Estimated the Seasonal Change of Temperature in Iraq Using GIS Techniques

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Abstract

Global warming is the scientific evidence that air temperatures the near surface of Earth are rising, and that higher temperatures threaten dangerous consequences earth such as drought, disease, floods, lost ecosystems. This aim of this research is analyzed the monthly means of daily values of air temperature in Iraq for the period of 1979 to 2010 by using GIS techniques. Data were obtained from the European Center for Medium-range Weather Forecasts (ECMWF). The initial diagnosis showed that there is no significant increase of maximum values of the mean temperature for the four parts(northern, central, western, and southern) of Iraq for the four seasons so we compared the area of maximum value of mean temperature which covered it and the results show there were an increase in the central and southern part of the country during summer and winter and there were no significant change in the temperature pattern for the northern and western part of the country , while the trend of change of the area of maximum value of mean temperature for spring and autumn and for the three periods were oscillating.

Key wards: GIS, Change of Temperature, Iraq

تخمين التغير الموسمي لدرجات الحرارة في العراق باستخدام تقنيات نظم المعلومات الجغرافية

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الخلاصة

اهم الدلائل العلمية على زيادة درجة حرارة الهواء بالقرب من سطح الارض هو ظاهرة الاحتباس الحراري والتي لها عواقب خطيرة مثل الجفاف والامراض والفيضانات وبالتالي خلل في النظام البيئي. يهدف هذا البحث تحليل المعدلات الشهرية اليومية لدرجة حرارة الهواء في العراق للفترة من 1979 الى 2010 وباستخدام تقنيات نظم المعلومات الجغرافيةGIS بتحليل بيانات المركز الأوروبي للتنبؤات الجوية المتوسطة المدى (ECMWF) حيث تم تشخيص اعلى معدلات لدرجات الحرارة التي تغطيها في الاقسام لاربعة لمناطق العراق :الشمالية ،الوسطى ،الغربية والجنوبية و للمواسم(شتاء ،ربيع ،صيف ،خريف) حيث أظهرت النتائج الاولية عدم وجود زيادة ملحوظة في المعدلات العليا لدرجات الحرارة وعلى هذا الاساس تم مقارنة المساحات التي تغطيها اعلى درجات الحرارة وللمناطق المذكورة انفا وللمواسم الاربعة والتي اظهرت زيادة ملحوظة في المساحة التي تغطيها اعلى معدلات لدرجات الحرارة في المنطقة الوسطى والجنوبية ولفصلي الصيف والشتاء في حين لايوجد تغير ملحوظ في نمط درجة الحرارة في المناطق الشمالية والغربية ، اما التغير بالنسبة لفصلي الربيع والخريف و للفترات الثلاثة فان اتجاه التغير متذبذب .

الكلمات المفتاحية: GIS ، تغيير درجة الحرارة، العراق

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1. Introduction

There is a growing concern about global warming and the impact it will have on people and the ecosystems on which they depend. Temperatures have already risen (0.8°C) since the start of the 20th century with much of this warming occurring in just the last 30 years and temperatures will likely rise at least another (2 °C), and possibly more than (11°C), over the next 100 years [1] . Global warming refers to an average increase in the earth's temperature, which in variation in the earth's global climate or in regional climates over time. It describes changes in the variability or average state of the atmosphere over time scales ranging from decades to millions of years. These changes can be caused by processes internal to the Earth, external forces (e.g. variations in sunlight intensity) or, more recently, human activities [2]. In recent usage, especially in the context of environmental policy, the term "climate change" often refers only to changes in modern climate, including the rise in average surface temperature known as global warming [3]. With the expansion of the global climatic datasets, a worldwide increase in the number of studies on climate variability has taken place, leading to a better understanding of the climate system (e.g. Jones and Mann, 2004 [4]; Charlson and Wigley, 1994 [5]; Nasrallah and Balling 1993 [6]; Wigley 2005 [7].

This aim of this research is to estimate the seasonal change of temperature in Iraq for the period (1979-2010) using GIS techniques. GIS is an important tool to map, assess, and monitor the changes in the urban environment.

2. Iraq Climate

The average temperatures in Iraq range from higher than (48 ^{o}C) in July and August to below freezing in January. A majority of the rainfall occurs from December through April, is more abundant in the mountainous region, and may reach (100 cm) a year in some places.

