska, while substantial decreases occurred in the North Pacific Ocean. This illustrates the considerable geographic spatial structure to interdecadal temperature variations associated with changes in the atmospheric circulation (Trenberth, 1990). Dwyer *et al.* (2012) analyzed the changes to the seasonality of surface temperature in response to an increase in greenhouse gases during the twenty-first century as represented by the CMIP3 models. They found large, robust, global changes to the annual cycle of surface temperature: a phase delay and an amplitude reduction. By analyzing these changes geographically, we found that the phase delay and amplitude decrease are strongest at high latitudes and drive the global response. These polar changes are consistent with an effective heat capacity increase of the surface layer due to sea ice loss. At low latitudes there is a small phase delay and an amplitude increase, which we linked to changes in the seasonality of the surface heat flux. Abdulkareem *et al.* (2013) analyzed monthly means air temperature in Iraq for the period (1979 to 2010) using GIS techniques they compared the area of maximum value of mean temperature which covered Iraq show that an increase in the central and southern part during summer and winter and there were no significant change in the temperature pattern for the northern and western part, while the trend of change of the area of maximum value of mean temperature for spring and autumn were oscillating. There has been a clear increase in surface air temperature since the beginning of the observational record especially in Baltic Sea Basin countries according to BACC II (Team, 2008). Long-term changes in seasonal temperature extremes based on daily data across Saudi Arabia for the period 1981–2010 show that The rapid rise (fall) of the number of warm (cool) days compared to warm (cool) nights is observed in the winter, summer and autumn (winter and spring) seasons. Warming of cool/warm nights is insignificant for the majority of stations in winter. The national average of mean value index diurnal temperature range shows an increasing trend for all seasons; however, its mixed increase/decrease trends are observed for the majority of stations in summer and autumn seasons. Time series analysis reveals that irrespective of seasons, warming is clearly visible in Saudi Arabia after 1997. Variations of warming for different regions across the country are also noticed (Nazrul Islam *et al.,* 2015). Annual season end dates are defined as the date when the 5-day moving average rose above (winter and spring) or fell below (summer and fall) the long term mean. Climatic season end dates fall between meteorological and astronomical season end dates. The length of summer has increased by an average of 13 days and the length of winter has decreased by an average of 20 days, which are more substantial seasonal changes than previous studies. These changes in season length have occurred largely within the past 36 years, corresponding to most aggressive anthropogenic climate change (Kutta and Hubbart, 2016). Since 1948 in United States, late starts of autumn and winter have been observed while earlier onsets of spring and summer have taken place. For the individual stations, the largest shifts occurred along coasts and in larger, more urbanized environments. Individual locations also showed increased variability in start date, and significant changes were found for all four seasons in the circulation approach. Seasons have been shown to be important for a variety of processes including phonological responses and human adaptation to extreme temperature environments; therefore, the consideration of season variability may be appropriate for future climatological research (Allen and Sheridan, 2016). Hassan and Muter (2016) describe the climate of Baghdad for Summer season using anomalies temperature where the highest increase of the minimum temperatures is 4 ºC, while for the maximum temperatures is 2 ºC. Czernecki and Miętus (2017) detect variability and changes in the occurrence of the thermal seasons in Poland where thermal summer became the longest season in 85 % of years after 1990 in comparison to less than 50 % in the period from 1951 to 1970. Also, the change in the annual course of monthly mean temperature results in the fact that thermal spring is becoming longer than thermal autumn. Al-Timimi and Al-Khudhairy (2018) form the results of temporal analysis of Monthly Maximum surface air temperature at 23 stations in Iraq during 1980-2015 showed that during winter, spring, summer and autumn have a positive trend in all the parts of Iraq. A tendency has also been observed towards warmer years, with significantly warmer summer and spring periods and slightly warmer autumn and winter. Since the beginning of the 20th century, the rise of global surface temperature according to instrumental observations was characterized by two global warming periods - warming of the mid-20th century and modern warming, separated by a period of global temperatures decline(Bokuchava *et al.* 2018). The eastern Mediterranean (EM) is expected to be influenced by climate changes that will significantly affect ecosystems, human health and socio-economic aspects. One aspect of climate change in this vulnerable area is the length of the seasons, especially that of the rainy winter season against the warm and dry summer. The analysis further suggests that at the end of the 21st century, the duration of the synoptic summer, characterized by the occurrence of the Persian Trough, is expected to be lengthened by 49%, while the synoptic winter, characterized by the occurrence of the Cyprus Low, is expected to be shortened by 56% under the RCP 8.5 scenario. This may lead to substantial changes in the hydrological regime and water resources, reduce the potential of dry farming, increase the risk of fires and air pollution and change the timing of seasonal health hazards (Hochman *et al.,* 2018). The objective of the study is to know whether there is overlap in moth or season actually or there is change only at temperatures in Iraq.

