HEAT WAVES INVESTIGATION DURING LAST DECADES INSOME CLIMATIC REGIONS IN EGYPT

SALEH, S. M., M. A. M. HEGGI, M. A. A. ABDRABBO and A. A. FARAG

Central laboratory for Agricultural Climate (CLAC), ARC, Giza- Egypt .

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Abstract

Egypt has been strickenby several extreme weather events during the last decades. The most famous heat wave was during winter season of 2010 and summer season of 2015. Global climate change will cause serious impacts on agriculture in the future. The aim of this study was to investigate heat wave events during the period from 1980up to 2015 in 3 governorates in Egypt. Major agricultural climatic regions were represented in this study; Behira governorate represents North Delta, Giza governorate represents Middle Egypt and Qena represents Upper Egypt. Monthly maximum and minimum air temperature were recorded in all governorates during the study period. The highest monthly maximum air temperature was recorded in summer season was in August 2015 followed by August 2012. Qena Governorate had the highest maximum air temperature followed by Giza Governorate while the lowest maximum air temperature was recorded in El-Behira Governorate. The daily maximum air temperature of the highest months was investigated to determine severe period of heat waves during these months. On the other hand, the highest extreme heat waves were recorded in winter season of 2010. In addition, monthly mean relative humidity percentage was collected for the same concerned governorates. The productivity of two of the major cereal crops in Egypt, during the heat waves events, were estimated during winter as well as summer seasons. The highest reduction of productivity for wheat and maize was recorded in Upper Egypt followed by Middle Egypt; while the lowest reduction was recorded in North Delta for wheat (winter season) and maize (summer season).

Key words: Extreme weather event – Climate change – Relative humidity - maximum andminimum temperature.

INTRODUCTION

According to the IPCC Fifth Assessment Report, the warming of the climate system is unequivocal and has been particularly pronounced since the 1970s (Hartmann et al., 2013). Weather fluctuations and other associated extreme events can cause severe losses to agricultural production with potential worldwide economic impacts (UNEP, 2009). Heatwaves are expected to become more frequent, intense and long lasting, mostly due to the increase in mean temperature and corresponding variability (Fischer and Schar, 2010). According to several authors, this event was so extreme in central Europe that it fell completely outside the range of any extreme episodes observed before, even for stations with more than 100 years of daily data (Schar et al., 2004).

The widespread decrease in carbon uptake matched the regions where very high temperature values were also preceded by a long period of below average precipitation, leading to strong soil moisture deficits. In the case of the 2003 heat wave, results indicated that moisture deficits coupled with high temperatures drove the extreme response of vegetation, while for the 2010 event very high temperatures appear to be the sole driver of very low productivity (Bastos et al., 2014).

In the last decades, the Euro-Mediterranean regionhas experienced an increase in extreme temperature events such as heat waves (Fontana, et al., 2015). Future climates are forecasted to include greater precipitation variability and more frequent heat waves, but the degree to which the timing of climate variability impacts ecosystems is uncertain (Craine, et al., 2012).

Increases in temperature, as already observed and simulated by General and Regional Circulation Model (RCMs and GCMs) in the Mediterranean basin, are expected to have a great impact on agriculture (Sadras and Monzon, 2006).

It is definitively accepted that our climate is changing due to increased 'greenhouse gases' atmospheric concentrations and this change is expected to have important impact on different economic sectors (e.g. agriculture, forestry, energy consumptions, tourism, etc.) (Hanson et al., 2006). The aim of this study is investigate the heat waves during last decades in three major climatic regions in the agriculture sector in Egypt to warn researchers and decision makers about the climatic variability during the last decades and then make proper strategic plan contained technical measurements to reduce the risk of extreme climatic events.

MATERIALS AND METHODS

This study investigates the heat waves events in the different climatic regions in Egypt during 1980 – 2015 to determine the worst heat waves and understand the impacts of heat waves on the agriculture sector.

Agro-climatic regions

Egypt divided into agro-climatic regions according to the cultivation areas and average temperature values. The most economically important agro-climatic regions in Egypt are: the Delta region represented by El-Behira governorates, the Middle Egypt region represented by Giza governorates and the Upper Egypt region Represented by

Qena Governorate (Fig. 1). These governorates were selected to cover the most important agricultural regions from North to South of Egypt (Farag, *et al.*, 2013).

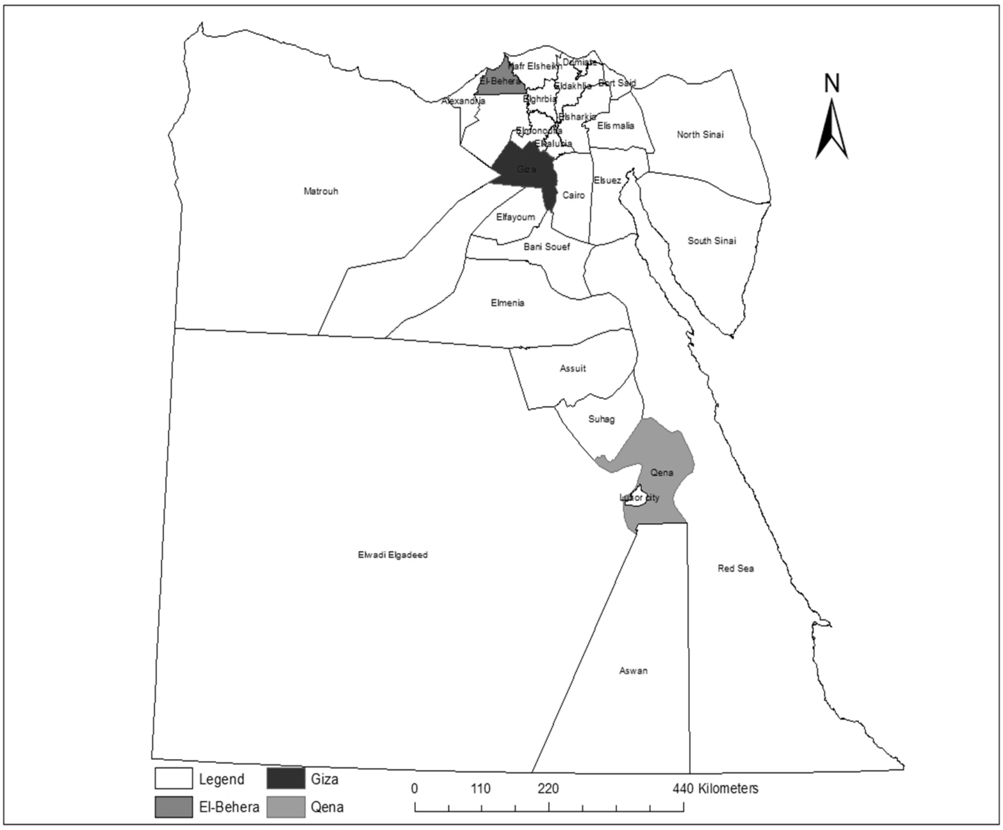


Fig. 1. Map of Egypt illustrates the study area of different climatic regions.

Climate data

The historical climate daily data of minimum and maximum air temperature(°C) and relative humidity (%) were collected from the Central Laboratory for Agriculture Climate (CLAC) and Egyptian Authority of Meteorology (EMA). The average monthly data from 1980 to 2015 were calculated from the collected daily data. The data for different locations were collected from meteorological stations of the different regions. The coordinates of the concerned automated weather stations are presented in Table (1).

Table 1. The coordinates of automated weather stations used in this study

No.	Station and Governorate	Latitude (°N)	Longitude (°E)
1	**Behira**	26.6	31.4
2	**Giza**	30.0	31.2
3	**Qena**	24.0	32.9

Statistical analysis

Statistical analysis was carried out using SAS software. The paired t– test was used to establish whether significant differencesexistsbetween the Current ETo in 1998 to 2007and estimated ETo under climate change in 2050s, 2100s at significant level 0.05 (SAS, 2000).

Productivity data

- Productivity data for each concerned crop (wheat in winter and maize in summer)during five years including each the extreme high temperature event.
- Comparison between productivity of concerned crops during extreme high temperature event in comparison with the productivity of the other years.

RESULTS AND DISCUSSION

Monthly maximum air temperature

The average monthly maximum air temperature (°C), for El-Behira Governorate from 1980up to 2015, every three months matching with the climatic seasons (winter, spring, summer and autumn) are presented in Figure (2).

Data indicated that the highest monthly air temperatures during summer season are during July and August followed by June; while the lowest average maximum air temperatures were recorded during December and January. However, highest monthly air temperature was recorded during spring and autumn (20 to 30°) during the most years of collected data (from 1980 up to 2015).Monthly air temperature in El-Behira around 15°C during December and January after that air temperature gradually increased during February and March with value about 18°C and then air temperature increased again during April and May to reach around 20°C. The monthly air temperature during the hottest months in El-Behira was around 30°C (June, July and August). August of 2015 consider the hottest month (33.4°C) followed byJuly month of 2012 compared to the other months during studied period.

Regarding the heat waves during winter season, February of 2010 considered the hottest month (22.6°C) compared to the same month in the whole studied period during the winter season (18.8°C). Giza and Qena had the same trend such as El-Behira with higher values. Qena had the hottest temperature followed by Giza while El-Behira had the lowest air temperature values (Figures 3 and 4).