The Iraqi climate is characterized by hot, dry summers, cold winters, and a pleasant spring and fall. Roughly 90% of the annual rainfall occurs between November and April, most of it in the winter months from December through March. The remaining six months, particularly the hottest ones of June, July, and August, at approximately (32 °C), are dry. The influence of the Arabian Gulf on the climate of Iraq is very limited. Near the gulf the relative humidity is higher than in other parts of the country.

In the western and southern desert region, the climate is characterized by hot summers and cool winters. In the rolling upland (foothill) region there is basically no precipitation in the summer and some showers in the winter. The alluvial plain of the Tigris and Euphrates Delta in the southeast receives most of its precipitation accompanied by thunderstorms in the winter and early spring. In the mountains of the north and northeast the climate is characterized by warm summers and cold winters [8].

3. Materials and Methodology

The data used in this study was obtained from Interim Reanalysis Project of the European Center for Medium-Range Weather Forecast (ECMWF). The date are the monthly means of daily values of temperature at 2m level covering Iraq as a grid of eighteen points extends from (29-37) ^{o}N latitudes and (38.5-48.5) ^{o}E longitudes with a uniform grid interval of 1.5 degrees in longitude and 1.5 degrees in latitude. The time is from January 1979 to December 2010. In order to investigate the seasonal change in temperature, two steps were used to analyze the data. The first step involved splitting the maximum of the mean temperature for three periods; 1979-1989, 1990-1999, and 2000-2010. In the second step the months of December, January, and February were chosen to represent the winter season, the months of March, April, and May represent the spring season, the months of June, July, and August represent the summer season, and finally the months of September, October , and November represent the autumn season. The Geographic Information System (GIS) was used to detect the seasonal change in temperature for the period of the study. The Iraqi Meteorological and Seismology Organization (IMSO) divide Iraq into four regions according to geological, meteorological and hydrological characteristics as follows:

a) The Northern Region: is bounded by longitudes 43.09 and 43.50 ^{o}E , and latitudes 34.11 and 36.19 ^{o}N.

b) Central Region: is bounded by longitudes of 45.20 and 45.19 ^{o}E, and latitudes 31.81 and 34.18 ^{o}N.

c) Western Region: is bounded by longitudes 43.19 and 44.32 ^{o}E and latitudes 30.30 and 33.15 ^{o}N.

d) Southern Region: is bounded by the longitudes of 44.45 and 48.50 ^{o}E and latitudes 30.11 and 32.30 ^{o}N.

4. Results and Discussion

The first analysis for the data showed that there is no significant increase of maximum values of the mean temperature for the four parts (northern, central, western, and southern) of Iraq for the four seasons so we compared the area of maximum value of mean temperature which covered it by using the GIS techniques have been employed to generate maps of estimated the mean temperature for the three periods of time (1979-1989, 1990-1999, and 2000-2010) and for the four seasons. The results are shown in figures 1 to 4 for the winter, spring, summer and autumn seasons respectively.

Figure 1 shows that for winter, the maximum of the mean temperature was ranging from (13 to 16 °C), during the first period and covering an area of about (554 km^2)and this area include the southern region and a small part of the central region, while during the second period the covered area was about (677 km^2)and during the third period the area of maximum of mean temperature was about(1417 km^2)which is covering most of southern region and extends further northward to cover a large part of the central region.

Figure 2 shows that for spring, the maximum of the mean temperature was ranging from (24 to 28 ^oC). The areas covered by this range of temperatures were (677 km^2) during 1979-1989, (1109 km^2)during 1990-1999, and (863 km^2)during 2000-2010 which covering the southern region and a little part from central region, as shown figs.(2). These areas include the southern region and extended to the central region during the period 1990-1999.

Figure 3 indicates that for the summer season the maximum of the mean temperature was between (36-39 ^oC) and these values cover areas of (2095 km^2 , 2218 km^2 , and 2587 km^2)for the three periods of time respectively. It is evident that area of the maximum of the mean temperature extended from south towards north to include a major part of the central region.