Materials and Methods

Study area and data

Iraq is located within the arid and semi-arid region The study area included middle and southern Iraq represented by stations (Baghdad, Hilla, Diwaniya, Nasiriyah, Najaf, Basra, Samawah, Amarah, Karbala, Khanaqin). The monthly temperature (^{o}C) for the period (1981-2017) taken from Iraqi Meteorological Organization and Seismology (IMOS).

To identify the changes in the length of the seasons or the change at temperatures in Iraq during the different seasons and over a long-term period, The basic statistical analyses (mean, standard deviation and time series) done for data to determine the behavior of temperatures for study area and comparing the monthly mean temperature of seasons for two periods : The first period A (1981-2000) and second period B (2001-2017) The reason for choosing these two periods is that global average temperature change begun significantly in the 2000s according to world Meteorological Organization (WMO), The approach has been used in Saudi Arabia (Nazrul Islam, 2015) but they used anomalies temperature.

Results and Discussion

Through the contour plot of mean monthly temperatures for 36 years of the study area it was found that middle and southern Iraq vary in temperature spatially and temporally, but in general the two regions experienced fluctuations in temperature for the duration of the study, see Fig. (1) , Temporal temperatures begin to Increase from January and continue until August and then begin to decrease wheel spatially the middle region less than temperature from southern most highest temperature for all months in Nasiriya and Basra. To know the change in the mean monthly temperatures were compared between the general mean of 36 years and period (A,B) as show in figure (2).in all stations the mean temperature of period A is less than general mean about (0.2-1) ^{o}C and period B greeter than general mean about (0.4-1.5) ^{o}C.

By analyzing the time series of the study area for the two periods (A and B) it is noted that the difference between their mean ranges between (0.1-2.7) the highest difference observed in March for all stations. The average temperature varies for one month during 36 years with a stander deviation ranging (1-2) for all months.

To determine the extent of the change in the average temperature of seasons the same method was applied. It was found that the general mean for 36 years of Winter ranges (10.5 -14), Spring (22-29), Summer (33-37) and Autumn (24-27). By comparing the quarterly mean for the A and B period it was found that There is no overlap between quarterly mean but there is a distinct change in the mean between the two periods, as well as in the different seasons. See Fig. (3). The increase in the mean for all seasons in period B where the highest different in spring and summer more than (1 ^{o}C)

Conclusions

These results of analyses the mean monthly and seasonally temperatures indicate There is no overlap in moth or season for two periods (A and B) but there is increase in mean temperature for all months and seasons of B period because of global climate change. the increase on spring and summer more than (1 ^{o}C) while winter and autumn less than (1 ^{o}C) for middle and southern Iraq. Nasiriyah, Najaf, Basra, Amarah and Khanaqin have maximum increase more than (1.5 ^{o}C) on summer.