Monthly minimum airtemperature

The average monthly minimum air temperature from 1980 up to 2015 in El-Behira governorate were ranged from 12.2to 25.3°C during the studied period (Figure 5). Whereas, average monthly minimum air temperature from 1980 till 2015 in Qena Governorate (Fig.7) had value from 11.2 – 27.3 °C. The lowest value of monthly minimum air temperature recorded at winter in Qena with value 5.7°C (January 1983). It is clear, monthly minimum air temperature gradually increased during last five years from 2010 till 2015 to reach 31 °C during August 2015 (Qena Governorate) followed by August 2010 (27.7°C) in Qena governorate.

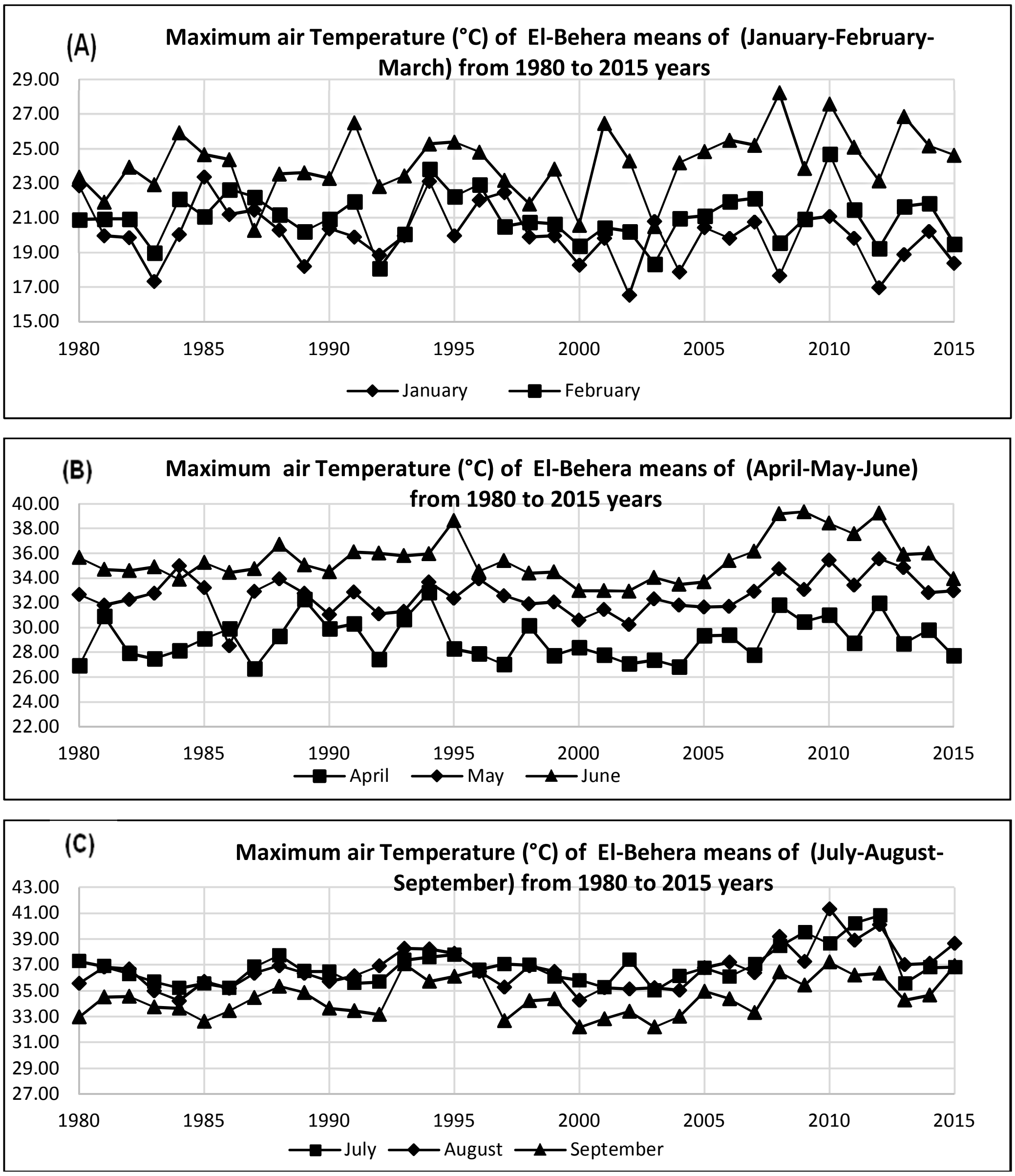


Figure (2a, b,c and d): Maximum monthly air temperature of El-Behira from 1980 to 2015.

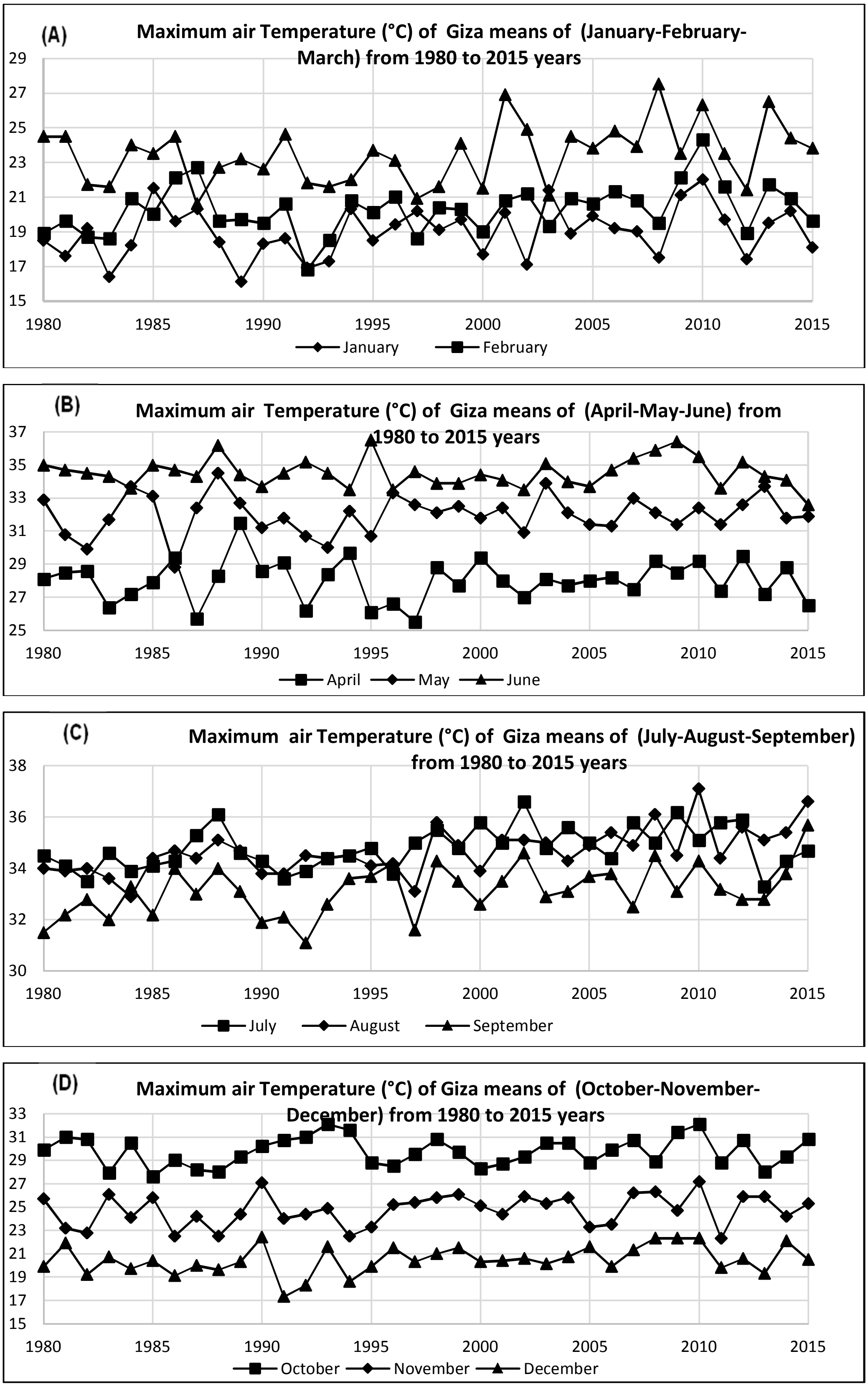


Figure (3 a,b,c and d): Maximum monthly air temperature of Giza from 1980 to 2015.