Figure 4 shows the results for the autumn season. It is seen that the maximum of the mean temperature was ranging from (27 to 29 ^oC). The covered areas were (492, 431, and 492 km^2) for the periods of 1979-1989, 1990-1999, and 2000-2010 respectively. It is evident that the differences between the areas are no very significant compared with the other three seasons.

The results of figures 1 to 4 also show that there was no significant change in pattern of the maximum of the mean temperature in the northern and western regions of Iraq.

Figure 5, which summarizes the above results, indicates that there were significant increase in areas of the maximum of the mean temperature in summer and winter season in the period of 1979-1989 compared with that of 1990-1999 and in the period of 2000-2010 compared with that of 1990-1999. This suggests the existence of temperature rise during the last decade particularly in the central and southern part of Iraq.

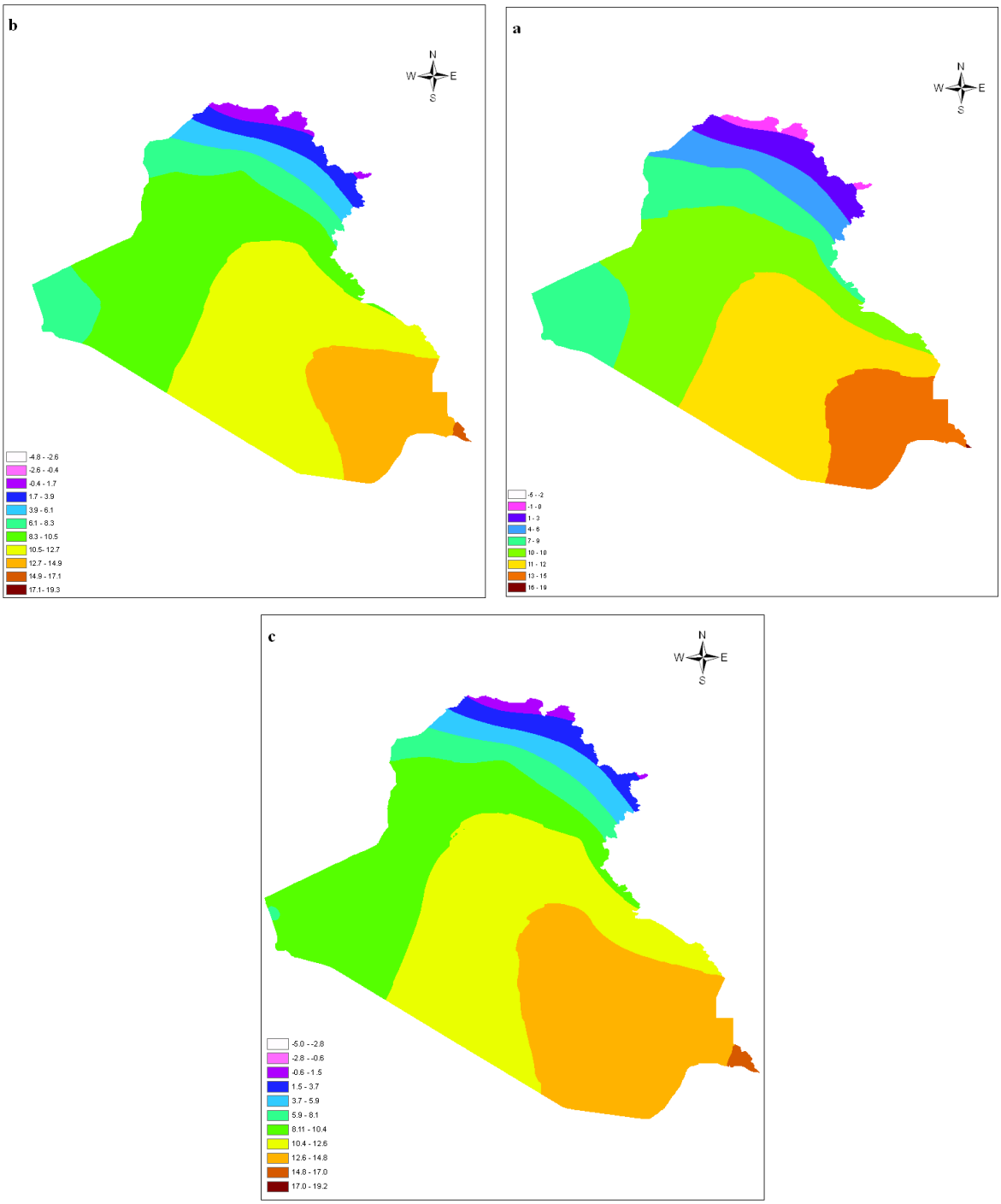

Figure 1-The mean temperature for winter at three periods: a (1979-1989), b (1990-1999) and c (2000-2010)

