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Climatological Trend of Air Temperature Anomalies in the South Eastern Mediterranean Sea

Ibrahim A. Maiyza, Tarek M. El-Geziry, Hussein I. Maiyza[1] and **Mohamed S. Kamel**

National Institute of Oceanography and Fisheries, Alexandria, Egypt
[1] Arab Academy of Science, Technology and Maritime Transport, Alexandria, Egypt

ia_maiyza@hotmial.com; tarekelgeziry@yahoo.com;
hussien19902007@yahoo.com; mskamela@yahoo.com

Abstract. The issue of the climate change has become one of the most interested topics. In this paper a fair trial is discussed to get a reasonable answer to the question: can the global warming be considered as an absolute continuous behaviour? , taking the south-eastern Mediterranean Sea as a case study. It depends on the analysis of continuous air temperature records (33 years) off the Egyptian Mediterranean coast. The linear regression trend of the monthly air temperature anomaly (MATA) shows a general decrease of 0.4116^o C /33 years (-0.0125^o C/year). The quadratic regression trend has a parabola form with a general decrease from 1958 to 1981 followed by a forward increase. Checking variations in the air temperature and hydrography together with the phenomenon of the River Nile droughts shows that the 70-year cycle appears to be one of the most affective contributors in the climatic change. This does not affect only the area of investigation for the present work but seems to have a worldwide impact (River Nile droughts and global fish production). It may be anticipated that the present warm part of climate cycle ends by 2016 to start a new cold part of climate cycle.

Keywords: Mediterranean Sea, temperature anomaly, regressions, climate change, River Nile drought.

Introduction

The study of surface temperature anomaly (STA) is fairly essential for solving many metrological and oceanographic problems (Heburn, 1985). The duration and wide occupation of STA gives the reason to study it as one of the main factors affecting climatic system of the Earth (Fedrouich, 1985 and Levitus, 1995).

Maiyza (1984) and Maiyza *et al.* (1995) studied the Long term variation of water temperature in the eastern and western Mediterranean Sea. Time distribution of sea surface temperature anomaly (SSTA) values display cycles fluctuated between 8 and 15 years. These cycles are nearly associated with the 11 year cycle of sun-spots activities (Maiyza *et al.*, 2010).

In their work about the mechanisms behind salinity anomaly signals of the North Atlantic, Sundby and Drinkwater (2007) stated that typical feature of the ocean is the large amplitude of inter-annual to decadal-scale variations compared to the multi-decadal and centennial-scale variations.

Maiyza and Kamel (2009 and 2010) and Maiyza (2011) strengthen the suggestion of oscillating sea surface temperature (SST) with time rather than continuous increasing due to the so-called global warming. The cycle of that oscillation must have a period that may extend to centuries. The result reveals a trend of general very slight decrease of SSTA and sea surface salinity anomaly (SSSA), with time in the order of about -0.3° C/61years (1948-2008) and 0.161/63years (1948-2010), respectively.

As the air-sea interaction is one of the highly appreciated concepts, it has been essential to look at the general trend of the air temperature anomaly (ATA) cycle.

The present work aims is to focus on the possible climatic cycles over the region of the south-eastern Mediterranean Sea in front of the Egyptian Mediterranean coast, in order to find a comprehensive answer to the question on the general behaviour of the climatic change.

Data and Method of analysis

The selected data set of the air temperature covers 33 years, based on 3 hours records, from January 1958 to December 1990. This is obtained from Ras El-Teen coastal meteorological station (31° 11.24' N; 29° 51.1' E), which, for the present area of investigation, represents the available most accurate and continuous meteorological data. This station is used as a representative meteorological point for the whole area of interest previously investigated by Maiyza and Kamel (2009 and 2010). The generated equations in their work are presently solved. The area of their investigation is the south-eastern Mediterranean Sea in front of the Egyptian Mediterranean coast. This area extends between latitudes 31 - 33° N and longitudes 25 - 34° E (Fig. 1). The area is divided into 18 grids of 1° x 1° size each.