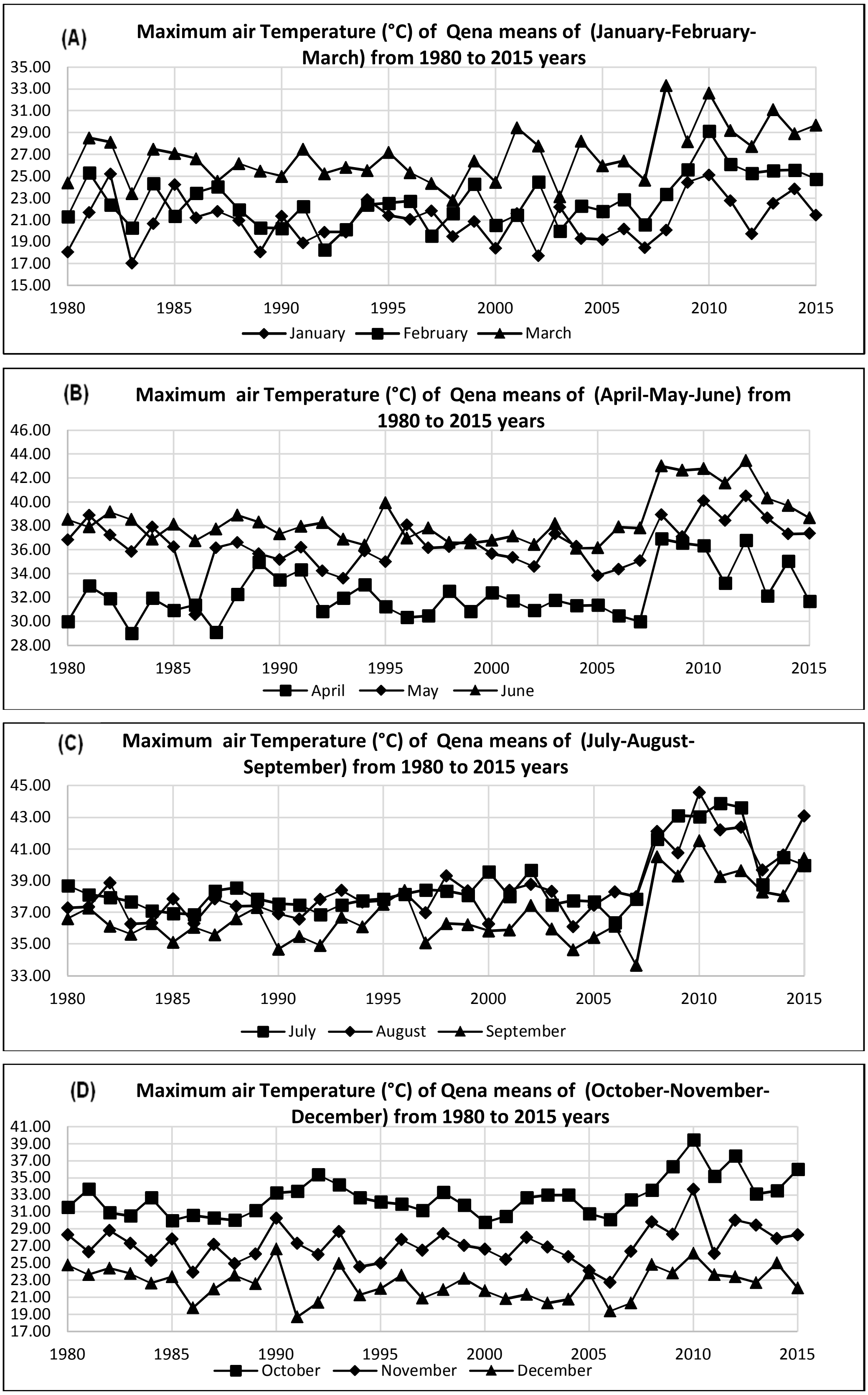
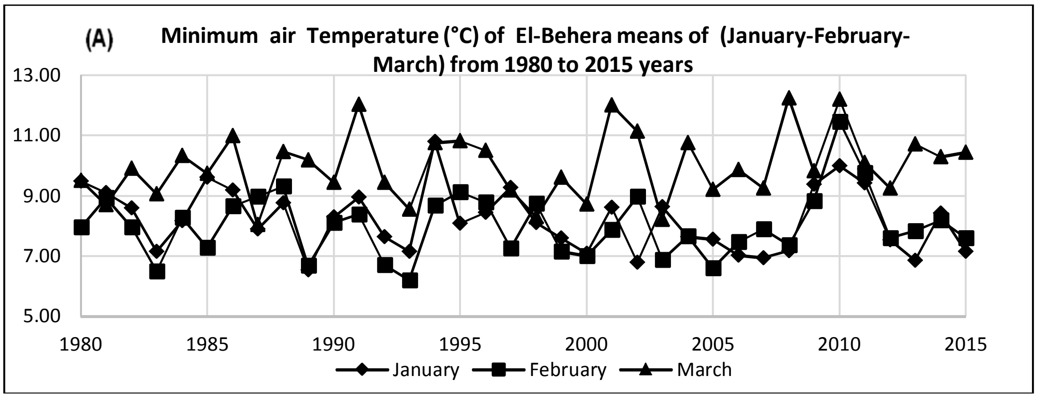
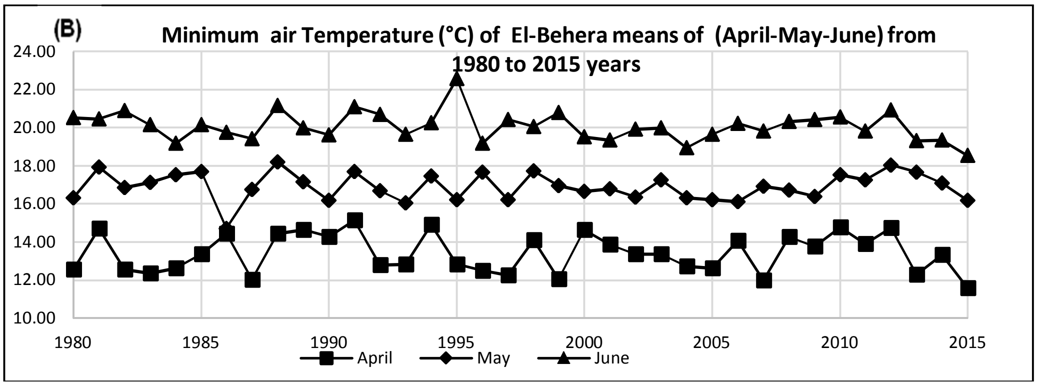
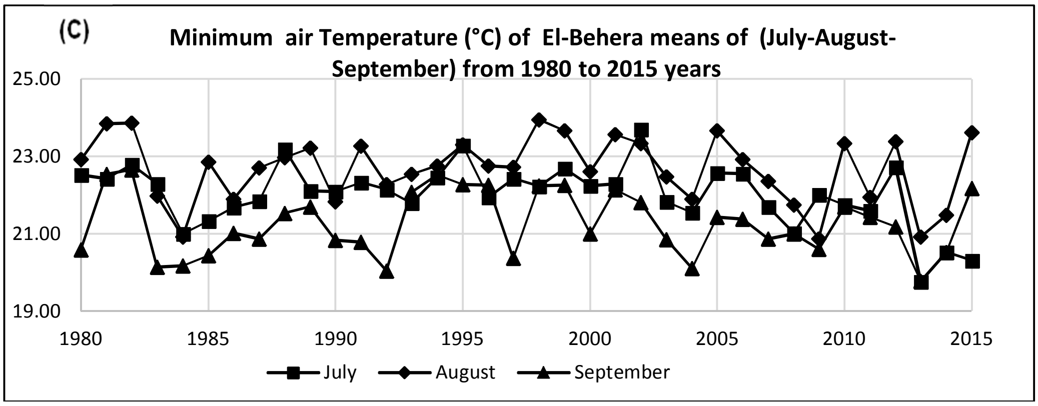


Figure (4 a,b,c and d): Maximum monthly air temperature of Qena from 1980 to 2015.







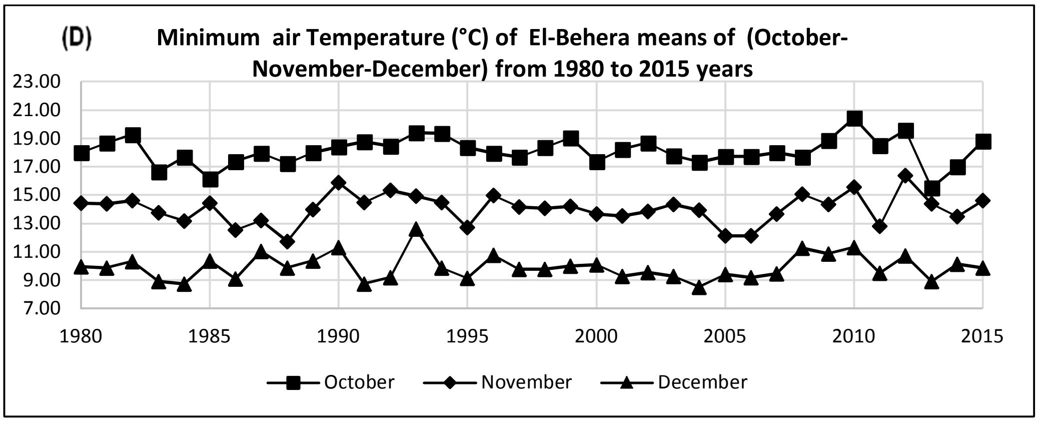


Figure (5 a,b,c and d): Minimum monthly air temperature of El-Behira from 1980 to 2015.