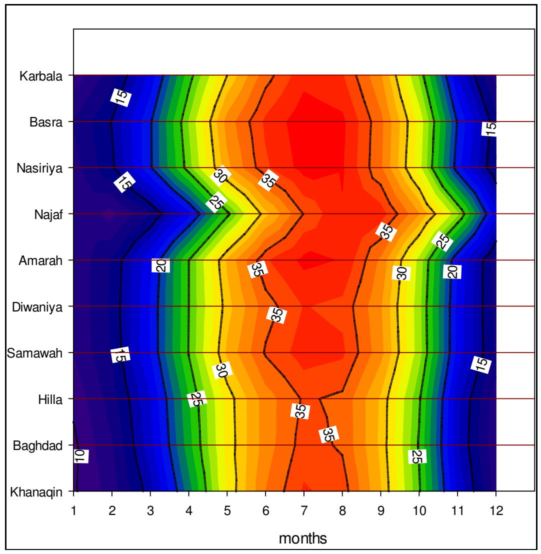
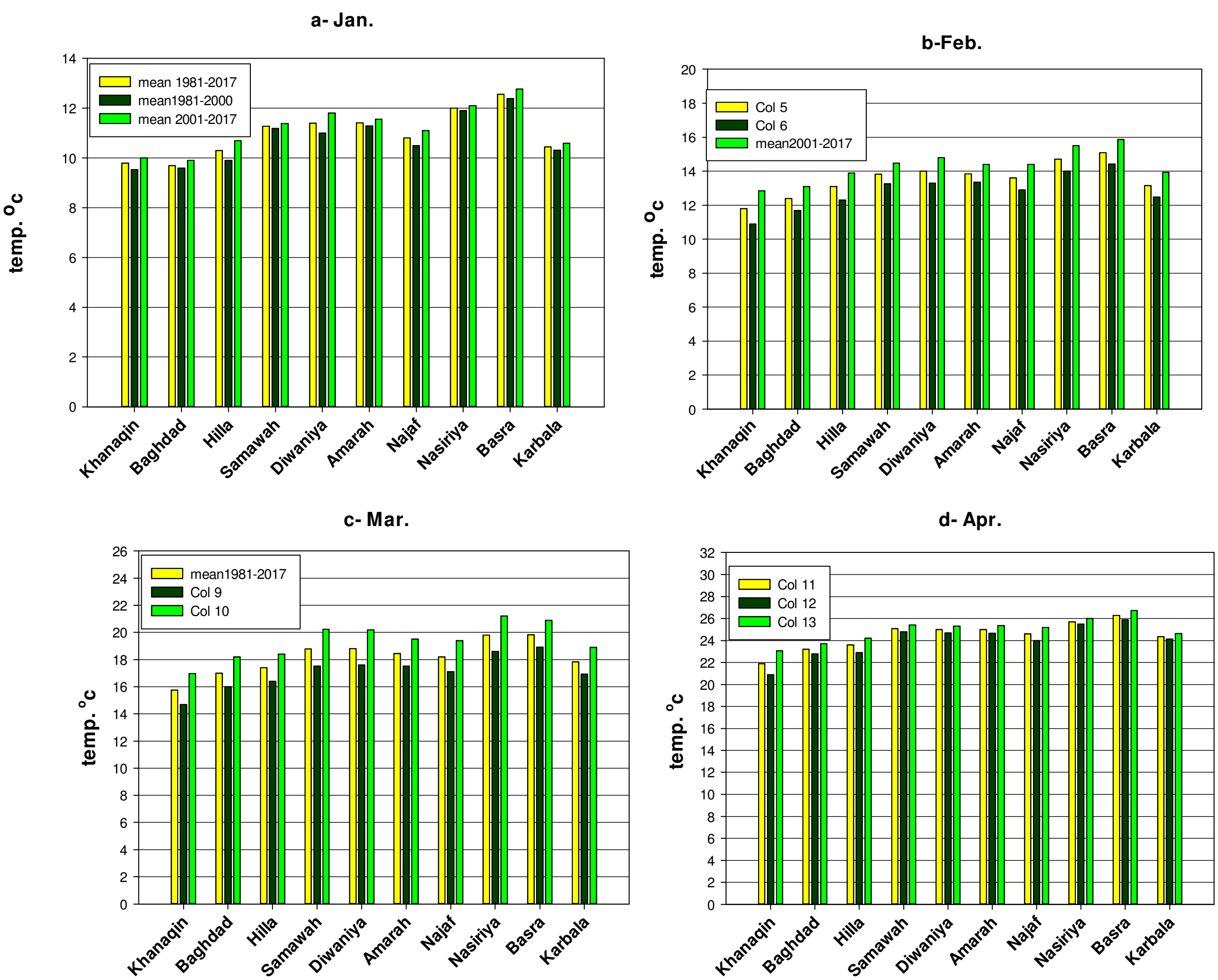
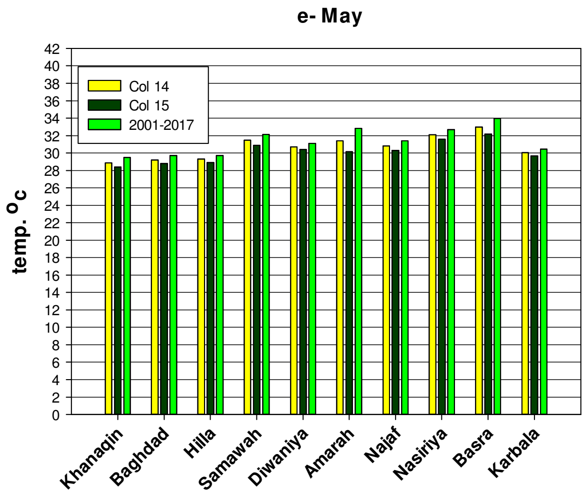