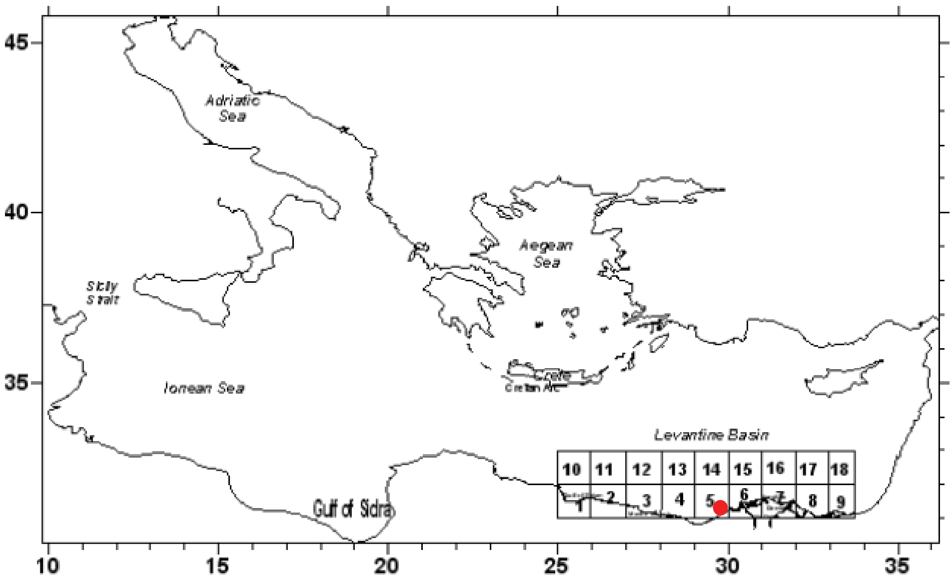

Fig. 1. The south-eastern Mediterranean coast off the Egyptian coast.
● Ras El-Teen Meteorological station

The mean monthly air temperature over the given 33 year data set and the monthly mean air temperature for every month in the whole data set are calculated. This is essential in order to secure a full elimination of any daily, annual or eleven year known cycles effects on the final calculations and results.

The deviation from the monthly mean is computed on monthly basis to express the monthly air temperature anomaly (MATA), using the following equation:

$$\Delta T = T - T_m \tag{1}$$

where,

ΔT is the MATA (°C),

T is the mean monthly air temperature (°C, mean for specific month every year) and

T_m is the monthly mean air temperature (°C, mean for specific month of all years)

The general trend of the monthly variation in MATA is examined using both linear and quadratic regressions. The representative equation for each regression model is generated for the whole data set using the MATLAB® software and figures are drawn using the same software.

The specific years of the lowest calculated MATA (present), SSTA and SSSA (Maiyza and Kamel, 2009 and 2010) are determined using the first derivative concept for the generated equations.

The available confirmed years of the River Nile drought are reviewed based on historical literature information. This covers dates back to the Prophet Joseph's era in Egypt in 1590 BC to the latest observed drought in the 1980s (El-Baz, 1986 and 1989; Gad El-Rab, 1994).

Results

The minimum MATA for the given period (1958-1990) is -2.26° C, while the maximum is 2.47° C. The standard deviation from the mean is 0.68. This coincides with the general negative anomalies behaviour of the SSTA, as shown in Fig. 2 (Maiyza *et al*., 2010) and with the lowest SSSA anomaly (1979) concluded by Maiyza and Kamel (2010).

Figure (3) represents the linear regression model of the MATA. The behaviour of this regression shows a general decrease in the MATA from January 1958 to December 1990. This decrease is in order of 0.4116° C/33 years (-0.0125° C/year). The linear model equation for the period of investigation is:

$$y(t) = 0.20615 - 0.0010386\,t \tag{2}$$

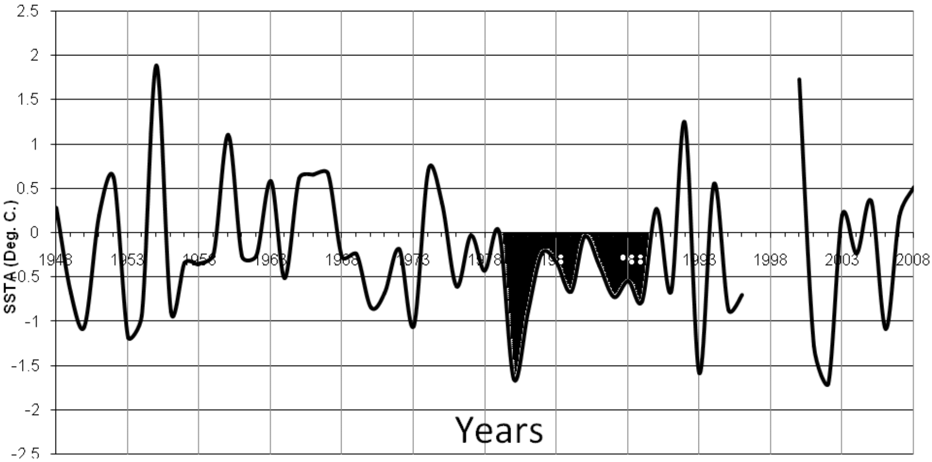

Fig. 2. Mean annual variation of SSTA of the South Eastern Mediterranean Sea (Maiyza *et al.,* 2010).