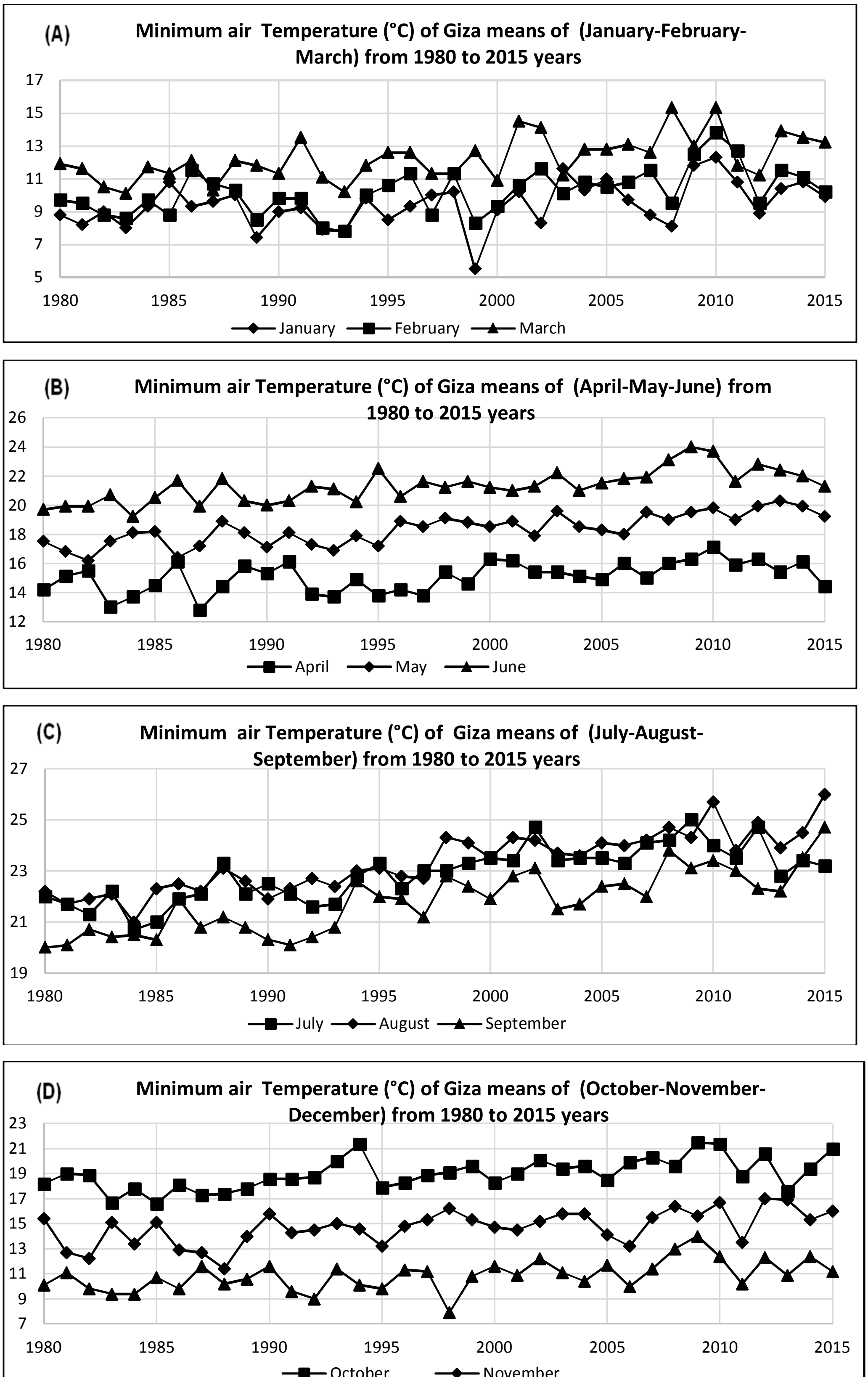


Figure (6 a,b,c and d): Minimum monthly air temperature of Giza from 1980 to 2015.

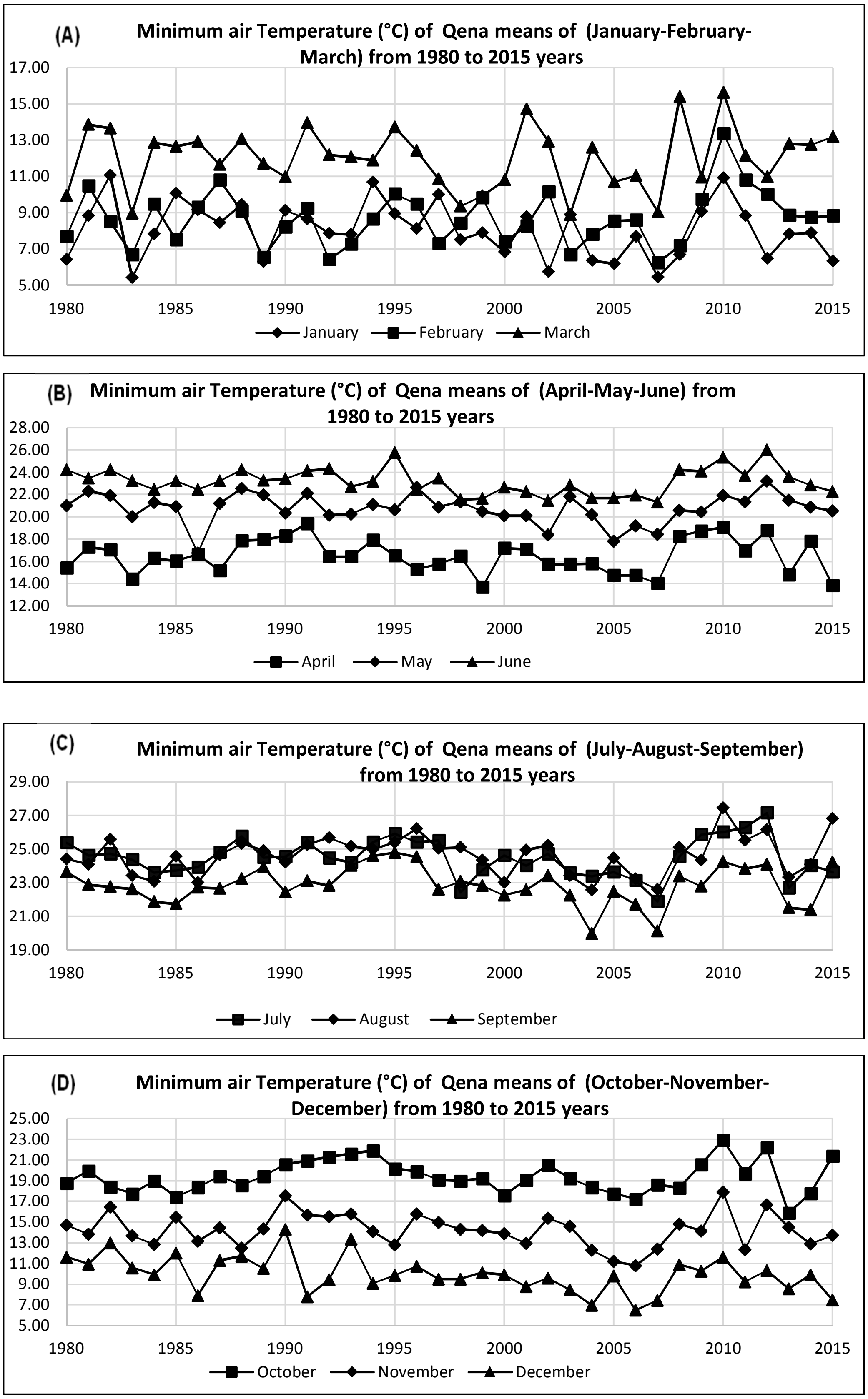


Figure (7a,b,c and d): Minimum monthly air temperature of Qena from 1980 to 2015.

Monthly relative humidity

The average monthly mean relative humidity from 1980 till 2015 in El-Behira Governorate was around 60 – 70% during all months (Figure 8). The highest relative humidity was recorded during winter and summer seasons with averages about 69%; January month had the highest relative humidity during 2014 season with value of 79.3% followed by January 1996 with value of 76.2 %. The lowest relative humidity was recorded in 2009 during the winter season (January, February and March). The lowest averagemonthly relative humidity recorded during the spring season (April, May and June) with value around 63 to 66%in El-Behira. Giza and Qena governorates had the same trend as El-Behira with lower values. Qena had the lowest relative humidity followed by Giza while El-Behira had the highest relative humidity values (Figures 9 and 10).

Daily maximum Temperature and heat waves events

Maximum and minimum daily air temperature of El-Behirain summer season at August 2010, 2012 and 2015 which consider the highest maximum air temperature during studied period(Figures11 and 12). Data showed that highest heat wave event was recorded during 2015 year. There were two heat wave events during August, 2015. The first one from 5th to 11th and the second from 13th till 17th. The temperature during heat waves exceeded 33°C during all heat waves period while the average temperature for August from 1980 – 2015 is 30.7°C. Year 2012 had the same trend with one heat wave event from 7th to 13th of August. The heat waves during 2010 are less than 2012 and 2015**.** We can conclude that the most severe heat wave was during August 2015. On the other hand, February of 2010 is a sample of heat wave during winter season. From the above we can conclude that heat waves become more frequent, moreintense and long lasting during the last decade. Moreover, the heat waves during summer in Qena were the hottest and longest; the temperature was above 44°C from the first of August till 23rd of August 2015. Regarding the heat wave during winter season, February of 2010 consider the hottest month compared to the same month during period of 1980 till 2015. The winter heat wave of 2010 started at

9th of February till the 21st of February. The maximum air temperature in Qena exceeded 37°C during this period (9th of February till the 21st of February 2015). The aspects of heat waves are linked with the impacts of climate change in Egypt (Abdrabbo, *et al*., 2013; Abdrabbo *et al*., 2015 and Farag *et al*., 2015). The arid areas of Egypt where temperature increase the evapotranspiration rate is already high and water table is shallow cause loss of water rapidly and consequently the aridity would increase.

