First Report

Climatology of Nile Delta, Egypt

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The Climatology of Nile Delta, Egypt

1. Introduction

Weather is the condition of the atmosphere over a brief period of time. For example, we speak of today's weather or the weather this week. Climate represents the composite of day-to-day weather over a longer period of time. Climate is usually defined by what is expected or "normal", which climatologists traditionally interpret as the 30-year average. By itself, "normal" can be misleading unless we also understand the concept of variability.

A climatologist attempts to discover and explain the impacts of climate so that society can plan its activities, design its buildings and infrastructure, and anticipate the effects of adverse conditions. Although climate is not weather, it is defined by the same terms, such as temperature, precipitation, wind, and solar radiation. The misconception that weather is usually normal becomes a serious problem when you consider that weather, in one form or another, is the source of water for irrigation, drinking, power supply, industry, wildlife habitat, and other uses. To ensure that our water supply, livelihoods, and lives are secure, it is essential that planners anticipate variation in weather, and that they recognize that drought and flood are both inevitable parts of the normal range of weather. Over Egypt and North Africa, the decrease in annual precipitation that is predicted in the 21st century will exacerbate these effects, particularly in semiarid and arid regions that rely on irrigation for crop growth. These effects of climate change are more dramatic for Tunisia country especially for water resources and arable cropland.

2. Geographical Area of Egypt:

Egypt occupies the northeastern corner of Africa from 22" to 31" North latitude and 24" to 36" East longitude. It is bounded in the east by the Red Sea, in the west by Libya, in the north by the Mediterranean Sea, and in the south by Sudan. The total land area is 997,688 square kilometers that comprise five major geographical regions: the Nile Valley (Upper Egypt, Lower Egypt), the Nile Delta, the Eastern Desert, Sinai, and the Western Desert. These geographical areas are divided into 26 administrative units or governorates that are grouped into four regions: Urban Egypt, Lower Egypt, Upper Egypt, and Frontier Egypt. The Nile Delta is an important economic region. It makes up 60 percent of current agricultural land and is home to over 60 percent of the population. It is the focal point for industry and commerce, bounded by Alexandria in the west, the Suez Canal in the east, and Cairo in the south. Its coastline is currently subsiding due to the loss of Nile sediments to the High Aswan Dam. This results in the potential loss of agricultural land and reduced productivity in coastal lands due to waterlogging and salinity. Egypt is very dependent on natural resources that are vulnerable to climate change. Egypt is vulnerable to the warming and potential changes in agriculture, water and land resources and the local and global agricultural markets that are forecast to accompany greenhouse-gas-induced climate change. A large portion of the arable land is in the Nile Delta and is particularly vulnerable to sea-level rise. Agriculture needs water from the Nile for irrigation which is vulnerable to precipitation and temperature changes within the entire Nile basin. Crop yields and crop water use could be affected by climate change.

3. The Description of Reported Data

Climate data used in this report for several meteorological surface stations were provided from the Egyptian Meteorological Authority (EMA). These data have been processed, tested as far as possible, and these stations distributed over Egypt. Figure (1) shows the distribution of the meteorological stations which used for the new normal book.

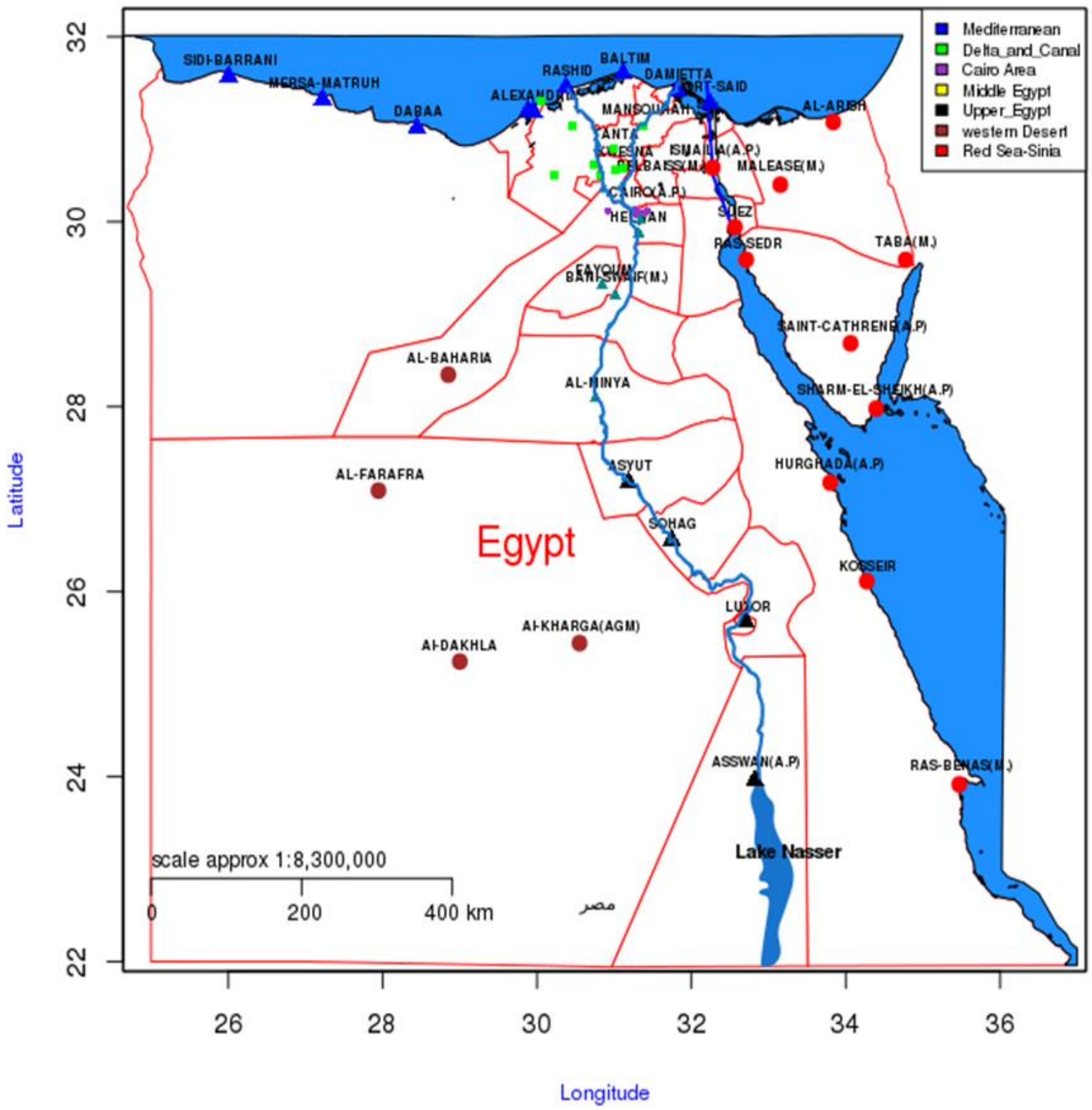

Figure 1: Some of the meteorological measurement sites in Egypt

4. Description of the meteorological variables used in this report:

The normal of monthly mean sea level pressure, relative humidity, mean temperature, maximum and the minimum temperature of the day beside the normal of total sum of the rain in month are calculated during the period of 1981-2010. The absolute values of the maximum and the minimum temperature and precipitation and the extreme values of maximum and the minimum temperature and precipitation in the past 30 years with the day of the event are taken.

4-1 Atmospheric Pressure: The monthly normal values of the atmospheric pressure corrected to Mean Sea Level (M.S.L) pressure are computed from their corresponding daily routine values observed at 24 hours over the month. The atmospheric pressure is measured by mercury barometers installed indoors. M.S.L pressure is the barometer reading corrected for the height of the barometer cistern above or below M.S.L at the station.

4-2 Relative Humidity: The monthly normal values of the relative humidity are computed from their daily routine values derived over 24 hours during the month. The relative humidity is derived from the dry and wet bulb thermometer readings using Jellink's psychomotor tables.

4-3 Air Temperature: The monthly normal values of the maximum and the minimum air temperatures are computed from their corresponding daily routine values observed over the month. The maximum (mercury) and the minimum (alcohol) thermometers are freely exposed in the louvered screens with bulbs at a height of 160:170cm above the ground. Dates of absolute maximum and minimum temperatures are included for actual occurrences.

4-4 Rainfall: The monthly total rainfall is the total rainfall during the month. The maximum rainfall in one day and date of occurrences are also included.

5. Terminology and definitions of different Weather phenomena:

Here we will describe the parameters in Tables (1, 2, 3, and 4). The frequency of weather phenomenon was calculated from daily data to represent the average number of event occurrence per days in every month during the period from 1981-2010.

5.1A day of rain is the day during which the total amount of rainfall is 0.1mm or more.

5.2A day of snow is the day during which snow, snowflakes, or snow shower is/are observed even if is so small in quantity in the rain-gauge.

5.3 A day of ice pellets is the day during which ice pellets are observed even if they are as small in quantity as to yield no measurable amounts of precipitation in the rain-gauge.

5.4A day of hail is the day during which either one or more of the following types of precipitation is/are observed even if they are so small in quantity as to yield no measurable precipitation in the rain gauge; Soft hail, Small hail, and Hail stone.

5.5A day of thunderstorm is the day during which thunder is heard at the station whether lightning is seen or not. A day on which lightning is seen but thunder is not heard at the station is not counted as a day of thunderstorm.

5.6 A day of mist or haze is the day during which the surface horizontal visibility at the station has deteriorated and became 1000-2000 meters or more due to mist or haze.(in case of mist relative humidity more than 75% but in case of haze less than75%).

5.7 A day of fog is the day during which the surface horizontal visibility at the station has deteriorated and fell below 1000 meters due to the fog.

5.8 A day of rising sand or rising dust is the day during which the horizontal visibility at the station has deteriorated and became between 1000-2000 meters or more due to rising sand or rising dust.

5.9 A day of duststorm or sandstorm is the day during which the horizontal visibility at the station has deteriorated and fell below 1000 meters due to dust storms or sandstorms.

5.10 A day of gale is the day during which the mean surface wind speed reached or exceeded 34 knots at the station for at least 10 minutes.

5.11 Number of days of occurrence of rain with amount (≥0.1, ≥1.0, ≥5.0, and ≥10mm) calculated from precipitation daily average and the total value of rain must be equal or greater than ≥0.1 as it includes the rain trace event. The amount of rainfall is normally measured by ordinary rain gauges at height of 90:100cm above the ground.

5.12 The elements used in preparing this table are the mean hourly values of the surface wind speed and the corresponding mean hourly values of direction taken from the daily records of the surface wind instruments installed at the stations. The mean hourly values are extracted for every hour of each day of the month and they refer to period of 60min centered at the hour. The mean monthly values of surface wind speed is the arithmetic mean over the month of daily hourly values.