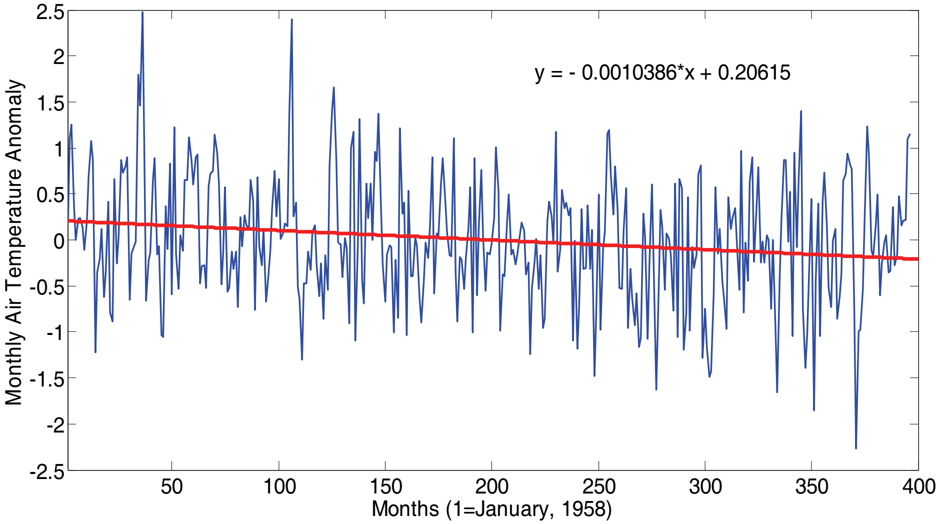

Fig. 3. The linear regression model for the MATA during the period (1958-1990).

The quadratic regression equation of the MATA, as shown in Fig. 4, is:

$$y\ (t) = 0.37918 - 0.003647\,t + 6.5703 \times 10^{-6}\,t^2 \qquad (3)$$

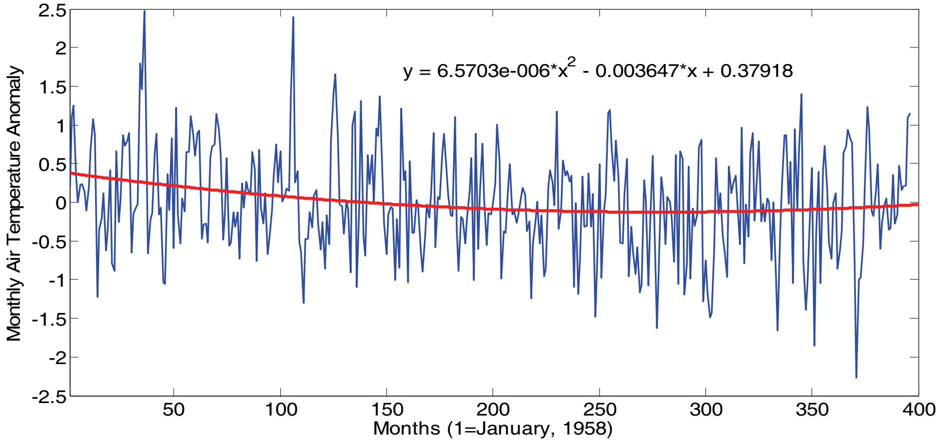

Fig. 4. The quadratic regression model for the MATA during the period (1958-1990).

This shows a general decrease in the MATA from 1958 to 1981 (lowest MATA, equation 3) followed by a forward increase. The lowest SSTA obtained from Maiyza and Kamel (2009, equation 5), however, occurs in 1984 having the same forward increase.

Discussion and Conclusion

In the present work both linear and quadratic regression models of the MATA are produced.

While the former shows a general decrease from 1958 to 1990 with an order of 0.4116° C/33 years (-0.0125° C /year), the later shows a decrease up to the year 1981 followed by a general forward increase. These results are in a good agreement with those obtained by Maiyza and Kamel (2009) for the SSTA using the same regression techniques. They concluded that the linear regression shows a general decrease of 0.3°C/61years. The lowest SSTA obtained from Maiyza and Kamel (2009) occurs in 1984.