Failure of only one critical protein system can cause defect of an organism. This fact may explain why most crop species survive sustained under high temperatures up to a relatively narrow range, 40 to 45°C. The relationship between the thermal conditions for an organism and the thermal dependence of proteins and enzymes has been well established (Senioniti et al., 1986). Heat stress may be an oxidative stress (Lee et al., 1983). Per-oxidation of cell membrane lipids has been observed at high temperature conditions (Mishra and Singhal, 1992), which is a symptom of cellular injury. The stress caused by high temperature occurrences has impacts on agricultural yields, even when the average temperature reaches one or two degrees above the ideal for the culture (Schlenker and Roberts, 2009).

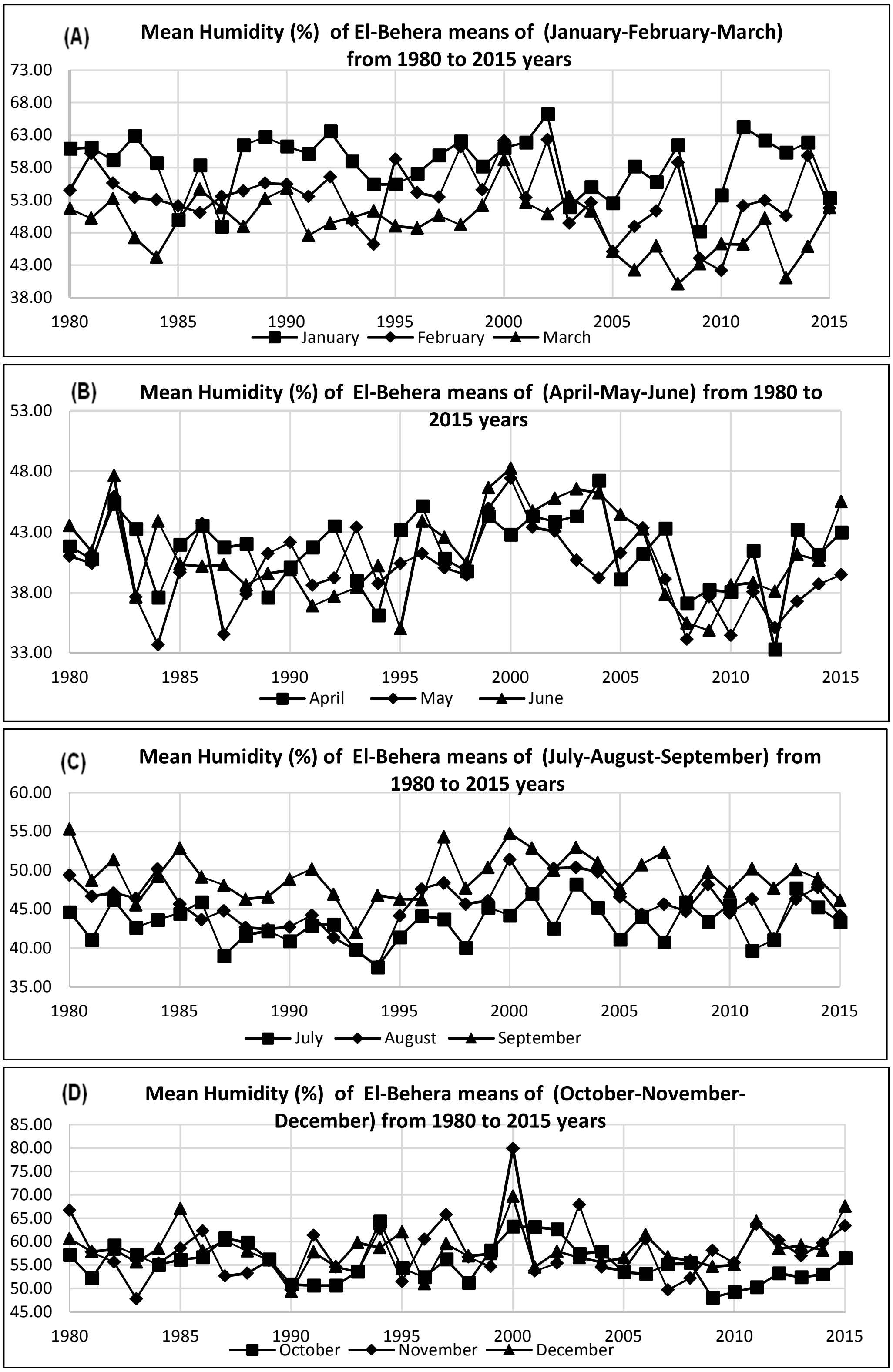


Figure (8 a,b,c and d): Monthly relative humidity of El-Behira from 1980 to 2015.

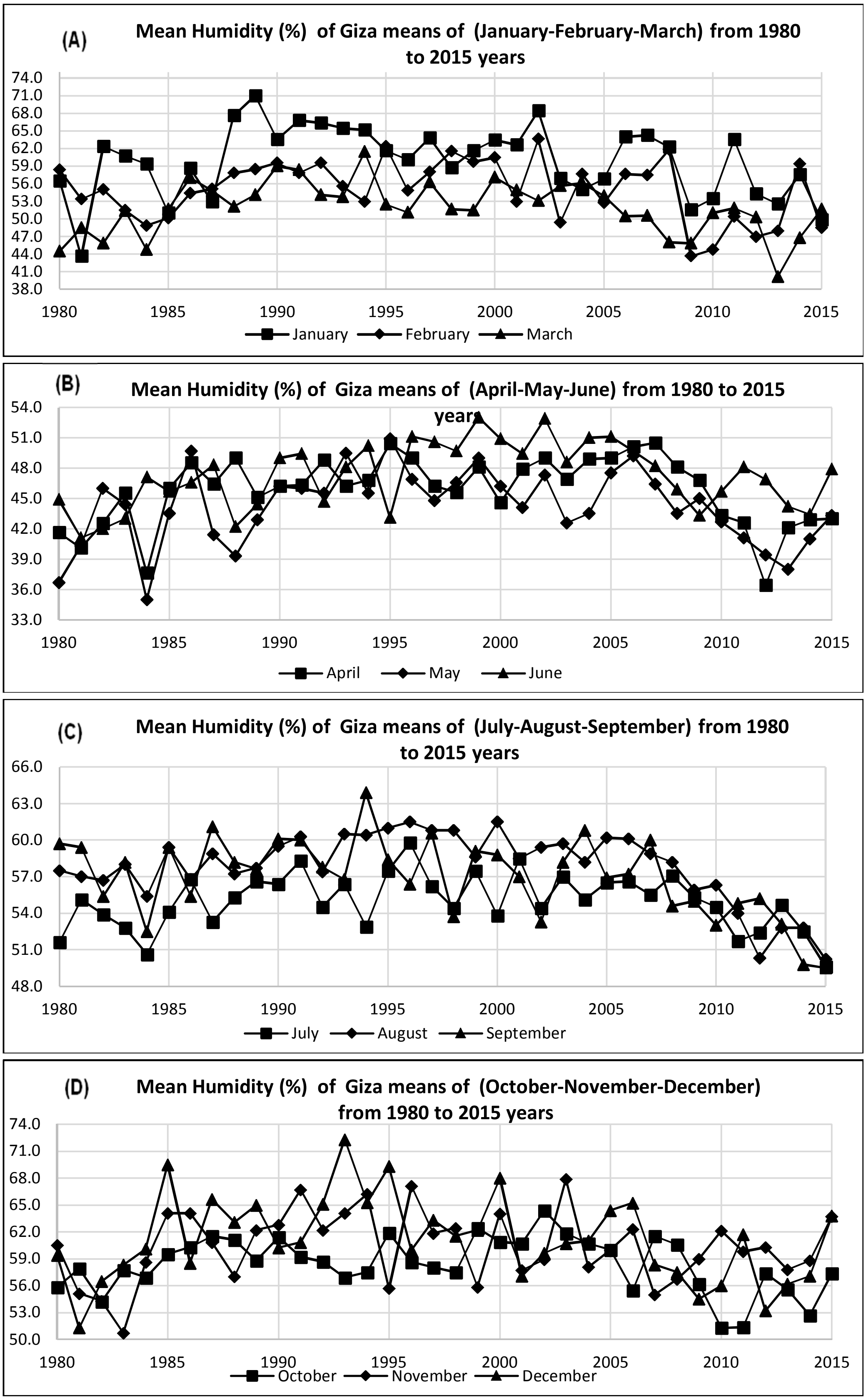


Figure (9a,b,c and d): Monthly relative humidity of Giza from 1980 to 2015.