5.13 The percentage frequencies of the surface wind blowing within the specified ranges of directions (ranges for wind direction are twelve ranges of 30^{o} each, beginning with the range "345^{0}-014^{0}" as being the true north) calculated over the month from their corresponding total monthly frequencies.

5.14 The number in hours of 'Variable' winds is the number of cases when the surface wind showed no definite direction over the period of the 60min centered at the hour or when vane sticking over that period due to the lightness of the wind and not responding to the variation in wind direction in such cases the mean wind speed over this period is normally less than 5 knots. The number in hours of calm winds is the number of cases where the surface wind has a mean speed less than one knot over that period whatever the mean wind direction over the same period.

5.15 Cloudiness, surface wind speed analysis (Percentage frequency of winds blowing within specified limits of speeds). The monthly mean value of the total sky covers at the main synoptic hours of observation are computed from routine observations of the total sky cover at these hours. The monthly mean value of the daily total sky cover is the arithmetic mean over the month of the daily hourly values or of the daily observation taken at the 8 synoptic hours (00, 03, 06, 09, 12, 15, 18, 21) total sky cover is in Oktas.

6. Climate of Egypt

Egypt's climate is semi-desert, characterized by hot dry summers, moderate winters and very little rainfall. The country is characterized by particular good wind regimes with excellent sites along the Red Sea and Mediterranean coasts. The Egyptian summer is hot and dry in most of the country, and humid in the Delta and along the Mediterranean Coast.

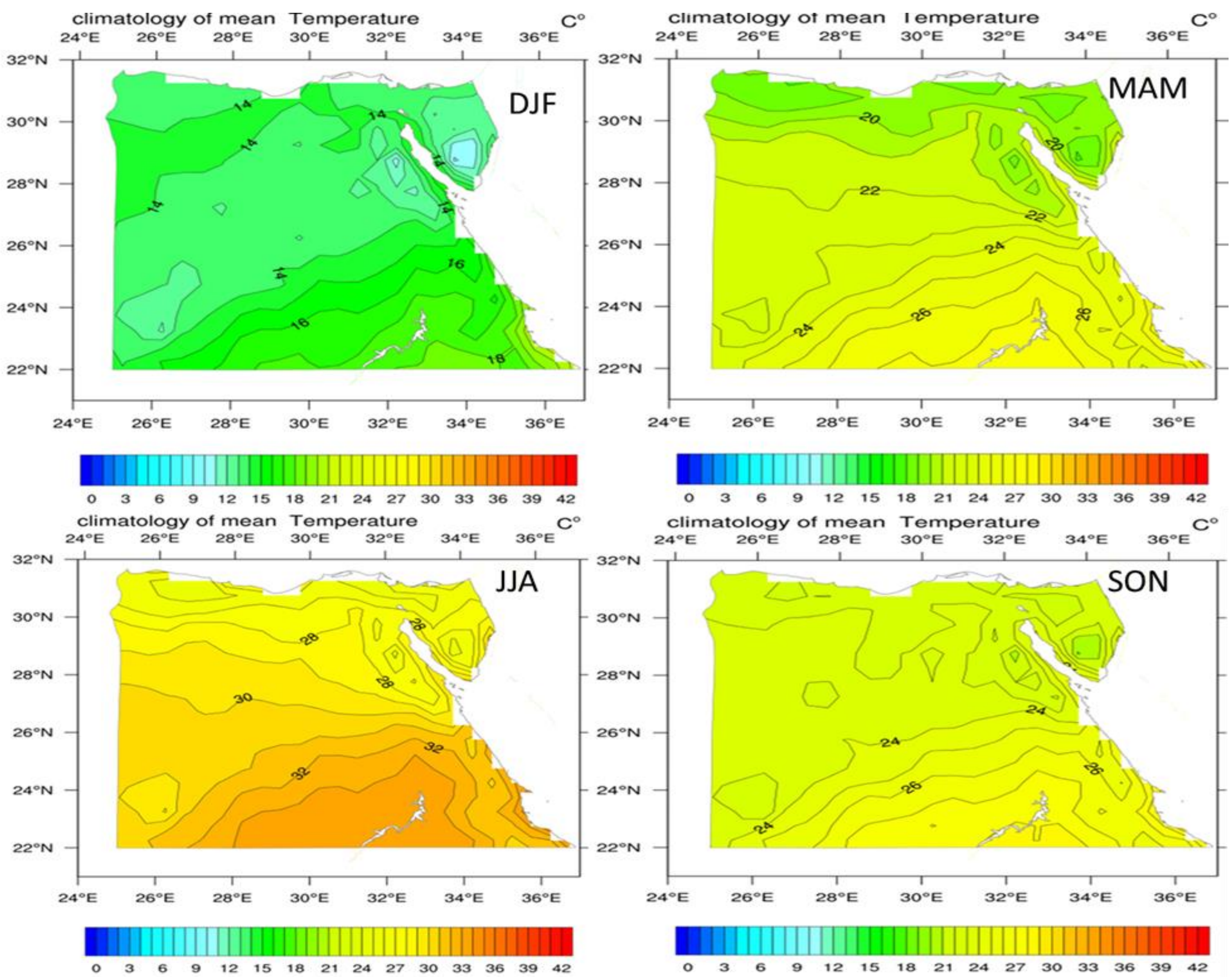

Figure 2: Seasonal Variation of the mean Temperature over Egypt

According to the Koppen definition, the Mediterranean climate is characterized by hot, dry, sunny summers and winter rainy season, in summer (June-July-August:

JJA) the climate is dominant by subtropical anticyclone, and southwest Asian monsoon.

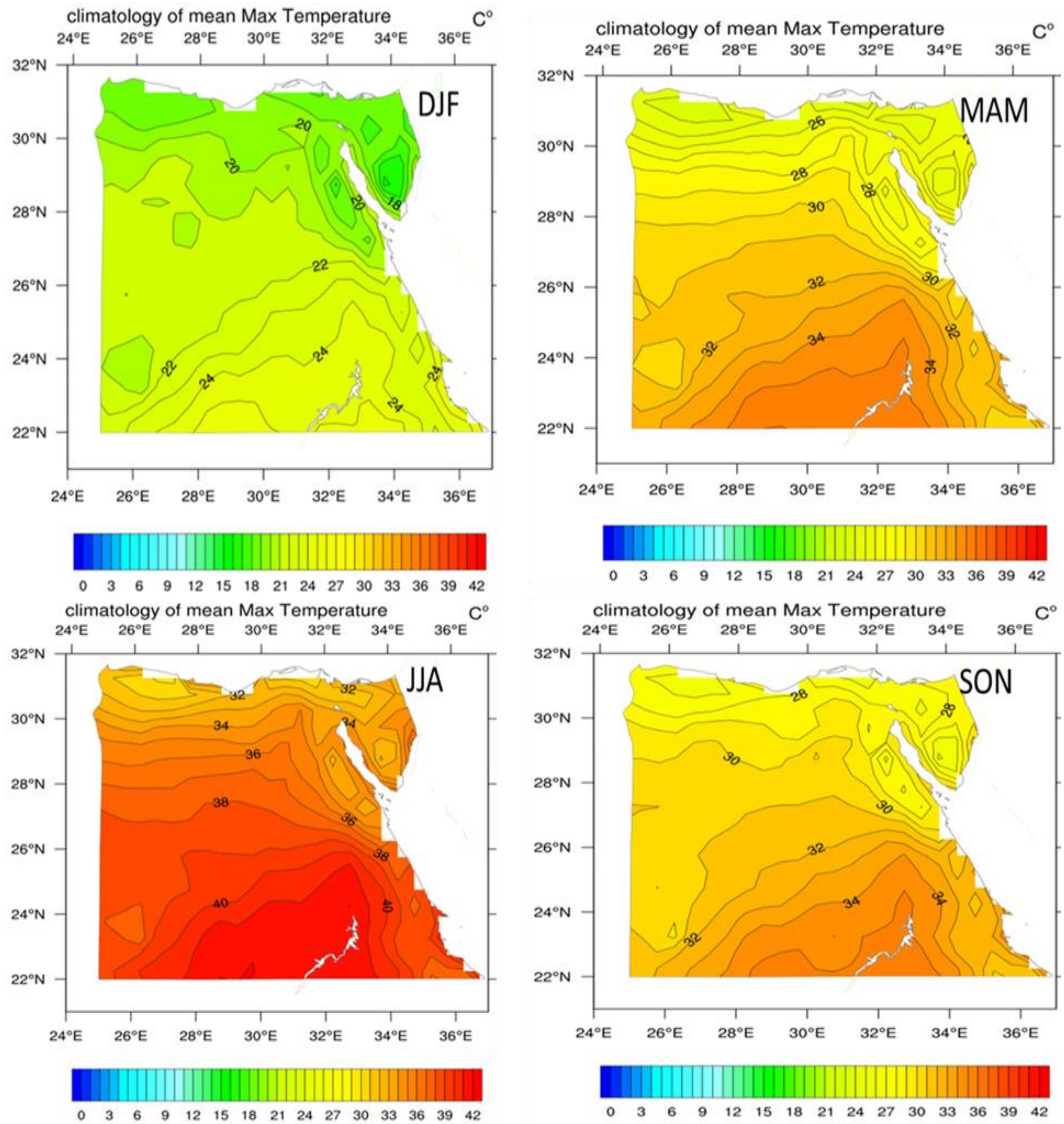

Figure 3: Seasonal Variation of the maximum Temperature over Egypt

The dominant pressure systems which influence the weather and climate over Egypt in different seasons are: In winter (December-January-February: DJF), the polar low-pressure system (Iceland low) and subtropical high pressure are affected weather over Egypt. In summer season (June-July-August: JJA), the low pressure system (Indian monsoon low) and also subtropical high pressure (Azores high) are prevailing, act as swim i.e. when Indian monsoon is dominant the subtropical high pressure is go back and vice versa. In spring (March-April-May: MAM) and autumn season (September-October-November: SON), the desert depression born in the Sahara south of Atlas Mountain and the Sudan monsoon low in the south and may be a Mediterranean low pressure in north are invaded.

As shown in Figure 3, the climate of Egypt is characterized by a hot season from May to October and a cool season from October to May. Extreme temperatures during both seasons are moderated by the prevailing northern winds. Summer season JJA is the hottest season, the general climate of the summer season is hot, dry and rainless. Clear skies often prevail, except for the coastal fair weather cumulus or early morning stratus clouds over across Egypt and disperse a few hours after sunrise. In summer depressions cease to move across Egypt and the weather becomes settled. The steady winds (north or northwest) blow persistently as they are part of the circulation around the huge Asiatic low cantered over north-western India. The climate of lower and middle Egypt is being affected by cool Mediterranean water that warm during the day time and rather cool by night. The maximum effects are obviously in coastal areas where is pleasant. The northeast trade prevail and subside down thus frequently form check the upward diffusion of water vapour and dust, giving raise to the formation of early fog, mist or deposition of dew. In the coastal region average annual temperatures range from a maximum of 37° C to a minimum of 14° C.

