# Seasonal variability of precipitation and temperature over Egypt during 2014 using Climate Monitoring Tool (CMT)


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## Introduction


**Keywords:** North Atlantic Oscillation; Oceanic Nino Index; Climate Monitoring tool; Seasonal variability; Egypt

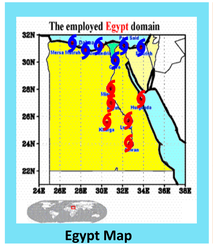

Climate Monitoring Tool (CMT) is used to generate time series and spatial analysis of both rainfall and temperature at different time scales for 12 Egyptian climate stations. The daily mean observations and monthly mean reanalysis data during the period 1974-2014 are used to discuss climatic distribution of precipitation and temperature over Egypt. This article aims at detecting the behavior of winter and summer season in 2014 with respect to climate base period of 1981-2010 for observations. The study also investigates correlations between the NAO, ONI and precipitation, temperature in both north and south of Egypt during the winter and summer seasons. The results showed that, 2014 was characterized by a sequence of warm waves during the winter and summer seasons. Precipitation was marked by a strong regional disparity with a rainfall deficit in the south and surplus in the north. Finally, Overall, precipitation was below normal and the temperature was above-normal in 2014 based on climatology period (1981-2010).

## Method

The climate monitoring tool (CMT) is developed to improve data in NOAA/Climate Prediction Center/ International Desks. In this study CMT uses as analytical tools capable of simulating and generation of data for weather/climate monitoring purposes.

**Observed mechanisms include:**

**Table 1 The data used in this study**

| location 12 stations over north and south Egypt | Type | Period | Resolution | Variables |
|---|---|---|---|---|
|   Egypt Map | ASCII file<br>Data for climate monitoring tool (CMT) | daily and monthly data 1974-2014 | Scattered stations exact coordinates | * t2m, t2max, t2min (°C), and precip (mm) EMA & http://en.tuiempo.net |
| | | monthly data 1974-2014 | exact coordinates | * North Atlantic oscillation index (NAO)<br>* Oceanic Nino Index (ONI) |

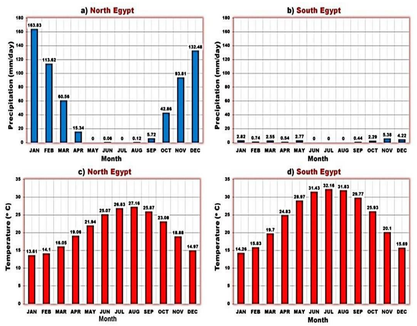



Figure (1c) is the same as figure (1a) but for mean temperature of the first six stations in the north of Egypt. The figure illustrates that, the maximum temperature occurs in summer season (JJA) with values of 27.2o C in August in the northern Egypt. The higher values of temperature over the following six stations in the southern part of Egypt occur in July, one month earlier than the stations in the northern Egypt, with values as high as 32.16 o C, as shown in figure (1d).

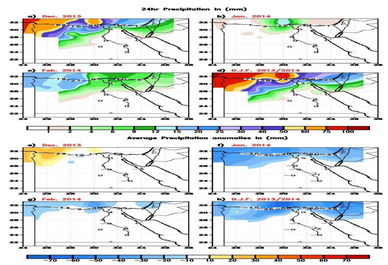
**Fig. 1: Observed monthly accumulated precipitation over north Egypt (a), and southern Egypt (b). Observed monthly mean temperature over north Egypt (c), and southern Egypt (d), averaged over the period 1981-2010**

## Results

**Table 2 Years classified using the value of SPI. Percentage frequency is detailed climatoclimatology period (1981-2010)**