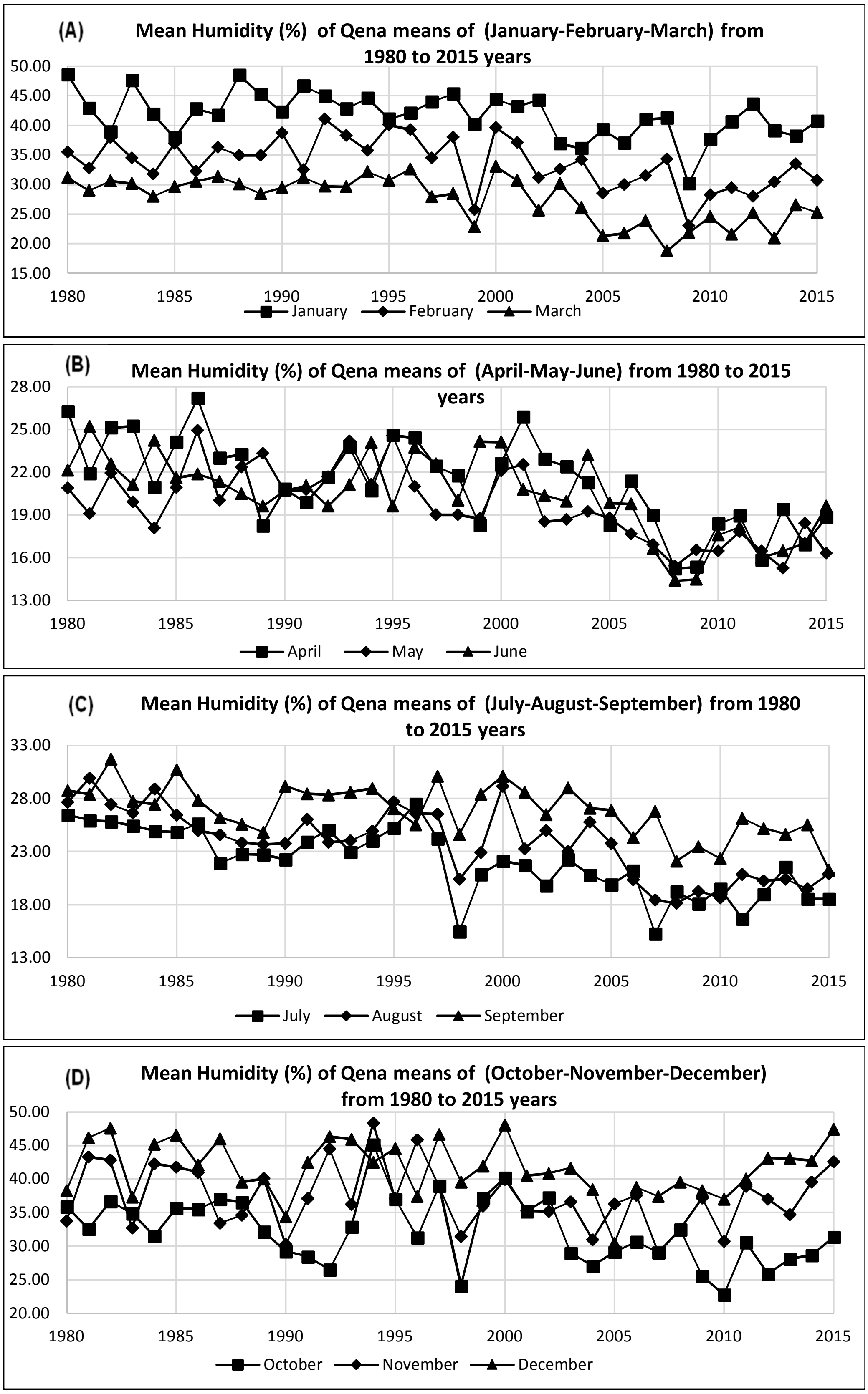


Figure (10a,b,c and d): Monthly relative humidity of Qena from 1980 to 2015.

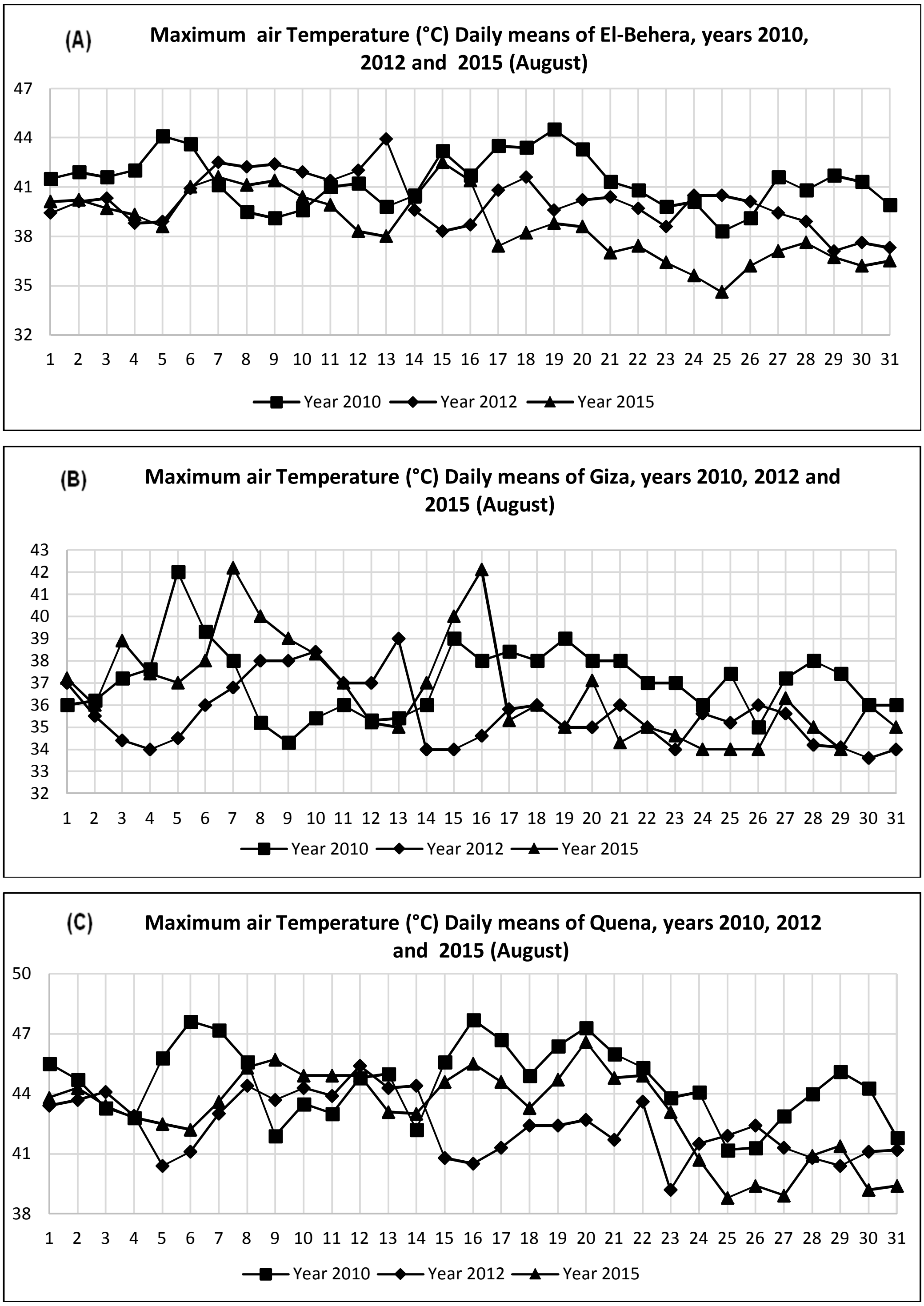
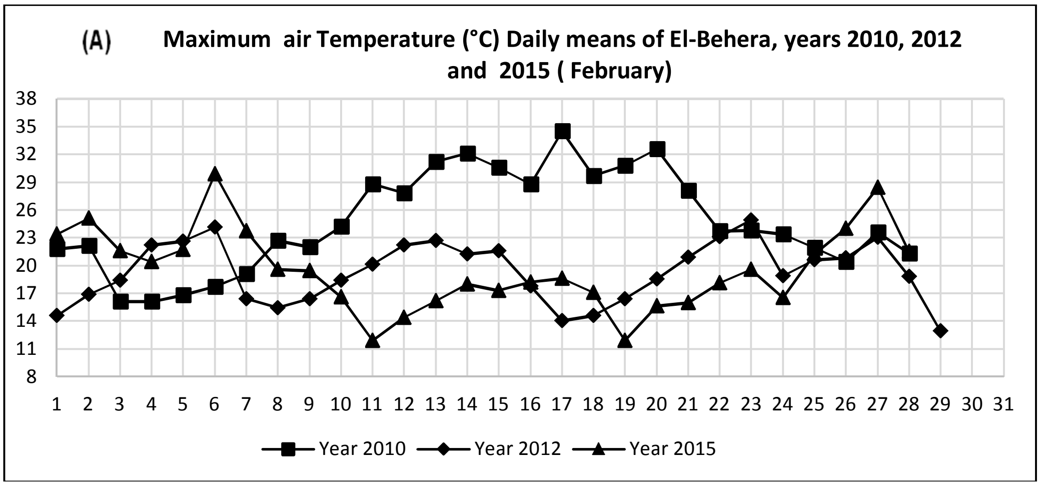
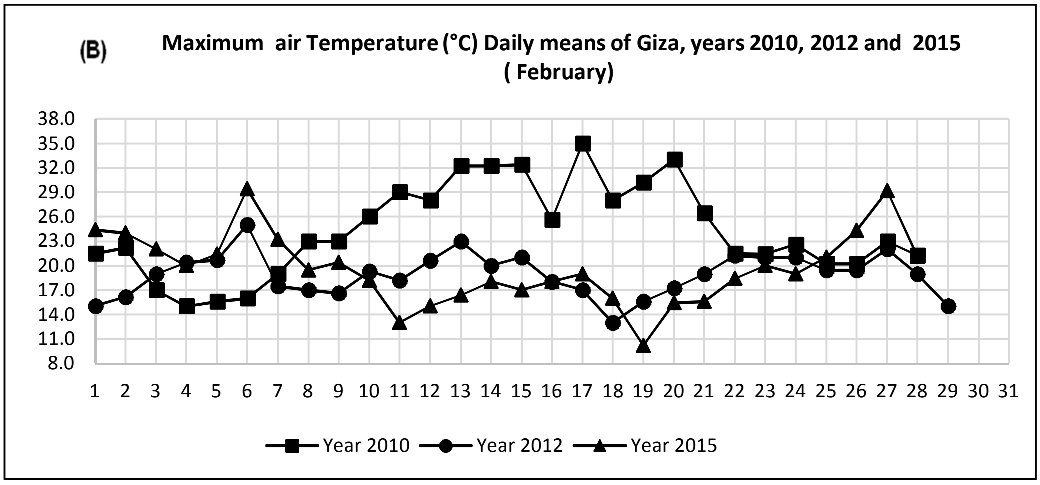