Wide variations of temperature occur in the deserts, ranging from a maximum of 46° C, during daylight hours, to a minimum of 6° C after sunset. During the winter season desert temperatures often drop to 0° C. The most humid area is along the Mediterranean coast, where the average annual rainfall is about 200mm. Precipitation decreases rapidly to the south; Cairo receives on average only about 29mm of rain each year, and in many desert locations it may rain only once in several years.

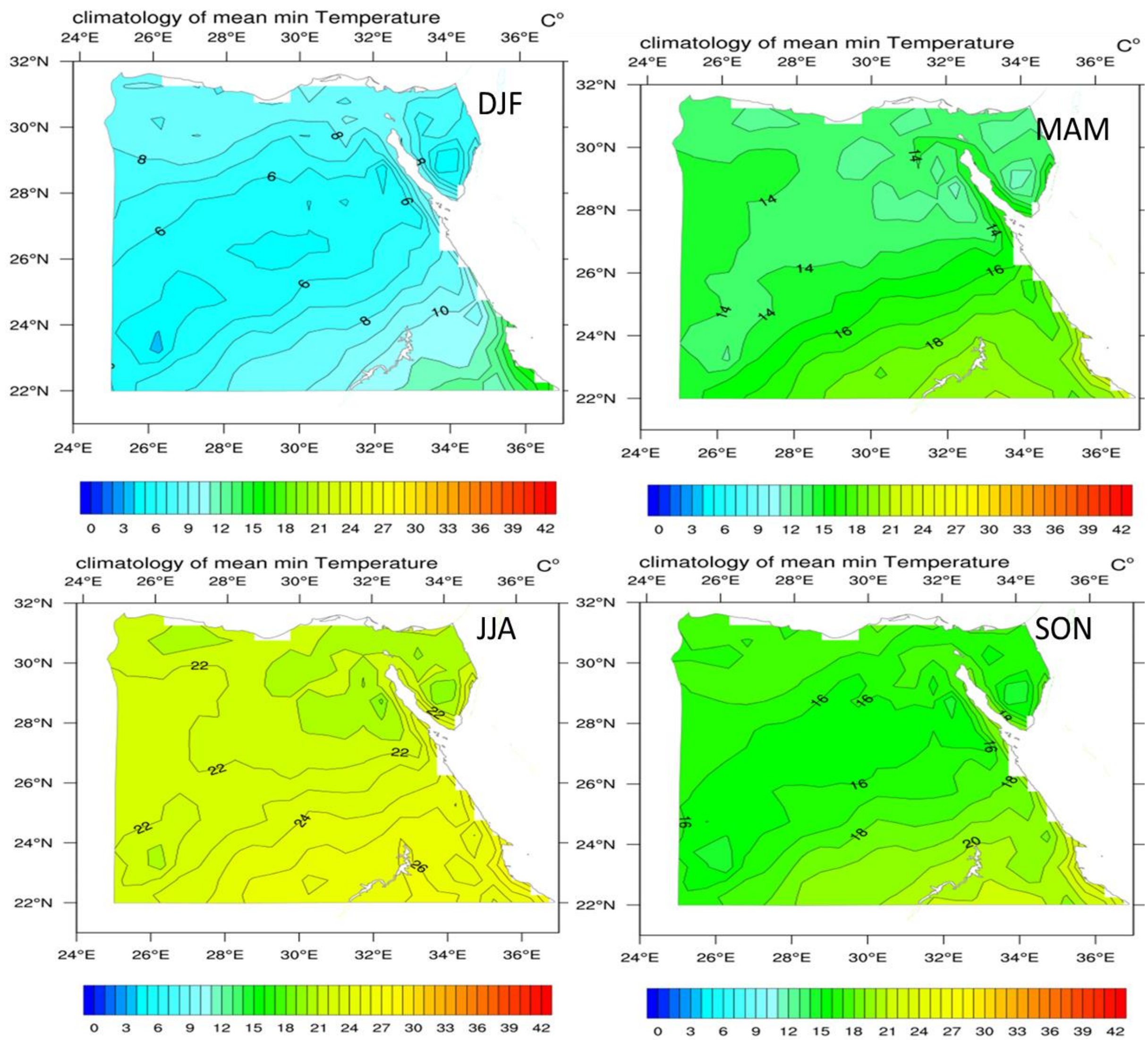

Figure 4: Seasonal Variation of the minimum Temperature over Egypt

Transitional seasons MAM and SON are nearly have similar minimum temperature pattern. The lowest minimum temperature pattern is detected in winter season DJF as shown in Figure 4. Winter is mild with some rain, but usually it is bright, sunny days with cold nights. In recent years the humidity has spread to Cairo, and the city swelters in August. Winter (between October and May) weather is colder than most people anticipate, and cold winds blow over the desert at sunrise and sunset.

In winter, as the sun apparently reaches its extreme southward displacement, north coast of Africa generally is invaded by the prevailing westerly of Europe. Another factor arises from the oscillations of the so-called Siberian anticyclone and accompanying rainfall in Egypt under such conditions, the wet prevailing westerly of Europe invade the north coast of Egypt and give rise to occasional rainfall with depression travelling from west to Egypt. Sand storm may also be experienced with fronts. Also, the most significant weather features of winter season in Egypt are due to active depression cantered in the vicinity of the island of Cyprus and it's called Cyprus low. Gales, line squalls heavy rain, thunderstorm and sand storm may be experienced from time to time by the Cyprus depression. Also the warm Mediterranean water plays an important role in supplying enormous amount of water vapour to the polar air mass moving south toward Egypt. The prices of supplying heat and moisture in the layer is continuous ad leads to instability and heavy showers. All climatic patters of pressure systems that invade Egypt during winter season are illustrate in Figure 5, which shows the seasonal pattern of Mean Sea Level Pressure average from 1984 to 2014 over Egypt.

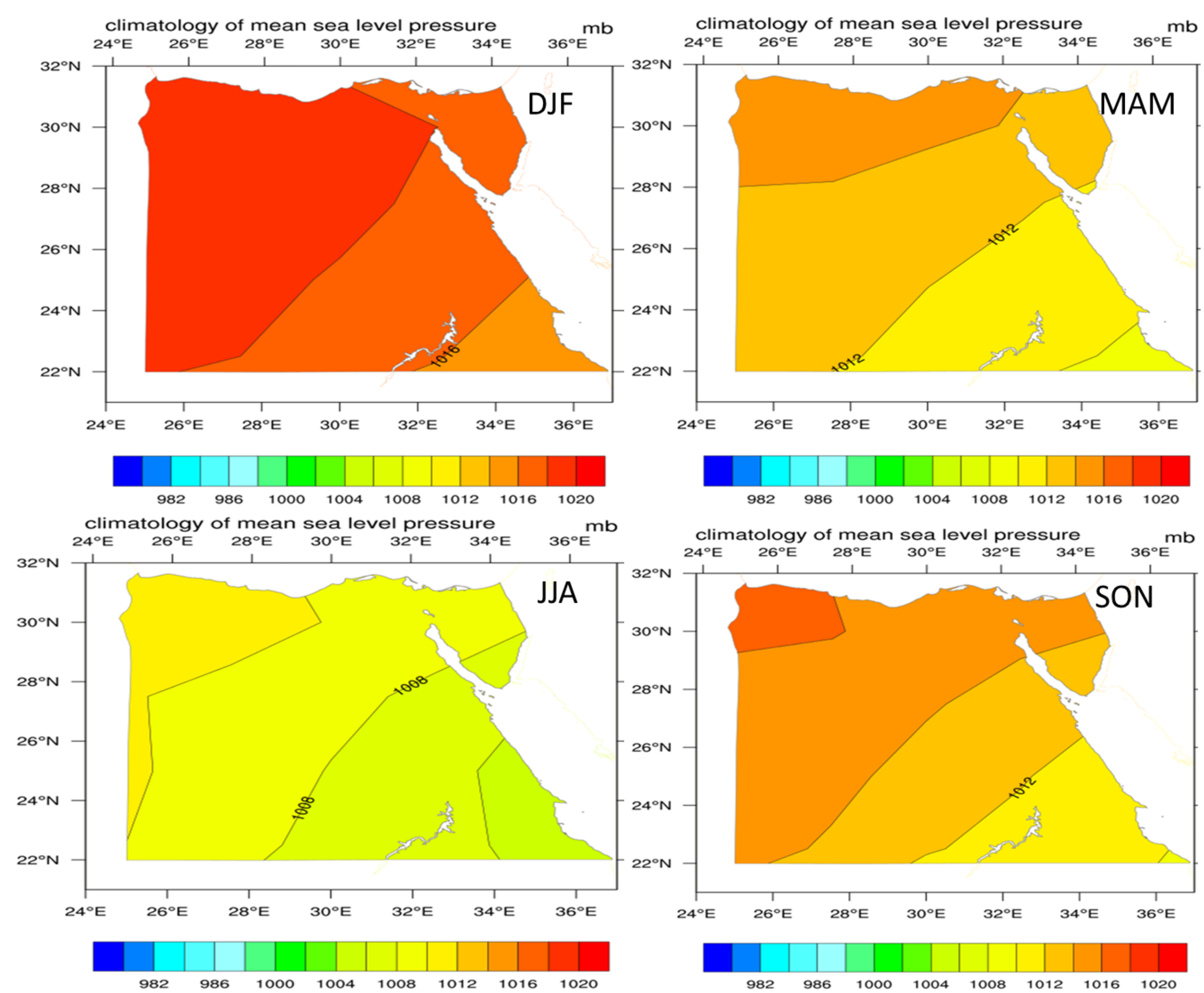

Figure 5: Seasonal Variation of the Mean Sea Level (MSLP) over Egypt

The most variability in MSLP is noticed in spring season. The main feature of the spring is the southward shift of the Mediterranean depression. The centres of the depressions move either along the coast line of the North Africa or rather south, where they are known as (***Khamasin depression***). The average frequencies of theses depressions are three or four per month but may vary between two and six per month. After the formation of so-called ***Khamasin depressions***, sever heat wave are experienced in regions affected by these hot winds. All record of maximum temperature is caused by this tropical continental hot air which is, at the same time, the reason for record of low relative humidity as shown in Figure 6.