| EGYPT | Category | Definition | Frequency (%) North | Years (41) (north) 1974-2014 | Frequency (%) South | Years (41) (south) 1974-2014 |
|---|---|---|---|---|---|---|
| DRY CASES | Extreme | SPI9 < -2 | 0 | - | 0 | - |
| | Severe | -2 < SPI9 < -1.5 | 2.44 | 2009/2010 | 0 | - |
| | Moderate | -1.5 < SPI9< -1 | 14.63 | 1976/1977, 1978/1979, 1983/1984, 1998/1999, 2008/2009, 2010/2011 | 0 | - |
| | Slight | -1 < SPI9 < -0.5 | 14.63 | 1981/1982, 1986/1987, 1993/1994, 1995/1996, 2011/2012, 2013/2014 | 43.9 | 1975/1976, 1976/1977, 1977/1978, 1979/1980, 1980/1981, 1981/1982, 1982/1983, 1983/1984, 1984/1985, 1986/1987, 1995/1996, 1997/1998, 2000/2001, 2002/2003, 2005/2006, 2006/2007, 2008/2009, 2011/2012 |
| NORMAL CASES | Normal | -0.5 < SPI9< 0.5 | 43.9 | 1975/1976, 1979/1980, 1980/1981, 1984/1985, 1985/1986, 1989/1990, 1990/1991, 1994/1995, 1996/1997, 1997/1998, 1999/2000, 2000/2001, 2002/2003, 2004/2005, 2005/2006, 2006/2007, 2007/2008, 2012/2013, | 34.15 | 1973/1974, 1978/1979, 1987/1988, 1989/1990, 1991/1992, 1992/1993, 1994/1995, 1998/1999, 1999/2000, 2001/2002, 2003/2004, 2004/2005, 2009/2010, 2013/2014 |
| WET CASES | Slight | 0.5 < SPI9< 1 | 9.76 | 1973/1974, 1977/1978, 2001/2002, 2003/2004 | 2.44 | 1993/1994 |
| | Moderate | 1 < SPI9 < 1.5 | 9.76 | 1974/1975, 1982/1983, 1987/1988, 1992/1993 | 7.32 | 1985/1986, 1988/1989, 1996/1997 |
| | Severe | 1.5 < SPI9 < 2 | 2.44 | 1988/1989 | 0 | - |
| | Extreme | SPI9 > 2 | 2.44 | 1991/1992 | 12.2 | 1974/1975, 1990/1991, 2007/2008, 2010/2011, 2012/2013 |

Drought and wet years classification for the rainy season (DJF), according to McKee (1993) is shown in table (2). Based on this the table, 2013/2014 is classified under slightly below normal rainfall category for northern, and normal category for southern Egypt.




Monthly and seasonal total precipitation and their anomalies during the winter season of year 2013/14 are illustrated in figure (2). Normally heavy rainfall events occur in January, while the largest rainfall was recorded during December 2013 of the winter season of 2013/14 over Egypt as in figure 2 (a, e). Overall, winter precipitation was below average by -39.3 % over the northern sector of the region. Mersa Matruh station in Egypt received 87.9 percent above normal rainfall in December 2013. Accumulated daily precipitation is analyzed using CMT for six stations over northern Egypt, which is represented in figure (3) left. The results of the CMT analysis using daily rainfall is consistent with results discussed in the previous paragraph. Accumulated daily precipitation is below normal along winter season of 2013/14 except Mersa Matruh and Port Said stations, which received above normal rainfall during December. Analysis over the remaining six stations from southern Egypt is shown in figure in figure (3) right. All stations in southern Egypt had below normal rainfall, except Hurguada station, which received above normal during winter.

**Fig. 2: Monthly mean rainfall (mm) for Egypt during (a) Dec 2013, (b) Jan 2014, (c) Feb 2014, and (d) DJF 2013/14 and rainfall anomalies (mm) for the same months, according to climatic period (1981–2010**

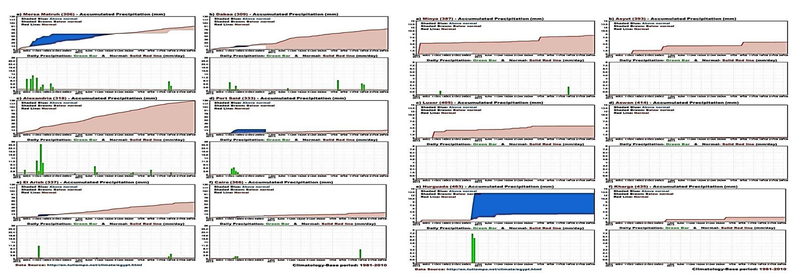


**Fig. 3: CMT analysis of observed daily and accumulated precipitation at 12stations in northern Egypt during Dec-Jan-Feb (DJF) 2013/14 based on climatology period from 1981 to 2010**

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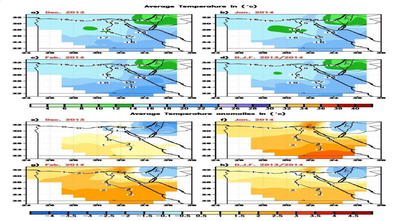
## Results contd.