Figure (11a,b,c and d):Heat waves events during summer season (August) 2010, 2012 and 2015 years in El-Behira, Giza and Qena Governorates.





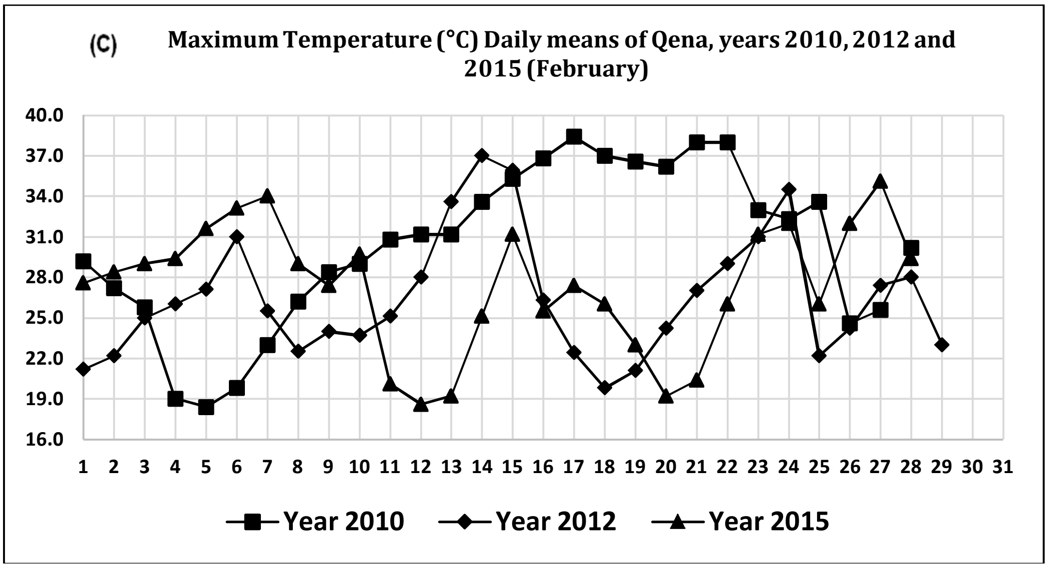


Figure (12a,b,c and d): Heat waves events during winter season (August) 2010, 2012 and 2015 years in El-Behira, Giza and Qena Governorates.

Standard deviation of maximum air temperature from 1980 to 2015

Data in Tables (2, 3 and 4) show the standard deviation analysis for maximum air temperature from the average for 1980 till 2015. Data show that there are significant values during most of years. The highest significant months were during 2010 in the different study areas; most months during 2010 are higher than the mean maximum air temperature. The second most significant year is 2014. Finally, August, September and October of 2015 had the most significant maximum air temperature. It is clear, the frequency of heat waves increased during the last five years than before. During 2010,2013 and 2014 heat waves was in winter and summer season; also heat waves was during 2010 during both winter and summer season. During 2010, 2012 and 2015 heat waves was during the summer season, the other heat waves was between the summer and winter season, didn't make significant harm for the agriculture activities. The most effective heat waves were during winter season of 2010 and during summer season of 2015 which happened during the critical stage of the major crops (wheat in winter and maize in summer). Not all significant values indicate strong heat waves events because the statistical analysis didn't show the value of the deviation of maximum air temperature. Above figures plus the statistical analysis can guide us for that the last five years had higher frequency of heat waves than the period of 1980 to 2009.

Table 2. Comparison of mean maximum temperature monthly records for each year from 1980 to 2015 for El-Behira governorate with value of the equation (overly Mean+SD)

Years	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1980	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	*	NS
1981	NS	NS	NS	*	NS	NS	NS	NS	NS	*	NS	*
1982	NS	NS	NS	NS	NS	NS	NS	NS	NS	*	NS	NS
1983	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	*	*
1984	NS	*	NS	NS	*	NS	NS	NS	NS	NS	NS	NS
1985	NS	NS	NS	NS	*	NS	NS	NS	NS	NS	*	NS
1989	NS	NS	NS	*	NS	NS	NS	NS	NS	NS	NS	NS
1990	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	*	NS
1993	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	*
1994	NS	NS	NS	*	NS	NS	NS	NS	NS	*	NS	NS
1996	NS	NS	NS	NS	NS	NS	NS	NS	*	NS	NS	*
1997	*	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1998	NS	NS	NS	*	NS	NS	NS	*	*	NS	NS	NS
2001	NS	NS	*	NS	NS	NS	NS	NS	NS	NS	NS	NS
2002	NS	NS	NS	NS	NS	NS	*	NS	*	NS	NS	NS
2003	*	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2007	NS	NS	NS	NS	NS	NS	*	NS	NS	NS	*	NS
2008	NS	NS	*	*	NS	*	NS	NS	NS	NS	*	*
2009	*	*	NS	NS	NS	*	*	NS	NS	*	NS	*
2010	*	*	*	NS	NS	NS	NS	*	*	*	*	*
2011	NS	NS	NS	NS	NS	NS	*	NS	*	NS	NS	NS
2012	NS	NS	NS	NS	*	NS	*	*	NS	*	*	NS
2013	NS	*	*	NS	*	*	NS	*	NS	NS	*	NS
2014	*	*	*	*	*	*	NS	*	*	NS	NS	*
2015	NS	NS	NS	NS	NS	NS	NS	*	*	*	NS	NS
Mean**	**18.42**	**18.78**	**20.78**	**24.13**	**26.62**	**28.86**	**30.12**	**30.71**	**29.98**	**27.64**	**23.87**	**20.20**
SD	**1.25**	**1.30**	**1.42**	**1.13**	**1.19**	**0.95**	**0.88**	**0.95**	**1.01**	**0.97**	**1.21**	**1.21**

Where: **: Mean maximum temperature in the months, NS: the yearly record per each month is filling within the range of less than or equal to (Mean + SD, *: the yearly record per each month is more than the value of (Mean + SD) and SD: Standard deviation

Table 3. Comparison of mean maximum temperature monthly records for each year from 1980 to 2015 for Giza governorate with value of the equation (overly Mean+SD)

Years	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1981	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	*
1984	NS	NS	NS	NS	*	NS	NS	NS	NS	NS	NS	NS
1985	*	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1986	NS	*	NS	*	NS	NS	NS	NS	NS	NS	NS	NS
1987	NS	*	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1988	NS	NS	NS	NS	*	*	*	NS	NS	NS	NS	NS
1989	NS	NS	NS	*	NS	NS	NS	NS	NS	NS	NS	NS
1990	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	*	*
1993	NS	NS	NS	NS	NS	NS	NS	NS	NS	*	NS	NS
1994	NS	NS	NS	*	NS	NS	NS	NS	NS	*	NS	NS
1996	NS	NS	NS	NS	*	NS	NS	NS	*	NS	NS	NS
1998	NS	NS	NS	NS	NS	NS	NS	*	*	NS	NS	NS
2000	NS	NS	NS	*	NS	NS	*	NS	NS	NS	NS	NS
2001	NS	NS	*	NS	NS	NS	NS	NS	NS	NS	NS	NS
2002	NS	NS	NS	NS	NS	NS	*	NS	*	NS	NS	NS
2003	*	NS	NS	NS	*	NS	NS	NS	NS	NS	NS	NS
2007	NS	NS	NS	NS	NS	NS	*	NS	NS	NS	*	NS
2008	NS	NS	*	NS	NS	*	NS	*	*	NS	*	*
2009	*	*	NS	NS	NS	*	*	NS	NS	*	NS	*
2010	*	*	*	NS	NS	*	NS	*	*	*	*	*
2011	NS	NS	NS	NS	NS	NS	*	NS	NS	NS	NS	NS
2012	NS	NS	NS	*	NS	NS	*	*	NS	NS	NS	NS
2013	NS	*	*	NS	*	NS	NS	NS	NS	NS	NS	NS
2014	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	*
2015	NS	NS	NS	NS	NS	NS	NS	*	*	NS	NS	NS
Mean	**19.0**	**20.3**	**23.5**	**28.0**	**32.0**	**34.5**	**34.8**	**34.7**	**33.2**	**29.8**	**24.8**	**20.5**
SD	**1.44**	**1.41**	**1.73**	**1.27**	**1.19**	**0.88**	**0.81**	**0.88**	**0.99**	**1.25**	**1.36**	**1.20**