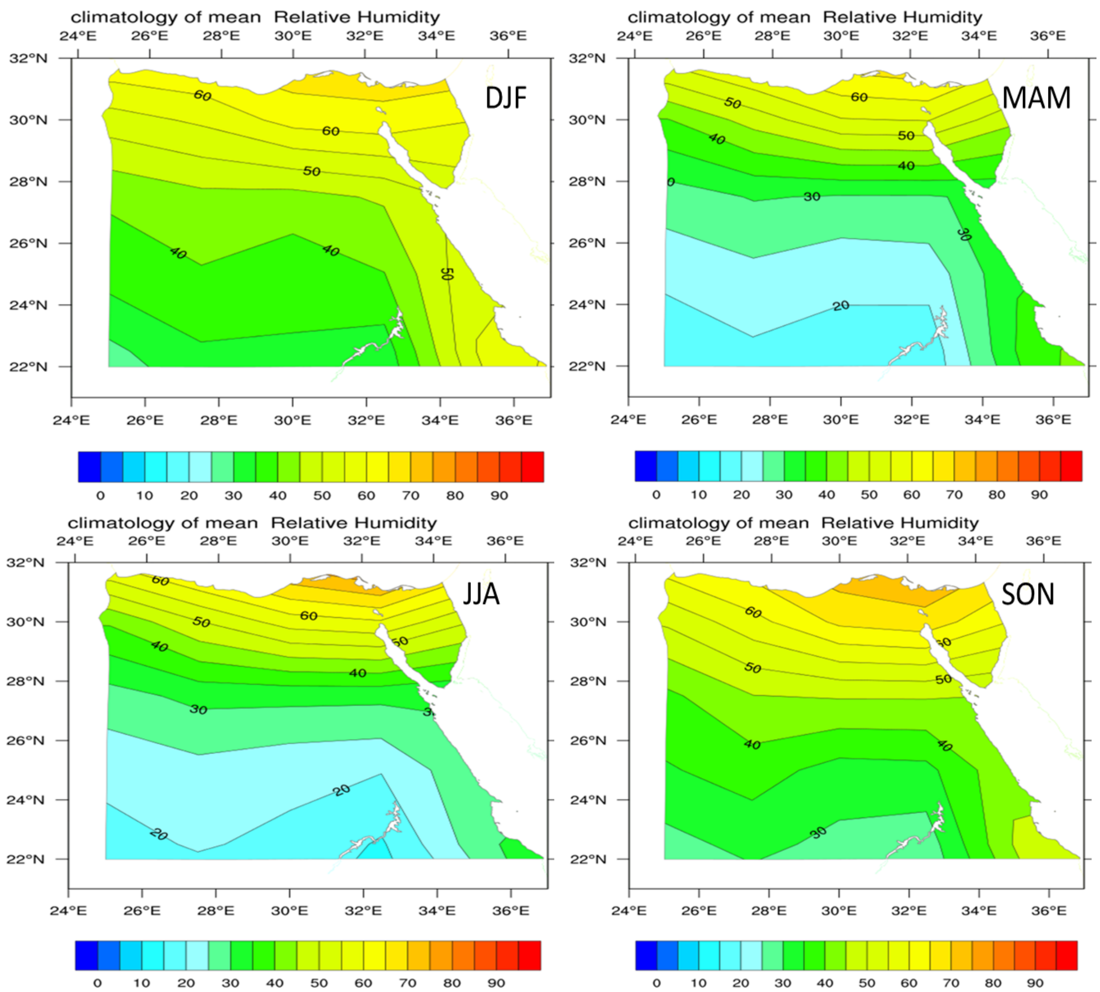

Figure 6: Seasonal Variation of the Relative Humidity over Egypt

The red sea dose not play a role in the aspect of thunderstorm over Egypt because it is enclosed by a high chain of mountain, but it play an essential role in lifting air masses. The Sudan trough may extend northward to cover not only the red sea but also east of the Mediterranean basin. Thunderstorms which may occurs in such case are due to the cold low aloft.

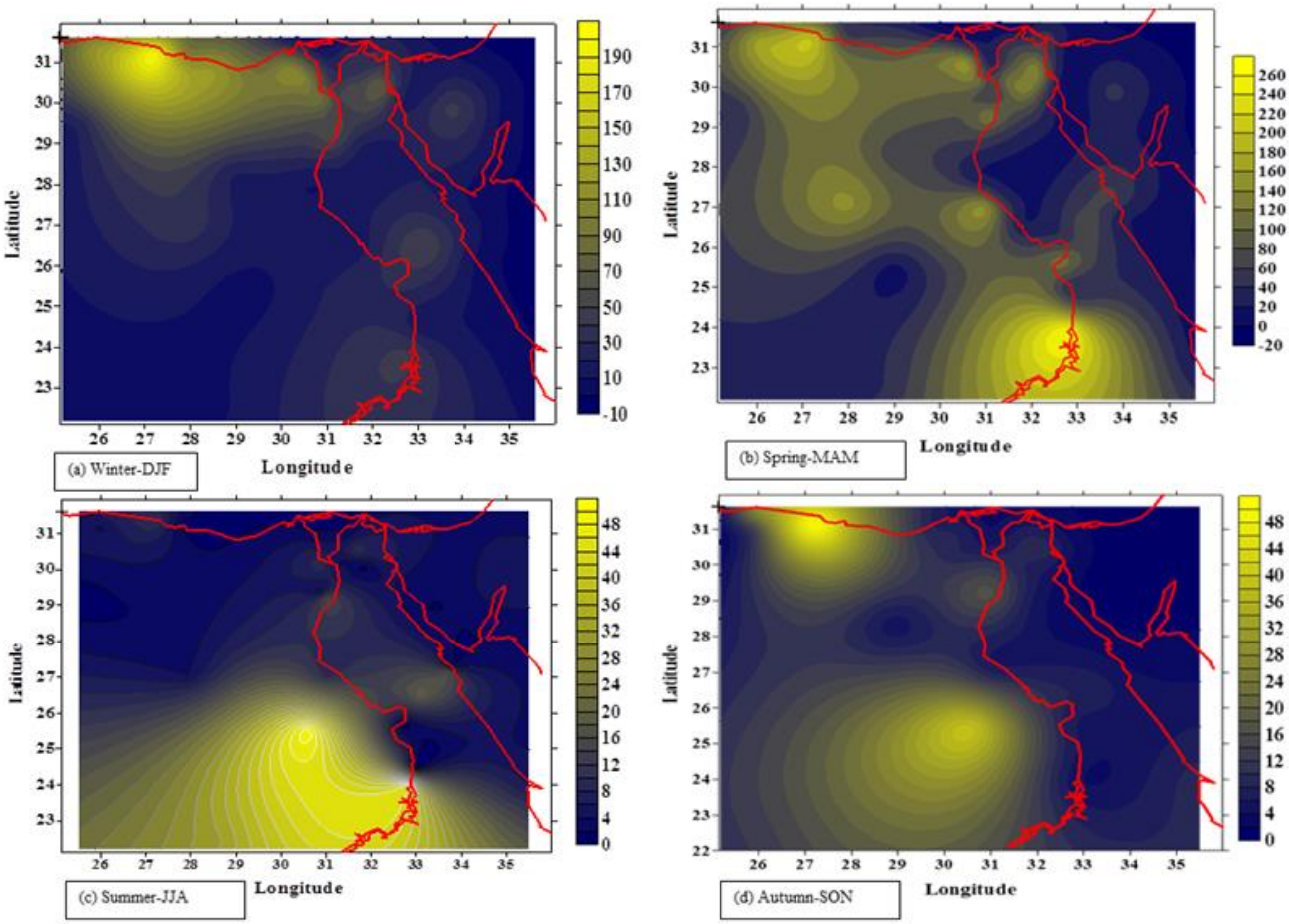

Figure 7 Spatial Distribution of total summation of dust weather phenomena occurrences during Winter-DJF, (b) Spring-MAM, (c) Summer-JJA, (d) Autumn-SON over Egypt from 1968-2012

Figures 7(a-d) shows the seasonal summation of the dust weather phenomena as categorized in table (1) over Egypt for the period from 1968 to 2012. In winter season (DJF) as shown in figure (7a), the maximum number of duststorm occurrences is located to the north along the coastal area of the Mediterranean sea with number of occurrences (100-190) hours/season, while it decreases gradually southward with number of occurrences (30-90) hours/season. In spring season (MAM) as shown in figure (7b) maximum number of occurrences rise to about 260 hours/season over the southern part of Egypt, while the northern part of Egypt has less number of occurrences than the south. In summer season (JJA), figure (7c) shows that number of occurrences is less than the other seasons with maximum values over the southern part of Egypt. The two peaks of maximum number of occurrences over the northern and southern of Egypt are noticed in autumn as shown in figure (7d).

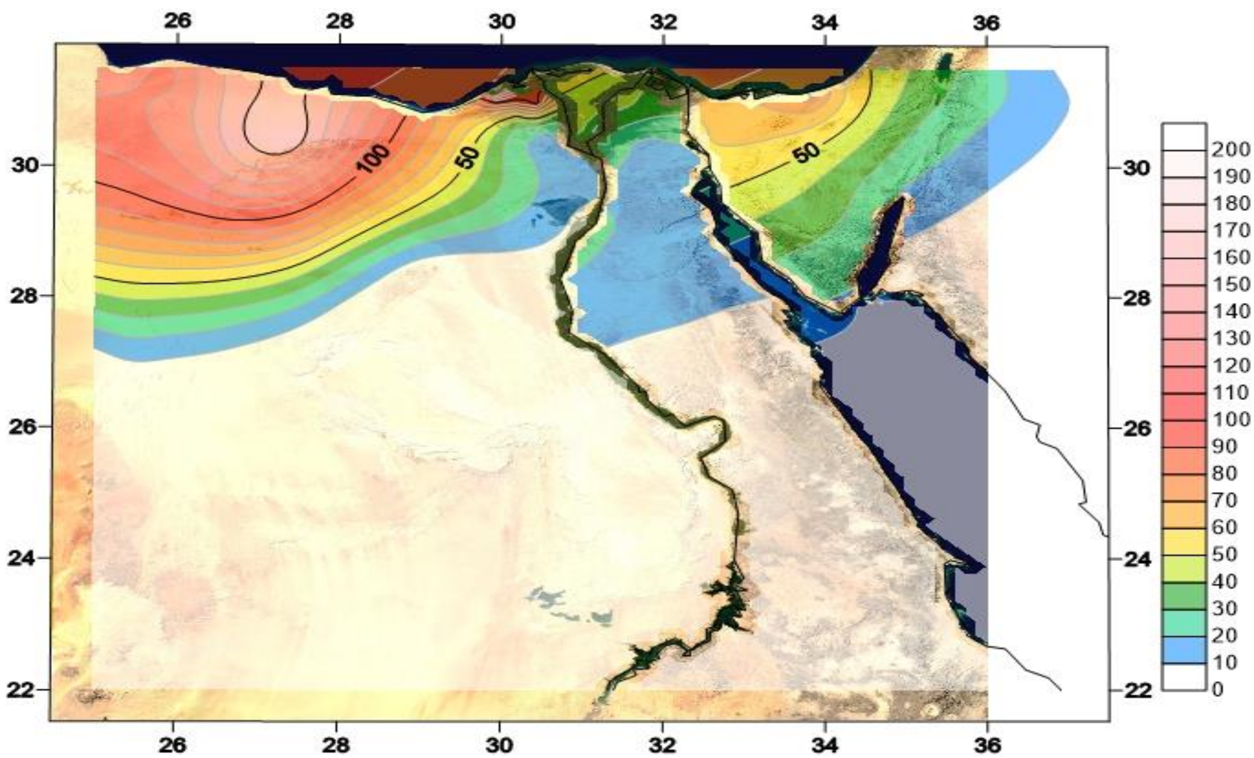

Figure 8: The annual rainfall over Egypt

In winter and autumn seasons (rainy seasons), the higher humidity in theses seasons are favours to greater frequencies of thunderstorms and heavier rainfall particularly in November. In autumns and spring the Sudan monsoon low becomes centres over the north of Sudan and its northward oscillation has direct influence on weather of Egypt, it causes local thunderstorms and flash floods especially over the northern red sea.