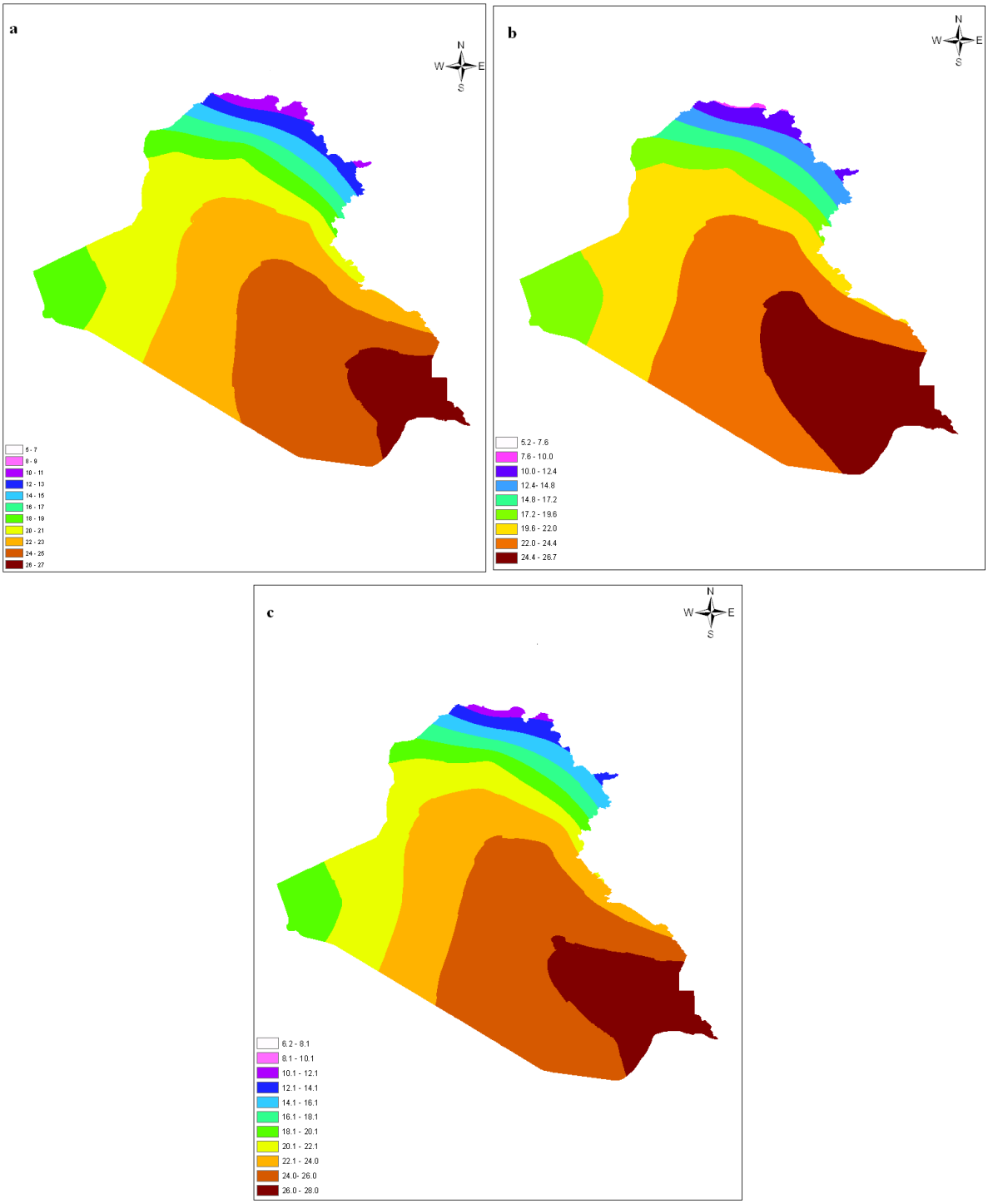

Figure 2-The mean temperature for spring at three periods: a (1979-1989), b (1990-1999) and c (2000-2010)