The mean monthly and applying equation (1) enable us to eliminate the daily and annual variation from the used data set. The influence of the 11-year solar cycle as a natural variability factor is of special importance for those who are interested in investigating inter-decadal climatic changes (Labitzke and Matthes, 2003). Though, using 33 years data set enables us to eliminate the effect of 11-year cycle of sun-spots activities (Maiyza *et al.*, 2010).

The results of the present work may be considered as a candle light against the global view towards the hypothesis of the continuous global warming. Many authors strengthen the suggestion of oscillating surface temperature with time rather than continuous increasing due to the so-called global warming. The cycle of that oscillation must have a period that may reach to centuries (Sundby and Drinkwater, 2007; Maiyza and Kamel, 2009)

The available meteorological and oceanographic data sets are limited to investigate larger cycles. For this purpose historical literature review on the River Nile drought, a well-known phenomenon mentioned in the three Holy Books and in the Egyptian history, can be of great help. It shows a cyclic period of this phenomenon. From the Prophet Joseph's era in Egypt in 1590 BC to the modern age, this drought can be summarised in Table (1). All listed references in Table (1) agree that the drought extends each time for an approximate period of +/- 7 years at every time of its occurrence. The droughts of less than 5 years continuity are not considered in this work. The River Nile droughts are more related to the droughts in the whole Nile valley (regional) rather than the area under investigation (local). This conclusion may need further investigation about some other parameters such as the pressure cycles.

From that table, it appears that the 70-year cycle may be factually considered as periodic cycle affects the River Nile drought, from dates back to BC up to the 1980s. Even over long time intervals, the difference between the confirmed Nile droughts cycle are always 70 years.

Moreover, the SSSA for the period (1948-2010) shows the same trend of decrease from 1948 to 1979 followed by a general forward increase (Maiyza and Kamel, 2010). This expresses the strong bond between the changes in the atmospheric parameters and the main properties of the aquatic environments.

Table 1. Different years of the River Nile drought based on historical data.

Difference (in years)	Year	Reference
2800=40*70	1590 B.C.	http://www.aawsat.com/leader.asp?section=3&article=537284&issueno=11258
490=7*70	1210	El-Fandy *et al.* (1994)
210=3*70	1700	El-Fandy *et al.* (1994)
70=1*70	1910	Flohn (1975) and El-Fandy *et al.* (1994)
	1980	El-Baz (1986 and 1989), El-Fandy *et al.* (1994) and Gad El-Rab (1994) Flohn (1975) and El-Fandy *et al.* (1994)

According to the results of the present research it may be deduced that the climate change issue, in the area of investigation, is not as severe as it is considered worldwide. The outcome of the present research reveals that the 70-year cycle may be of special interest (Table 1). This agrees with the 60-70 years cyclic climatic fluctuations detected by Schlesinger and Ramankutty (1994) and Minobe (1997, 1999, 2000); and the 60-year periodicity concluded by Baumgartner *et al*. (1992) and Klyashtorin and Lyubushin (2003 and 2007). It is documented that this 70-year cycle also affects many human activities, *e.g.* the fisheries activities along the Japanese coastlines (Kawasaki, 1994). Other cycles ranging between 55 to 100 years were also detected *e.g*. the 55-year cycle of the European sardine and the South-African anchovy catches and the 100-year cycle of the north arctic cod biomass (Hylen, 2002).

In conclusion, checking variations in the air temperature and hydrography together with the phenomenon of the River Nile drought shows that the 70-year cycles appears to be one of the most affective contributors in the climatic change. This does not affect only the area of investigation for the present work but seems to have a worldwide impact as shown from the above mentioned literature.

It may be anticipated according to the present cycle calculations that the present warm part of climate cycle ends by the 2016 to start a new cold part of climate cycle (This conclusion needs further investigation about some other parameters such as the pressure cycles).

The advantage in getting these cycles detected and checked is that their occurrence is periodic which enables them to be modelled and their effects to be anticipated for future changes in the climate and consequently in the economic activities. The model of these activities is conditional by having at least three complete cycles of recorded data in order to produce a fair judge. It is highly recommended to build strong bonds between researchers keen to investigate this topic in order to develop a global model, which can be applied to follow-up this important phenomenon. In the same time, it is strongly recommended getting a fair historical research, by historiologists, on the Nile drought cycle.

References

Baumgartner, T.R., Soutar, A. and **Ferreira-Bartrina, V.** (1992) Reconstruction of the history of Pacific sardine and Northern Pacific anchovy populations over the past two millennia from sediments of the Santa Barbara basin. *CalCOFI Report,* **33**: 24-40.