7. Climate Nile Delta of Egypt

7.1 Seasonal Climate Variations

The seasonal pattern of (December-February DJF), (March-May MAM), (June-August JJA), and (September-November SON) and annual absolute temperature and percentage precipitation changes are taken in this report over Nile Delta. Over all, the Nile Delta has a hot desert climate as the rest of Egypt, but its northernmost part, as is the case with the rest of the northern coast of Egypt which is the wettest region in the country, has relatively moderate temperatures, with highs usually not surpassing 31 °C in the summer. Only 100–200 mm of rain falls on the delta area during an average year, and most of this falls in the winter months. The delta experiences its hottest temperatures in July and August, with maximum average of 34 °C. Winter temperatures are normally in the range of 9 °C at nights to 19 °C at days. With cooler temperatures and some rain, the Nile Delta region becomes quite humid during the winter months.

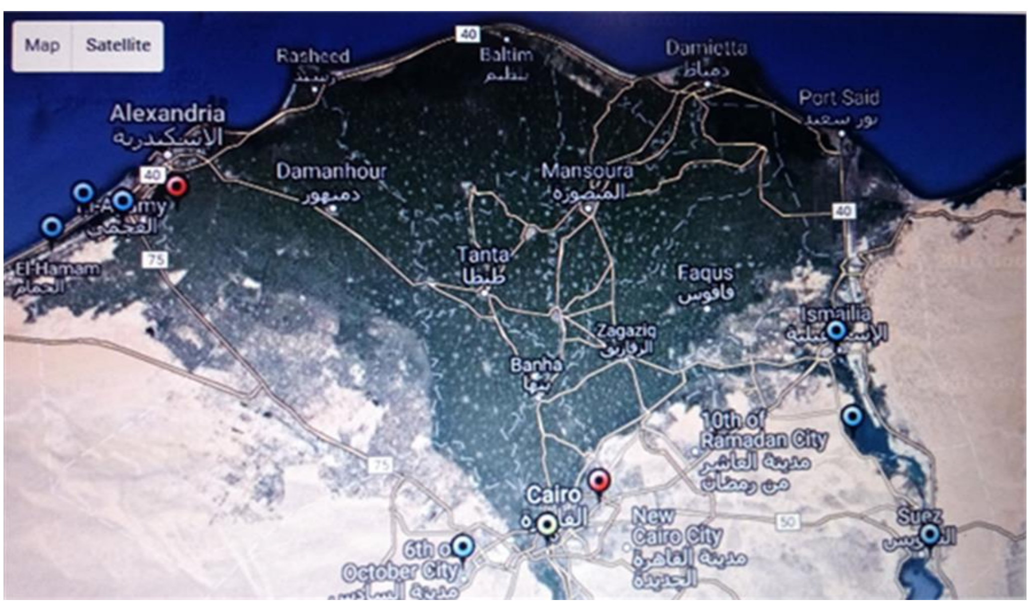

Figure 9: The Nile Delta from google map

The Nile Delta of Egypt contains several governortes such as: Alexandria, Beheira, Kafr el Sheikh, Gharbiya, Minufiya, Qalyubiya, Dakahlia, Damietta, Sharqiyah, Port Said. Large cities located in the Nile Delta: Abusir, Alexandria , Avaris, Bilbeis, Bubastis, Canopus, Damanhur, Desouk, Damietta, El Mahalla El Kubra, Kafr El Sheikh, Leontopolis, Mendes, Mit Abu El Kom, Mansoura, Naucratis, Pelusium, Port Said, Rosetta, Sais, Tanis, Tanta, Zagazig. In this repot we selected some meteorological sites to represent the whole delta. The selected stations are contains Bilbeis city (Sharqia Governorate), Damanhour city (Beheira Governorate), Tanta city (Gharbia Governorate) and Damietta city (Damietta Governorate).

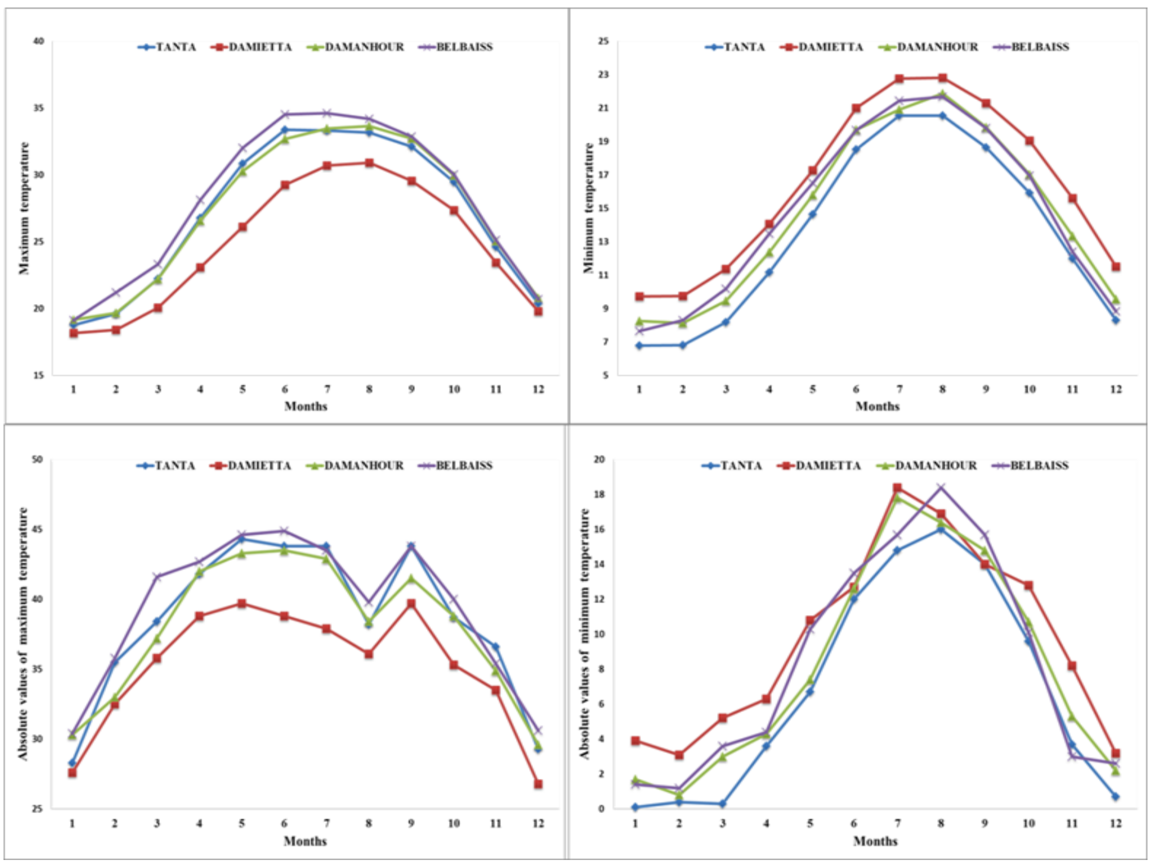

Figure 10: The monthly variations of temperature over the selected cities in the Delta of Egypt

Figure 10 shows the monthly variations of maximum, minimum and absolute minimum and maximum temperature over the selected cities in the Delta of Egypt. Bilbeis city is located at Sharqia Governorate and it has a desert climate. There is virtually no rainfall all year long in Bilbeis. The climate here is classified as BWh by the Köppen-Geiger system, where (BWh = Hot desert climate). The average annual temperature is 21.1 °C in Bilbeis. The rainfall here averages 29 mm. The difference in precipitation between the driest month and the wettest month is 7 mm. The variation in temperatures throughout the year is 14.5 °C. The driest months from is June to September, with 0 mm of rainfall. The greatest amount of precipitation occurs in October, with an average of 28 mm.

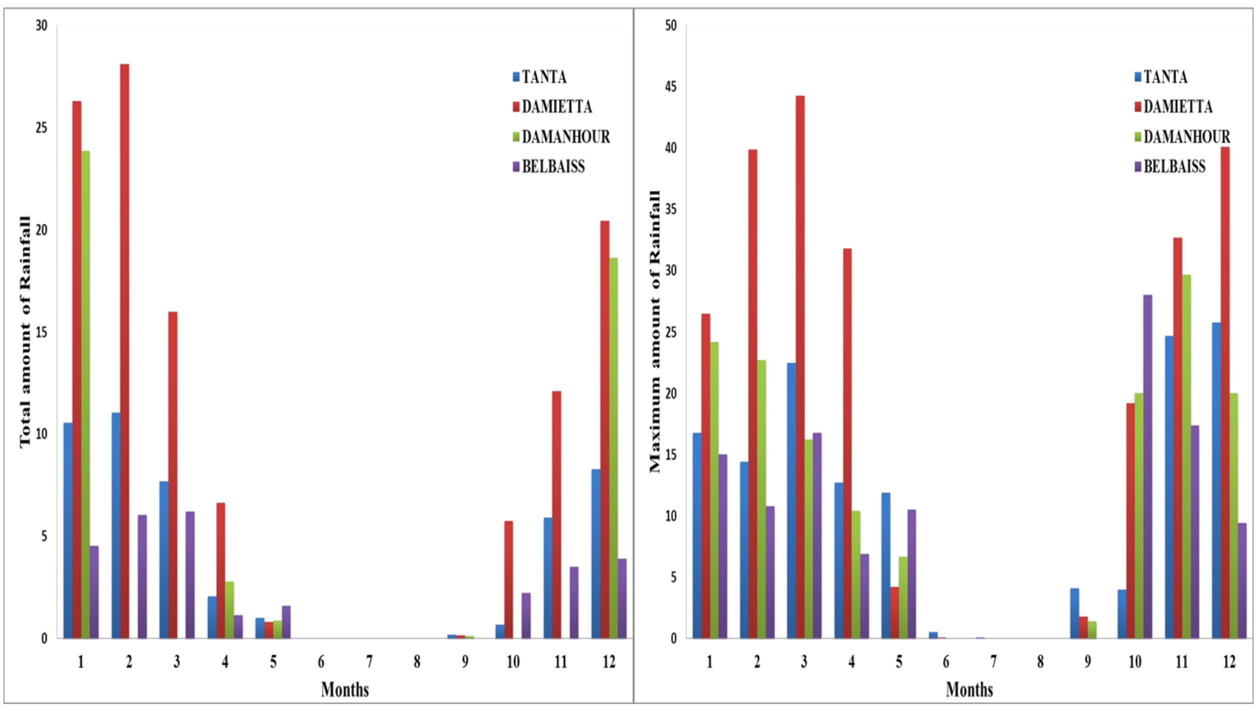

Figure 11: The monthly total and maximum rainfall

The total rainfall over Bilbeis, Damanhour , Tanta and Damietta is 29.12, 46.28, 116.31mm, respectively. The maximum values of rainfall over Bilbeis, Damanhour , Tanta and Damietta is 28, 29, 25.8 and 44.3 mm respectively.