Where: **: Mean maximum temperature in the months, NS: the yearly record per each month is filling within the range of less than or equal to (Mean + SD, *: the yearly record per each month is more than the value of (Mean + SD) and SD: Standard deviation

Table 4. Comparison of mean maximum temperature monthly records for each year from 1980 to 2015 for Qena governorate with value of the equation (overly Mean+SD)

Years	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1980	NS	NS	NS	NS	NS	*	NS	NS	NS	NS	NS	NS
1984	NS	NS	NS	NS	*	NS	NS	NS	NS	NS	NS	NS
1985	*	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1990	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	*
1993	NS	NS	NS	NS	NS	NS	NS	NS	NS	*	*	*
1994	*	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1995	NS	NS	NS	NS	NS	*	NS	NS	*	NS	NS	NS
1996	NS	NS	NS	NS	*	NS	NS	NS	*	NS	NS	NS
1998	NS	NS	NS	NS	NS	NS	NS	*	*	NS	NS	NS
1999	NS	*	NS	*	NS	NS	NS	NS	NS	NS	NS	NS
2000	NS	NS	NS	*	NS	NS	*	NS	NS	NS	NS	NS
2001	NS	NS	*	NS	NS	NS	NS	NS	NS	NS	NS	NS
2002	NS	*	NS	NS	NS	NS	*	NS	*	NS	NS	NS
2003	NS	NS	NS	NS	*	NS	NS	NS	NS	NS	NS	NS
2004	NS	NS	NS	NS	*	NS	NS	NS	NS	NS	NS	NS
2005	NS	NS	NS	NS	NS	NS	NS	*	NS	NS	NS	*
2006	NS	NS	NS	NS	NS	*	NS	*	NS	NS	NS	NS
2007	NS	NS	NS	NS	NS	NS	NS	NS	NS	*	NS	NS
2008	NS	NS	*	NS	NS	*	NS	NS	*	NS	NS	*
2009	*	NS	NS	*	NS	*	*	NS	NS	*	NS	NS
2010	*	*	*	*	NS	*	NS	*	*	*	*	*
2011	NS	NS	NS	NS	NS	NS	*	NS	NS	NS	NS	NS
2012	NS	NS	NS	*	NS	*	*	NS	NS	*	*	NS
2013	NS	*	*	NS	*	*	NS	NS	NS	NS	*	NS
2014	*	NS	*	*	NS	NS	NS	*	NS	NS	NS	*
2015	NS	NS	NS	NS	NS	NS	NS	*	*	*	NS	NS
Mean	**22.94**	**25.16**	**29.70**	**35.03**	**39.01**	**41.19**	**41.45**	**41.29**	**39.57**	**35.62**	**29.15**	**24.31**
SD	**2.113**	**2.350**	**2.207**	**1.424**	**1.467**	**0.882**	**1.075**	**1.319**	**1.259**	**1.709**	**1.982**	**2.000**

Where: **: Mean maximum temperature in the months, NS: the yearly record per each month is filling within the range of less than or equal to (Mean + SD, *: the yearly record per each month is more than the value of (Mean + SD) and SD: Standard deviation

Production of wheat and maize crops during most severe heat waves events

Data in Tables (5) show the production of some winter crop (wheat) in El-Behira Giza and Qena from 2008 to 2013 (during hottest heat waves during last ten years). North Delta (El-Behira Governorate) had the highest production values during all years followed by Middle Egypt (Giza Governorate; while the lowest production was recorded in Upper Egypt (Qena Governorate). The lowest production (Ton per Feddan) was recorded during 2010 (the highest winter heat wave event). The average production of the selected years was 2.85, 2.83 and 2.5 ton /Feddan for El-Behira, Giza and Qena, respectively. The production of wheat during 2010 was lower than the average by 8.5, 8.0 and 35% in El-Behira, Giza and Qena, respectively. It is clear, that production of wheat decline sharply in Upper Egypt because of heat wave events. This data revealed that, the heat waves during winter season of 2010 reduced productivity by different values in the different climatic regions. Regarding data in Table (5) related to the annual production of maize in El-Behira, Giza and Qena governorates. The highest production was recorded in 2013 season compared to the maize production in the other years from 2010 till 2015. This data matching with the monthly air temperature data (Figures, 1, 2 and 3); the lowest maximum air temperature during summer season (especially during August) where recorded in 2013.The lowest maize production (Ton per Feddan) was recorded during 2015 (the highest summer heat wave event). The average maize production of the selected years was 3.43, 3.35 and 1.7 ton /Feddan for El-Behira, Giza and Qena, Respectively. The production of maize during 2015 was lower than the average by 8.2, 9.1 and 15.1 % in for El-Behira, Giza and Qena, Respectively. From these data we can say the most vulnerable area for heat waves is the Upper Egypt region maybe because the air temperature in this region is already higher than the other areas; and then with heat waves events the production decline sharply because plants in this area face high heat stress conditions (abdrabbo, *et al.*, 2015 and Farag, *et al.*, 2015). The high temperature with low relative humidity cause of high water requirements and drought events in the Upper Egypt (abdrabbo et al., 2013).

Table 5. Productivity (Ton /Fed.) of wheat and maize under the heat waves events in El-Behira, Giza and Qena Governorates.

Productivity Ton /feddan for Winter crops							
Corps	Governorates	Years					
		2008	2009	2010	2011	2012	2013
Wheat	El-Behira	3.052	2.846	2.618	2.821	2.895	2.925
	Giza	2.958	2.951	2.618	2.601	2.975	2.913
	Qena	2.542	2.501	1.615	2.845	2.828	2.725
Pro Productivity Ton /feddan for Summer crop							
Corp	Governorates	Years					
		2010	2011	2012	2013	2014	2015
Maize (white and corn crop)	El-Behira	3.62	3.74	3.75	4.17	3.73	3.43
	Giza	3.79	3.60	3.60	4.13	3.65	3.35
	Qena	1.73	1.77	2.19	2.41	2.24	1.70

Source: Periodical statistical reports from Egyptian Ministry of Agriculture and Land Reclamation from 2008 to 2015.

CONCLUSION

This study investigated the heat waves events from 1980 to 2015 for different climatic regions in Egypt. The highest heat waves events during winter were recorded during 2010; whereas the highest summer heat waves were recorded during 2015. The production of two of the major cereal crops in Egypt during the heat wave events was investigated. The highest reduction of productivity for wheat and maize was recorded in Upper Egypt region. Further studies are needed for the socioeconomic consequences of the reduction of productivity.

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دراسة الموجات الحرارية خلال العقود الماضية في مختلف المناطق المناخية في مصر

سمير محمود صالح ، محمد عبد المحسن حجي ، محمد عبدربه ، أحمد عوني أحمد فرج

المعمل المركزي للمناخ الزراعي – مركز البحوث الزراعية – الدقي – الجيزة

مرت مصر بظواهر جوية شديدة التطرف خلال العقود الماضية ، وكانت الموجة الحرارية الاكثر خلال فصل الشتاء ٢٠١٠ وفصل الصيف ٢٠١٥ ، وتغيرالمناخ العالمي لة آثاره خطيرة على الزراعة في المستقبل ، وكان الهدف من البحث هو دراسة الموجات الحرارية خلال الفترة من ١٩٨٠ وحتى ٢٠١٥ في محافظات مصر ، وتمثلت المناطق الرئيسية المناخية الزراعية في هذا البحث؛ شمال الدلتا ويمثلها محافظة البحيرة، مصر الوسطى ويمثلها محافظة الجيزة، وجنوب صعيد مصر ويمثلها محافظة قنا، وتم دراسة الحد الأقصى والأدنى الشهري من درجة حرارة لجميع المحافظات خلال للفترة من ١٩٨٠ حتى ٢٠١٥ ، وسجلت أعلى درجة حرارة الشهرية عظمى فيفصل الصيف في أغسطس ٢٠١٥ وتليها أغسطس ٢٠١٢ ، وكانت محافظة قنا أعلى درجة حرارة عظمى يليها محافظة الجيزة بينما سجلت أقل درجة حرارة عظمى في محافظة البحيرة، وكان التحقيق في درجة حرارة العظمى اليومية للأعلى أشهر لتحديد الفترة الشديدة وموجات الحرارة خلال هذه الأشهر المعنية من ناحية أخرى سجلت أعلى موجات الحرارة الشديدة فيفصل الشتاء من عام ٢٠١٠ للمحافظات المختارة ، بالإضافة إلى ذلك تم جمع المعدل الشهري لنسبة الرطوبة النسبية لنفس المحافظات المعنية. وتبين ان إنتاجية اثنين من محاصيل الحبوب الرئيسية في مصر خلال الموجات الحرارة قد سجل أعلى موجة فى موسم الصيف والشتاء . واعلى انخفاض انتاجية مسجل لمحصولى القمح شمال الدلتا والذرة في اقليم الصعيد مصر ثم مصر الوسطى بينما (شمال الدلتا) اقل انخفاض انتاجية مسجل فى القمح (موسم شتوى) والذرة (موسم صيفى).