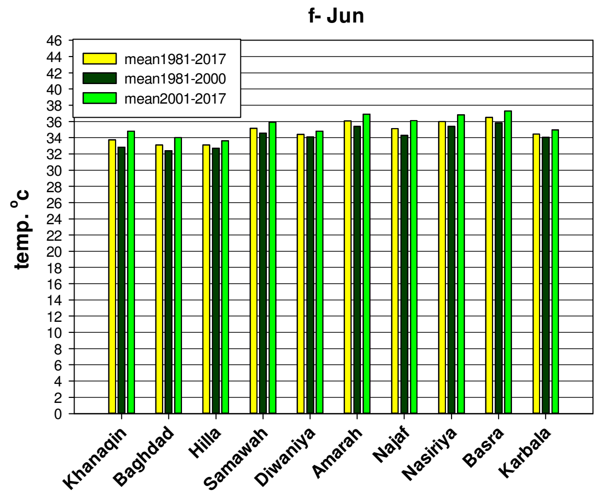
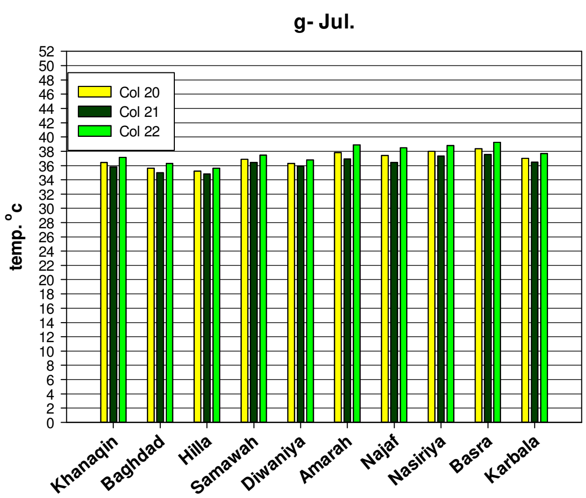