The highest monthly values of rainfall are recorded over Damietta, while the lowest values are detected over rainfall over Bilbeis as shown in Figure 11. Indeed Damanhour city which is located at Governorate Beheira, being located close to the Nile Delta and the northern coast of Egypt, that give Damanhur a hot desert climate, moderated by blowing winds coming from the Mediterranean Sea, typical to the coast. The city gets average precipitation during winter and rare rain during other seasons. Hail and frost are not unknown specifically during winter. With an average of 20.42 °C, August is the warmest month. In January, the average temperature is 13.15 °C. It is the lowest average temperature of the whole year. The driest month is June. There is 0 mm of precipitation in June. Most precipitation falls in January, with an average of 23.8 mm. The precipitation varies 25 mm between the driest month and the wettest month. The average temperatures vary during the year by 13.4 °C. Wind rose contains mean scalar wind speed and percentage frequency of surface winds blowing within specified directions. The elements used in preparing Figure 12 are the mean hourly values of the surface wind speed and the corresponding mean hourly values of direction taken from the daily records of the surface wind instruments installed at the stations. The mean hourly values are extracted for every hour of each day of the month and they refer to period of 60min centered at the hour. The mean monthly values of surface wind speed are the arithmetic mean over the month of daily hourly values. The percentage frequencies of the surface wind blowing within the specified ranges of directions (ranges for wind direction are twelve ranges of 30° each, beginning with the range "345^0-014^0" as being the true north) calculated over the month from their corresponding total monthly frequencies. The number in hours of 'Variable' winds is the number of cases when the surface wind showed no definite direction over the period of the 60min centered at the hour or when vane sticking over that period due to the lightness of the wind and not responding to the variation in wind direction ,in such cases the mean wind speed over this period is normally less than 5 knots. The number in hours of calm winds is the number of cases where the surface wind has a mean speed less than one knot over that period whatever the mean wind direction over the same period.

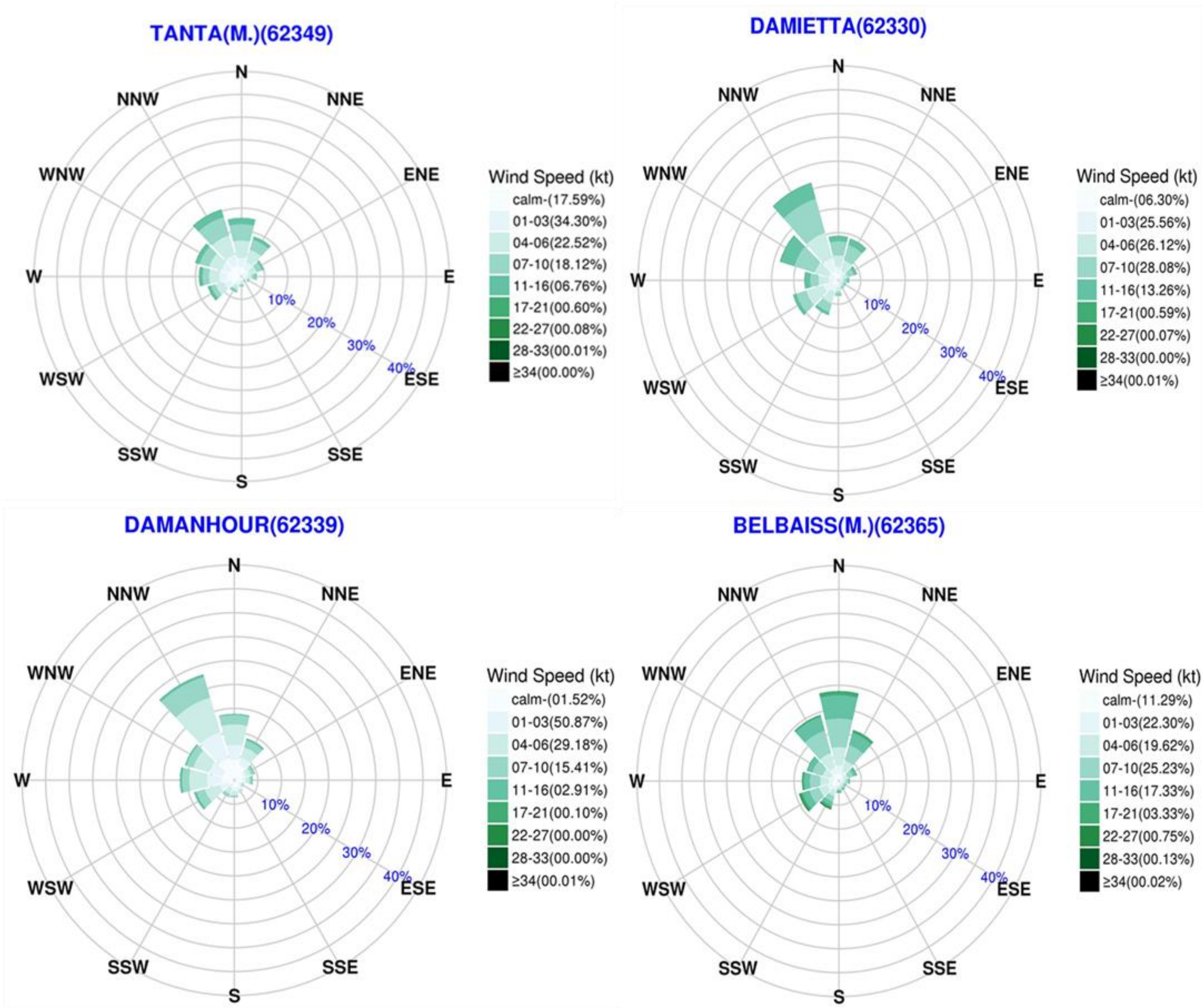

Figure 12: The wind speed and direction over Delta of Egypt

As shown from Figure 12, the most dominant wind direction over Bilbeis, Damanhour , Tanta and Damietta is north (N) with 11.29% calm wind, north-north west (NNW) with 1.52 % calm wind, north-north west (NNW) with 17.95% calm wind, and north-north west (NNW) with 6.30% calm wind respectively.

Dumiat's climate is a desert one. During the year, there is virtually no rainfall in Dumiat. According to Köppen and Geiger, this climate is classified as BWh. In Dumiat, the average annual temperature is 20.2 °C. The average annual rainfall is 111 mm. Precipitation is the lowest in June, with an average of 0 mm. Most of the precipitation here falls in January, averaging 26 mm. At an average temperature of 26.3 °C, August is the hottest month of the year. January is the coldest month, with temperatures averaging 13.2 °C. Between the driest and wettest months, the difference in precipitation is 26 mm, throughout the year; temperatures vary by 13.1 °C. Köppen-Geiger climate classification system classifies its climate as hot desert (BWh), but blowing winds from the Mediterranean Sea greatly moderate the temperatures, typical to the Egypt's north coast, making its summers moderately hot and humid while its winters mild and moderately wet when sleet and hail are also common.

7.2 Extreme Weather Events (EWE)

Extreme weather includes unrespectable, unusual, unpredictable severe or unseasonal weather; weather at the extremes of the historical distribution—the range that has been seen in the past. Establishing the most likely causes behind an extreme weather event can be challenging, since these events are due to combinations of multiple factors, including natural variability. Nevertheless, scientists have been able to draw a connection between some types of extreme climate patterns—an even some individual events—and climate change. A good way to think about this connection is to focus on whether an extreme weather event was made *more likely* by climate change.

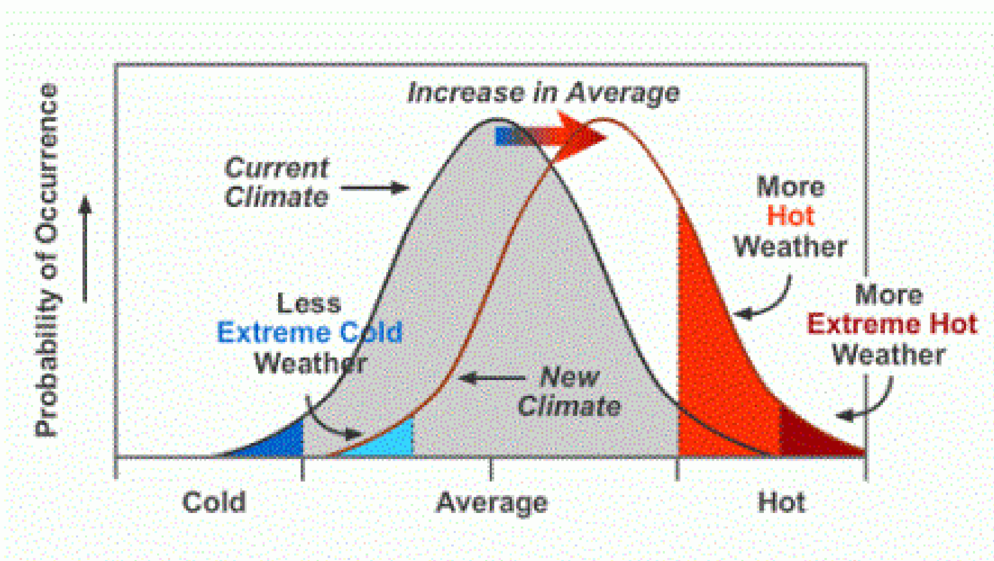

Figure 13: Climate Change and Extreme Weather

Often, as shown in Figure 13, the extreme events are based on a location’s recorded weather history and defined as lying in the most unusual ten percent. In recent years some extreme weather events have been attributed to human-induced global warming, with studies indicating an increasing threat from extreme weather in the future. A climate extreme is a significant departure from the normal state of the climate, irrespective of its actual impact on life or any other aspect of the earth's ecology.

a) Extreme weather events are becoming more frequent and/or severe over Egypt. This is consistent with what we expect with a warming planet.
b) Increasingly frequent and/or severe weather events have serious consequences for society and ecosystems.
c) Between 2011 and 2013, Egypt experienced different case studies of weather events that each caused lots of damages.

d) Changes in some weather events are more closely linked to climate change than others.
e) Understanding the links between climate change and extreme events can help us plan for the future.