Monthly and seasonal average temperature and their anomalies during the winter season of year 2013/14 are illustrated in figure (4). Overall, winter temperature was above normal in all three months over most of the study area except Delta region, which showed below normal temperature in December 2013. The CMT moving daily average temperature analysis over the six stations in northern Egypt figure (5) left shows that temperature was above normal during first 10 days of December 2013, while it remained near normal in the rest of the season. The similar temperature pattern is noticed in southern Egypt during December 2013, with slightly above normal temperature observed toward send of the period as in figure (5) right.

**Fig. 4: Monthly mean rainfall (mm) for Egypt during (a) Dec 2013, (b) Jan 2014, (c) Feb 2014, and (d) DJF 2013/14 and rainfall anomalies (mm) for the same months, according to climatic period (1981–2010**

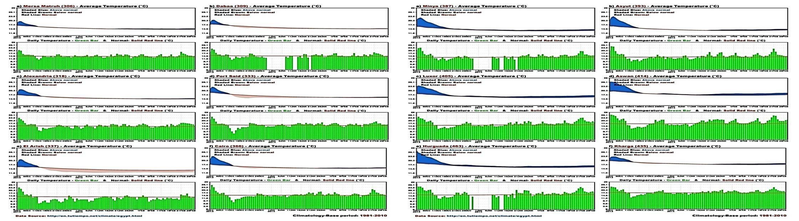
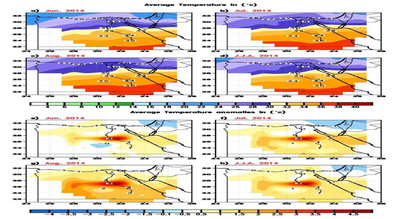


**Fig. 5: CMT analysis of observed daily and accumulated precipitation at 12stations in northern Egypt during Dec-Jan-Feb (DJF) 2013/14 based on climatology period from 1981 to 2010**



Monthly mean temperature, seasonal average and their anomalies during summer season (JJA) 2014 are illustrated in figure (6). Temperature distribution shows a gradual increase from north to south and ranges from 24° to 36° C in all summer months. Temperature anomaly shows that, the area of study is above normal with the maximum surpluses of 4° C in middle Egypt closest to Asyut station. Moving daily average temperature near normal according to CMT, based analysis over northern stations figure (7) left. While Asyut station, records significant above normal temperature as compared to the other stations in southern Egypt as shown in figure (7) right.

**Fig. 6: Monthly mean rainfall (mm) for Egypt during (a) Dec 2013, (b) Jan 2014, (c) Feb 2014, and (d) DJF 2013/14 and rainfall anomalies (mm) for the same months, according to climatic period (1981–2010**

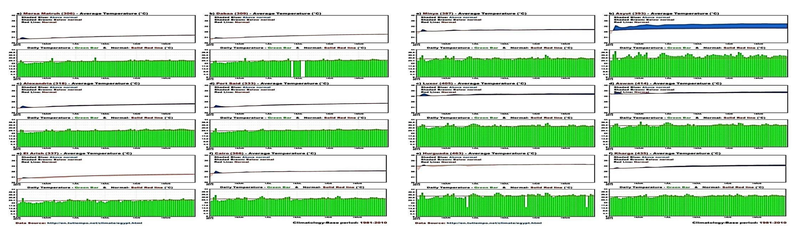


**Fig. 7: CMT analysis of observed daily and accumulated precipitation at 12stations in northern Egypt during Dec-Jan-Feb (DJF) 2013/14 based on climatology period from 1981 to 2010**

## Conclusion

The CMT tool is run using daily observation to analyses the evolution of rainfall, temperature in a given season. In general, below normal precipitation and above-normal temperature was observed over Egypt during the year 2014.

## References


Ebrahim, Awatif, Tarek Sayad, and Fathy M. El-Hussainy. ipitation and Temperature over Egypt During 2014 Using Climate Monitoring Tool (CMT)." *EnvironmentAsia* . Volume 13 Number 2 (May 2020)