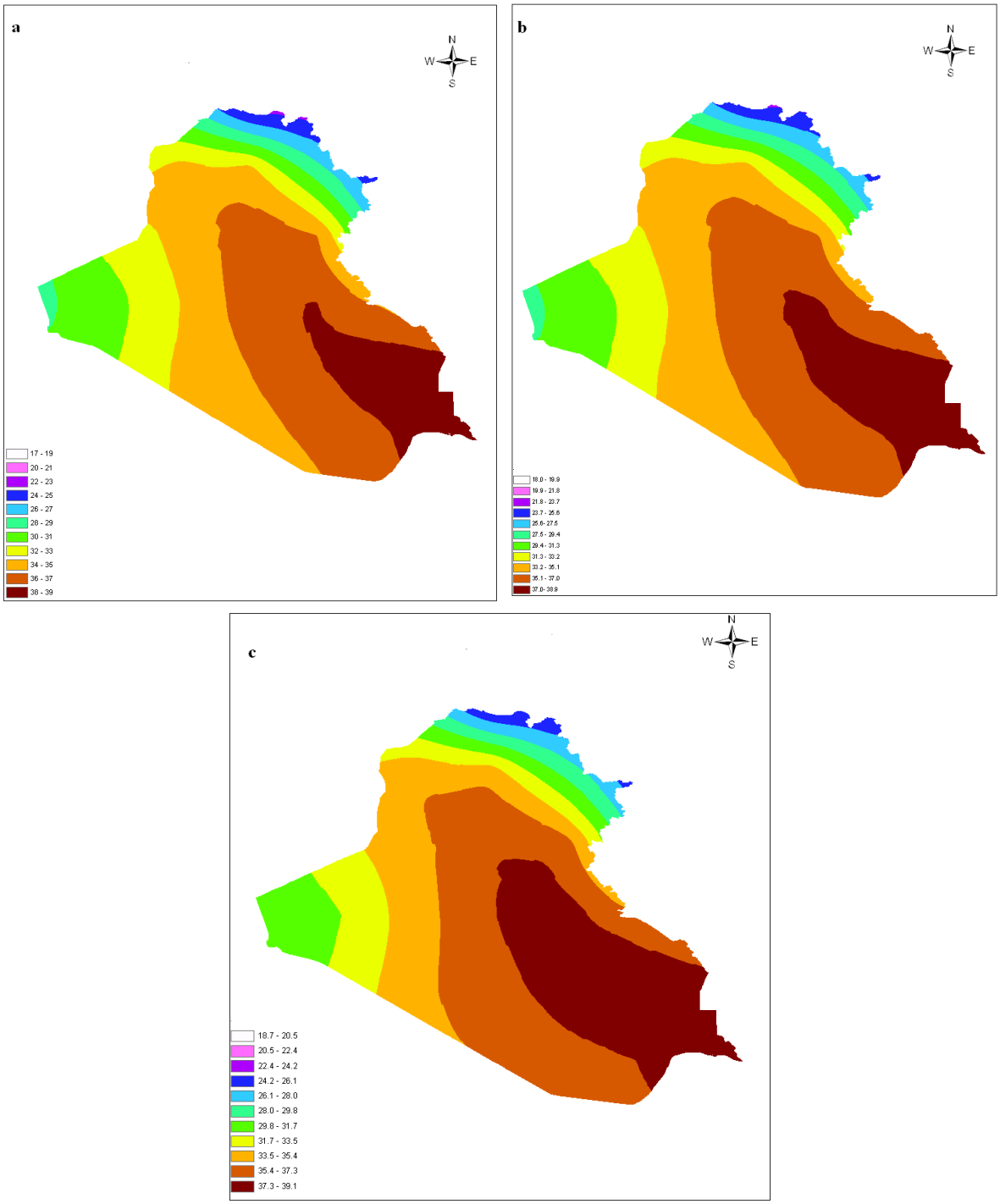

Figure 3- The mean temperature for summer at three periods: a (1979-1989), b (1990-1999) and c (2000-2010)