There have been changes in some types of extreme weather events in the Egypt over the last several decades, including more intense and frequent heat waves, less frequent and intense cold waves, and regional changes in floods, droughts, and wildfires. This rise in extreme weather events fits a pattern you can expect with a warming planet. Scientists project that climate change will make some of these extreme weather events more likely to occur and/or more likely to be severe.

7.2.1 Heat Wave

A heat wave is a prolonged period of excessively hot weather, which may be accompanied by high humidity, especially in oceanic climate countries. While definitions vary, a heat wave is measured relative to the usual weather in the area and relative to normal temperatures for the season. Temperatures that people from a hotter climate consider normal can be termed a heat wave in a cooler area if they are outside the normal climate pattern for that area. Heat waves form when high pressure aloft (3,000–7,600 metres) strengthens and remains over a region for several days up to several weeks. This is common in summer (in both Northern and Southern Hemispheres) as the jet stream follows the sun. On the equator side of the jet stream, in the upper layers of the atmosphere, is the high pressure area. Summertime weather patterns are generally slower to change than in winter. As a result, this upper level high pressure also moves slowly. Under high pressure, the air subsides (sinks) toward the surface, warming and drying adiabatically. This warmer sinking air creates a high level inversion that acts as a dome capping the atmosphere, inhibiting convection, thereby trapping high humidity warm air below it. Typically, convection is present along the periphery of the cap where the pressure becomes less. This peripheral convection, however, can add to the high pressure dome by ventilating the upper level outflow of the thunderstorms into it. The end result is a continual build-up of heat at the surface that people experience as a heat wave.

7.2.2 Cold Wave

A cold wave (known in some regions as a cold snap) is a weather phenomenon that is distinguished by a cooling of the air. Specifically, a cold wave is a rapid fall in temperature within a 24-hour period requiring substantially increased protection to agriculture, industry, commerce, and social activities. The precise criterion for a cold wave is determined by the rate at which the temperature falls, and the minimum to which it falls. This minimum temperature is dependent on the geographical region and time of year.

Tables (1, 2, 3 and 4) represent the extreme events over the Nile Delta during the period 1981-2010.

Station Name: DAMIETTA (62330)															
Month	Period :1981-2010														
	Number of Days of Occurrence of														
	Rain with Amount				Rain	Freezing Rain	Snow	Ice Pellets (Glaze)	Hail	Thunder storms	Fog vis. <1000 (metres)	Mist or Haze vis.≥1000 (metres)		Dust or Sandrising vis. ≥1000 (metres)	Dust or Sandstorms vis.<1000 (metres)
	≥0.1 mm.	≥1.0 mm.	≥5.0 mm.	≥10.0 mm.								Mist	Haze		
January	8.87	4.93	1.70	0.77	8.87	0.00	0.00	0.00	0.00	0.07	0.17	4.47	0.43	0.23	0.00
February	8.00	5.03	1.67	0.70	8.10	0.00	0.00	0.00	0.00	0.13	0.10	2.73	0.27	0.60	0.00
March	4.93	2.53	1.07	0.43	4.93	0.00	0.00	0.00	0.00	0.03	0.03	1.60	0.33	0.97	0.03
April	2.10	1.07	0.43	0.17	2.10	0.00	0.00	0.00	0.00	0.10	0.00	0.77	0.30	0.70	0.00
May	0.90	0.27	0.00	0.00	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.13	0.47	0.00
June	0.07	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.10	0.07	0.00
July	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.17	0.00	0.00
August	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.13	0.20	0.03	0.00
September	0.33	0.03	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.03	1.67	0.13	0.03	0.00
October	2.10	1.07	0.33	0.20	2.10	0.00	0.00	0.00	0.00	0.07	0.00	1.87	0.57	0.07	0.00
November	4.27	2.10	0.67	0.33	4.33	0.00	0.00	0.00	0.00	0.00	0.07	3.10	0.23	0.00	0.00
December	6.87	3.90	1.23	0.37	6.90	0.00	0.00	0.00	0.00	0.07	0.07	4.63	0.27	0.17	0.00
Total	38.44	20.93	7.10	2.97	38.63	0.00	0.00	0.00	0.00	0.47	0.47	24.33	3.13	3.34	0.03
Annual Mean	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 1: The extreme values and weather phenomena at the Damietta station

Station Name: DAMANHOUR (62339)														
Month	Period : 1981-2010													
	Number of Days of Occurrence of													
	Rain with Amount				Rain	Freezing Rain	Snow	Ice Pellets (Glaze)	Hail	Thunder storms	Fog vis. <1000 (meters)	Mist or Haze vis.≥1000 (meters)		Dust or Sand-rising vis. ≥1000 (meters)
	≥0.1mm	≥1.0mm	≥5.0mm	≥10.0mm								Mist	Haze	
January	8.17	4.72	1.45	0.48	8.28	0.03	0.00	0.00	0.00	0.03	0.34	6.48	0.90	0.45
February	7.38	4.52	1.38	0.55	7.38	0.00	0.00	0.00	0.00	0.03	0.31	5.69	0.59	0.72
March	4.52	2.59	0.62	0.21	4.55	0.00	0.00	0.00	0.00	0.03	0.14	5.69	1.03	1.28
April	1.52	0.72	0.14	0.03	1.52	0.00	0.00	0.00	0.00	0.07	0.07	3.00	1.03	0.66
May	0.69	0.17	0.07	0.00	0.69	0.00	0.00	0.00	0.00	0.00	0.03	0.97	0.62	0.48
June	0.00	0.00	0.00	0.00	0.00	0.00	0.S00	0.00	0.00	0.00	0.00	0.76	0.14	0.00
July	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.79	0.48	0.00
August	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	2.46	0.43	0.00
September	0.18	0.07	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.11	2.93	0.54	0.04
October	1.43	0.75	0.25	0.07	1.46	0.00	0.00	0.00	0.00	0.04	0.21	4.82	0.46	0.11
November	3.75	2.14	0.54	0.21	3.79	0.00	0.00	0.00	0.00	0.00	0.25	8.11	0.46	0.07
December	6.07	3.61	1.36	0.43	6.18	0.00	0.00	0.00	0.04	0.00	0.75	8.71	0.68	0.46
Total	33.71	19.29	5.81	1.98	34.07	0.03	0.00	0.00	0.04	0.20	2.21	51.41	7.36	4.27
Annual Mean	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 2: The extreme values and weather phenomena at the Damanhour station

Station Name: TANTA (M.) (62349)															
Month	Period :1981-2010														
	Number of Days of Occurrence of														
	Rain with Amount				Rain	Freezing Rain	Snow	Ice Pellets (Glaze)	Hail	Thunder storms	Fog vis. <1000 (meters)	Mist or Haze vis.≥1000 (meters)		Dust or Sand-rising vis. ≥1000 (meters)	Dust or Sandstorms vis.<1000 (meters)
	≥0.1 mm.	≥1.0 mm.	≥5.0 mm.	≥10.0 mm.								Mist	Haze		
January	4.83	2.37	0.43	0.20	5.30	0.00	0.00	0.00	0.00	0.07	3.13	21.20	14.70	2.03	0.00
February	5.30	2.63	0.60	0.13	5.83	0.00	0.00	0.00	0.00	0.17	2.43	19.43	13.83	2.97	0.13
March	3.00	1.47	0.47	0.17	3.43	0.00	0.00	0.00	0.00	0.07	2.80	23.03	16.90	3.97	0.13
April	1.23	0.53	0.07	0.03	1.27	0.00	0.00	0.00	0.00	0.00	2.10	21.97	17.40	4.37	0.13
May	0.50	0.20	0.03	0.03	0.53	0.00	0.00	0.00	0.00	0.00	2.03	21.37	18.20	2.70	0.13
June	0.03	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	1.43	20.87	17.37	1.03	0.00
July	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	3.50	25.27	20.87	0.30	0.00
August	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.10	26.33	20.13	0.07	0.00
September	0.07	0.07	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.03	4.00	24.83	16.60	0.30	0.03
October	0.67	0.20	0.00	0.00	0.77	0.00	0.00	0.00	0.00	0.10	4.10	24.17	18.57	0.90	0.00
November	1.97	1.07	0.23	0.10	2.33	0.00	0.00	0.00	0.00	0.03	3.13	22.07	16.30	1.30	0.00
December	4.03	1.90	0.37	0.07	4.60	0.00	0.00	0.00	0.00	0.03	3.27	21.00	15.03	1.57	0.07
Total	21.63	10.43	2.20	0.73	24.27	0.00	0.00	0.00	0.00	0.50	36.02	271.54	205.90	21.51	0.62
Annual Mean	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 3: The extreme values and weather phenomena at the Tanta station

Station Name: BELBAISS (M.) (62365)															
Month	Period: 1981-2010														
	Number of Days of Occurrence of														
	Rain with Amount				Rain	Freezing Rain	Snow	Ice Pellets (Glaze)	Hail	Thunder storms	Fog vis. <1000 (meters)	Mist or Haze vis.≥1000 (meters)		Dust or Sand-rising vis. ≥1000 (meters)	Dust or Sandstorms vis. <1000 (meters)
	≥0.1 mm.	≥1.0 mm	≥5.0 mm	≥10.0 mm								Mist	Haze		
January	3.23	1.10	0.20	0.03	3.30	0.00	0.00	0.00	0.00	0.07	4.00	13.40	12.67	5.07	0.27
February	3.20	1.60	0.27	0.07	3.23	0.03	0.00	0.00	0.07	0.17	2.27	11.33	10.97	7.07	0.33
March	2.00	1.33	0.47	0.10	2.07	0.00	0.00	0.00	0.00	0.30	2.77	12.60	11.80	6.37	0.53
April	0.63	0.33	0.07	0.00	0.73	0.00	0.00	0.00	0.00	0.13	1.70	10.37	10.30	5.83	0.50
May	0.47	0.20	0.07	0.03	0.47	0.00	0.00	0.00	0.00	0.10	1.20	12.17	13.20	3.67	0.30
June	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.47	12.60	14.03	1.63	0.00
July	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.37	16.90	17.73	0.77	0.00
August	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.73	18.70	16.53	0.17	0.00
September	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	17.27	15.47	0.43	0.07
October	0.47	0.27	0.07	0.07	0.47	0.00	0.00	0.00	0.00	0.20	5.60	15.57	17.17	1.97	0.00
November	1.17	0.57	0.13	0.10	1.20	0.00	0.00	0.00	0.00	0.03	4.97	13.57	14.00	3.00	0.00
December	1.97	0.80	0.27	0.00	2.07	0.00	0.00	0.00	0.00	0.07	4.57	13.93	14.03	4.33	0.20
Total	13.14	6.20	1.55	0.40	13.54	0.03	0.00	0.00	0.07	1.07	37.65	168.41	167.90	40.31	2.20
Annual Mean	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 4: The extreme values and weather phenomena at the Belbaiss station

The spring and the autumn are transitional seasons. Rainfall over Nile Delta is concentrated in northern coast and the North West in winter season. The synoptic situation in winter is formed by dynamical low pressure systems (Cyprus lows) over the eastern Mediterranean Sea. Occasionally, these systems develop into deep cyclogenes is that cause a series of severe weather events as they cross the Mediterranean Sea in association with upper level troughs. Upper level troughs are regarded as key factors in activity of mid-latitudes, such as the Mediterranean Sea system, in addition to the subtropical jet stream in the upper troposphere, which was very strong. These phenomena in combination led to the atmospheric instability which involved vertical velocity, divergence, and vorticity at the high levels. The previous synoptic situation and the resulting meteorological condition lead to heavy rainfall. The rainfall amount distribution at DAMIETTA illustrate the higher portion of rain > 0.1 mm in winter and autumn season as shown in Figure 14.