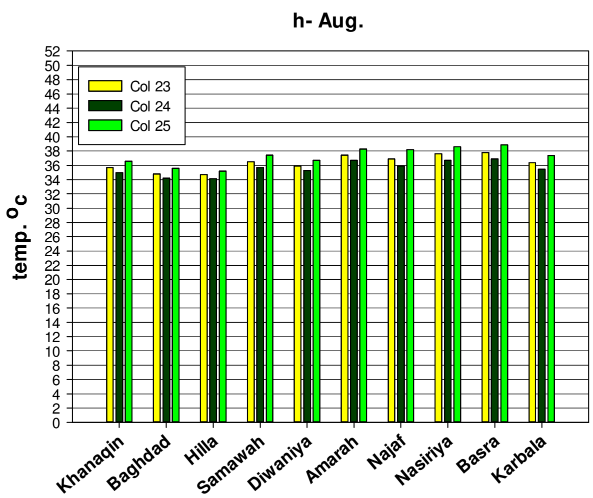
Fig. 1 : Spatially and temporally of mean temperature for period (1981-2017).

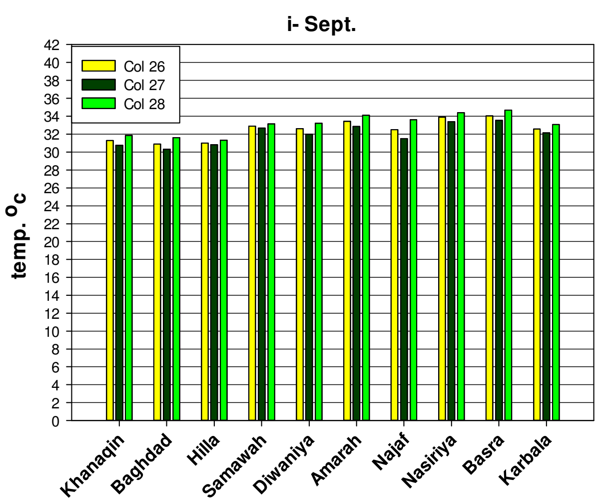


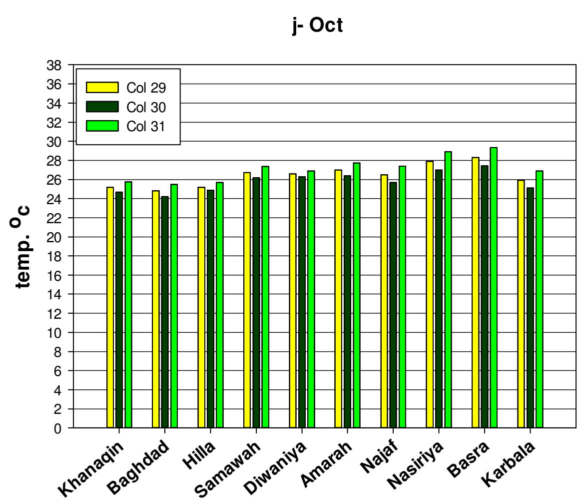

e- May
temp. °c
Col 14
Col 15
2001-2017
Khanaqin
Baghdad
Hilla
Samawah
Diwaniya
Amarah
Najaf
Nasiriya
Basra
Karbala


f- Jun
temp. °c
mean1981-2017
mean1981-2000
mean2001-2017
Khanaqin
Baghdad
Hilla
Samawah
Diwaniya
Amarah
Najaf
Nasiriya
Basra
Karbala


g- Jul.
temp. °c
Col 20
Col 21
Col 22
Khanaqin
Baghdad
Hilla
Samawah
Diwaniya
Amarah
Najaf
Nasiriya
Basra
Karbala


h- Aug.
temp. °c
Col 23
Col 24
Col 25
Khanaqin
Baghdad
Hilla
Samawah
Diwaniya
Amarah
Najaf
Nasiriya
Basra
Karbala


i- Sept.
temp. °c
Col 26
Col 27
Col 28
Khanaqin
Baghdad
Hilla
Samawah
Diwaniya
Amarah
Najaf
Nasiriya
Basra
Karbala


j- Oct
temp. °c
Col 29
Col 30
Col 31
Khanaqin
Baghdad
Hilla
Samawah
Diwaniya
Amarah
Najaf
Nasiriya
Basra
Karbala