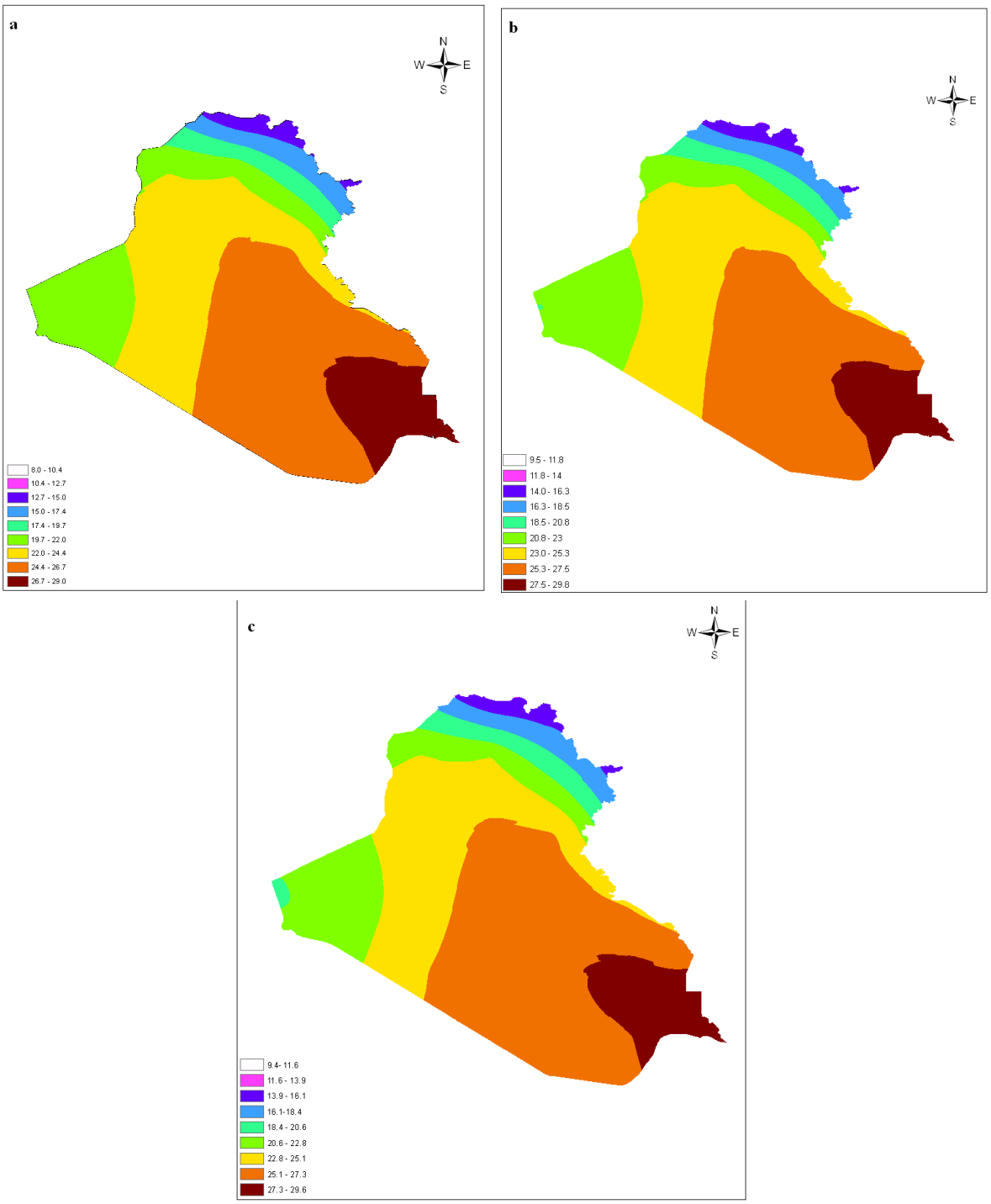

Figure 4- The mean temperature for autumn at three periods: a (1979-1989), b (1990-1999) and c (2000-2010)