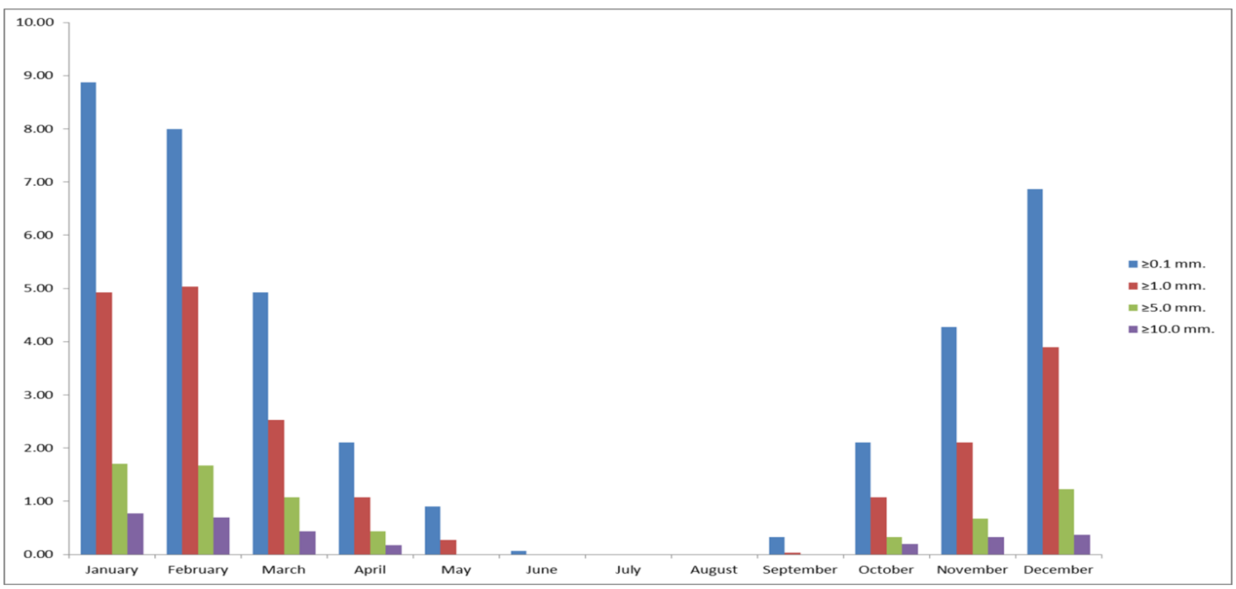

Figure 14: Rainfall distribution over Damiett

Number of occurrences of the weather phenomena such as fog, mist and haze is illustrated in Figure 15 in Damiett. Winter is the most dominant season for mist occurrences

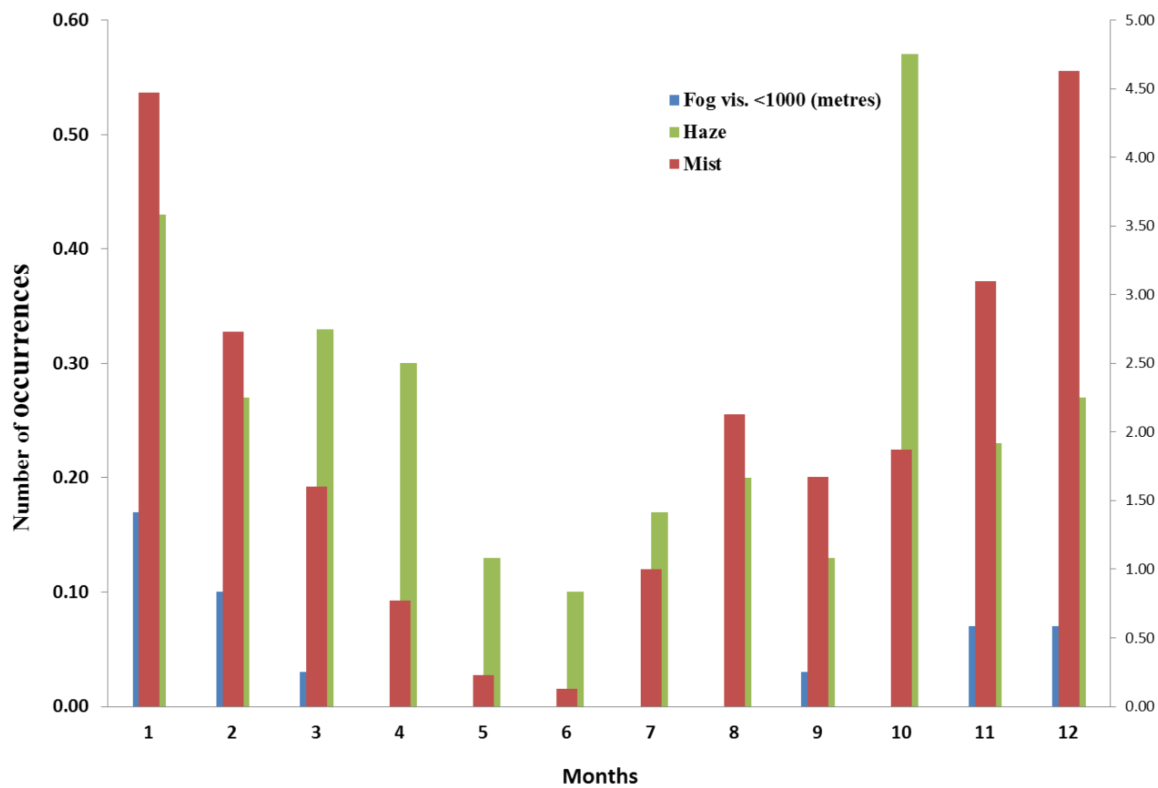

Figure 15: Number of Occurrences of Mist, Fog and Haze over Damiett

Figure 16 illustrate monthly variability of hot days Damiett. One can find from the figure 16 that, maximum occurrence of extreme hot days is found in May and September mainly in the last decade, the figure shows a significant increase in hot days with time,

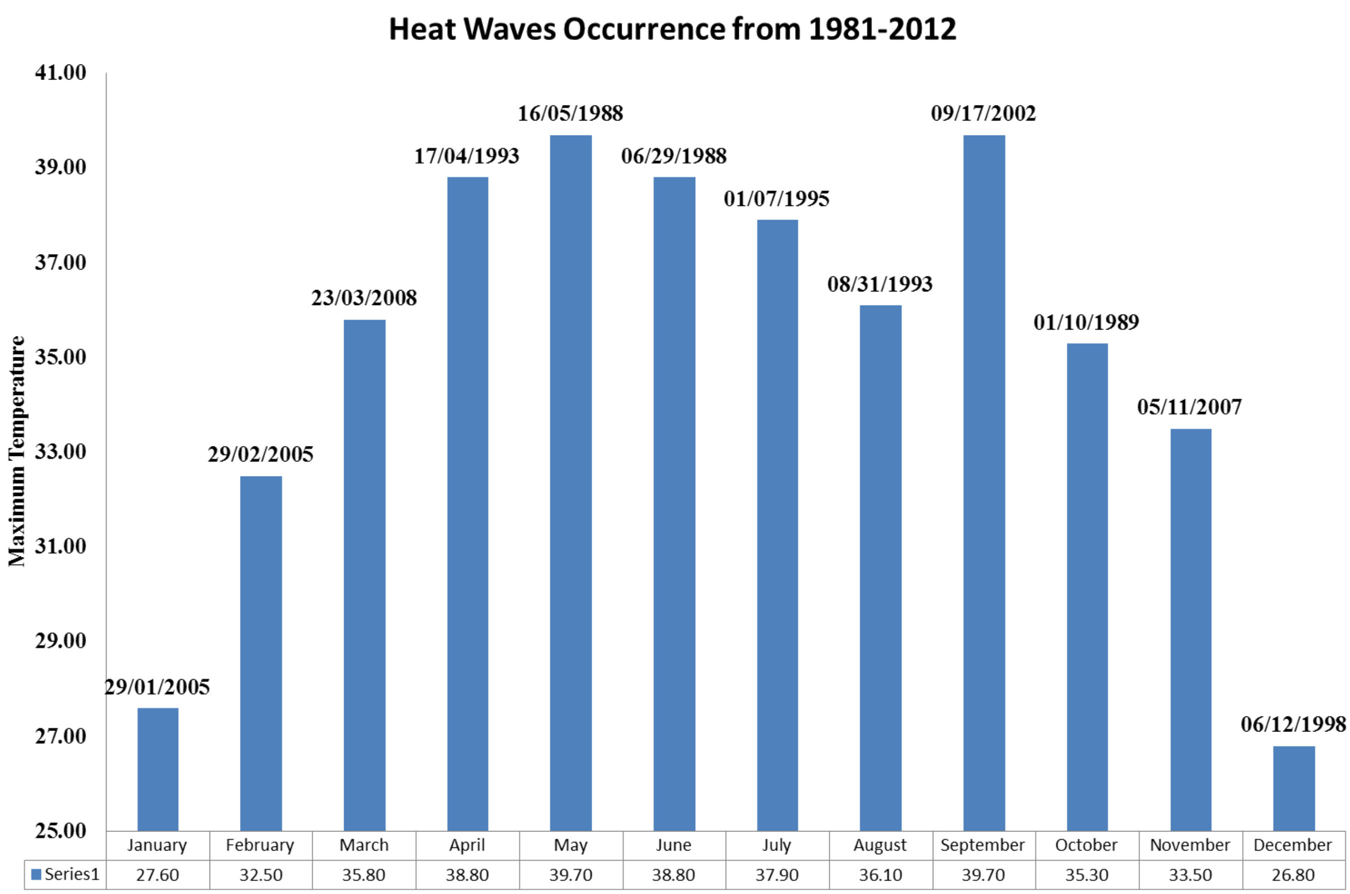

Figure 16: Number of Occurrences of Heat Waves over Damiett