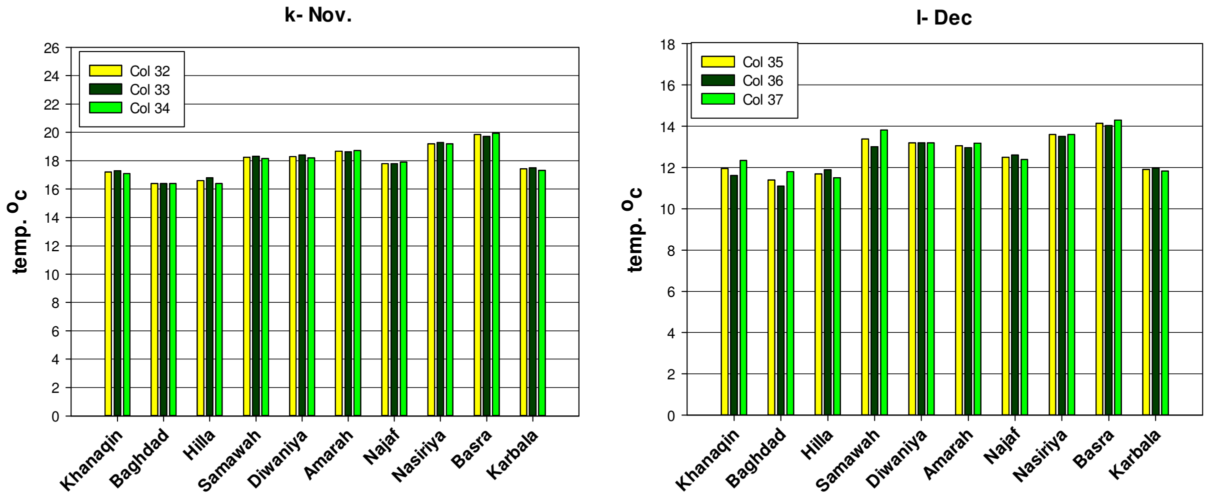


Fig. 2 : Mean monthly temperature

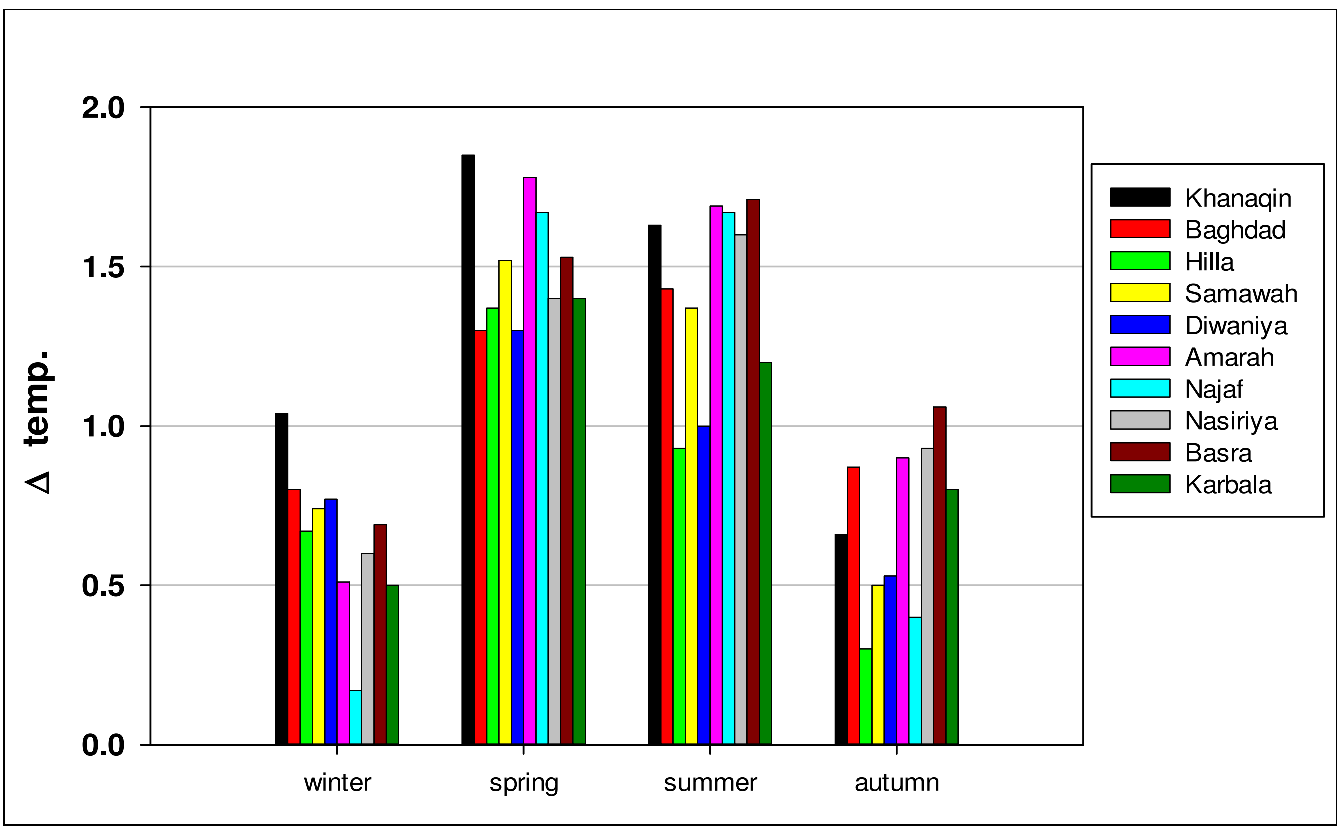


Fig. 3 : Change in seasonal mean temperature between period A and B.

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