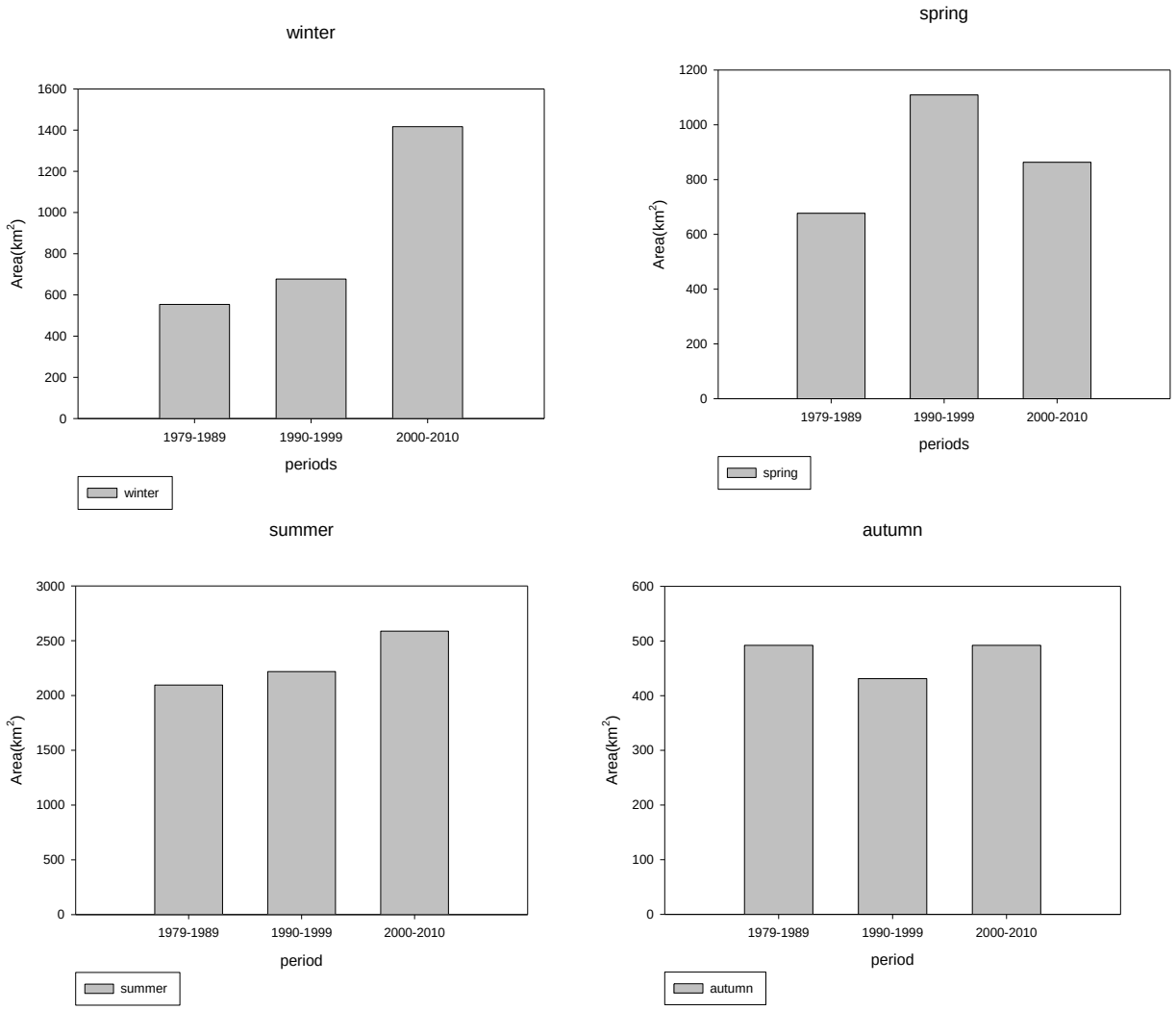

Figure 5-The change of area in the three periods in winter, spring , summer and autumn

5. Conclusions

The results show that there were no significant change in maximum value of mean temperature for the three periods but there were an increase in the area of maximum value of mean temperature in the central and southern part of the country during summer and winter particularly during the period 2000-2010 and there were no significant change in the area of temperature pattern for the northern and western part of the country. Simple change in area of maximum mean of temperature in spring and autumn.

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