El-Baz, F. (1986) Space photographs of drought in Africa. *In: Lunar and Planetary Science XVII, Lunar and Planetary Institute, Houston, Texas:* 200-201.

El-Baz, F. (1989) Monitoring Lake Nasser by space photography. Remote Sensing and Large-Scale Global Processes. *(Proceedings of the IAHS 3rd International Assembly, Baltimore, MD, May 1989). IAHS Publ.* **186**: 177-181.

El-Fandy, M.G., Ashour, Z.H. and **Taiel, S.M.M**. (1994) Time series models adoptable for forecasting Nile floods and Ethiopian rainfalls. *Bulletin of the American Meteorological Society,* **75** (1): 83-94.

Fedrouich L.A. (1985) Regular formation of large scale temperature anomalies of the surface layer in the northern Pacific Ocean. *Ph.D. Thesis,* Moscow Univ., 24p.

Flohn, H. (1975) History and intransitivity of climate. *World Climate Data Programme, WMO, Geneva, WMO/GARP publications series,* **16**: 106-117.

Gad El-Rab, R. (1994) Heat, Salt and Water Budget of Lake Nasser. *M. Sc. Thesis,* Faculty of Science, Aswan, Assuit Univ., 110p.

Heburn G.W. (1985) Effect of wind versus hydraulic forcing on the dynamics of the western Mediterranean Sea. *Rapp. Comm. Int. Mer Medit*., **29**, (3).

Hylen, A. (2002) Fluctuations in abundance of Northeast Arctic cod during the 20th century. *ICES Marine Science Symposia:* 534-550.

Kawasaki, T. (1994) A decade of the regime shift of small pelagics. *FAO expert consultation (1983) to the PICES III (1994). Bulletin of the Japanese Society of Fisheries Oceanography* **58**: 321-333.

Klyashtorin, L.B. and **Lyubushin, A.A.** (2003) On the coherence between dynamics of the world fuel consumption and global temperature anomaly. *Energy & Environment,* **14**: 773-782.

Klyashtorin, L.B. and **Lyubushin, A.A.** (2007) Cyclic climate changes and fish reproductivity. *Editors: Gary D. Sharp. ISBN 978-5-85382-339-6*, 226p.

Labitzke, K. and **Matthes, K.** (2003) Eleven-year solar cycle variations in the atmosphere: observations, mechanisms and models. *The Holocene*, **113** (3): 311-317.

Levitus, S. (1995) Interannual to decadal scale variability of the world Ocean. *IAPSO XXI General Assembly, Honolulu, Hawaii, USA*, August 5-12, 1995.

Maiyza, I.A. (1984) Long term variation of water temperature in the eastern part of the Mediterranean Sea, *Ph. D. Thesis, Moscow Univ*., 240p (in Russian).

Maiyza I.A. (2011) Continuous global warming or progressive part of long term temperature cycle: Personal history with the problem. *Chapter 20 in Book "Environmental Pollution and its Relation to Climate Change"* Editors: Ahmed El Nemr, Nova Publishers.

Maiyza I.A., Mohamed, E.E., Saad, N.N. and **Sharaf El-Din, S.H.** (1995) Sea surface temperature anomalies in the western Mediterranean. *IAPSO XXI General Assembly, Honolulu, Hawaii, USA,* August 5-12, 1995.

Maiyza, I.A. and **Kamel, M.S** (2009) Climatological Trend of Sea Surface Temperature Anomalies in the South Eastern Mediterranean Sea. *Journal of King Abdul-Aziz University, Marine Science*, **20**: 59-66.

Maiyza I.A. and **Kamel, M.S.** (2010) Climatological trend of Sea surface salinity anomalies in the South Eastern Mediterranean Sea. *Accepted in Journal of King Abdul-Aziz Univ.* **21**(2): 62- 73.

Maiyza, I.A., Said, M.A. and **Kamel, M.S** (2010) Sea Surface Temperature Anomalies in the South Eastern Mediterranean Sea. *Journal of King Abdul-Aziz University, Marine Science,* **21**(1): 151-159.

Minobe, S. (1997) A 50-70 year climatic oscillation over the North Pacific and North America. *Geophysical Research Letters*, **24**: 683-686.

Minobe, S. (1999) Resonance in bi-decadal and penta-decadal climate oscillations over the North Pacific: Role in climatic regime shifts. *Geophysical Research Letters*, **26**: 855-858.

Minobe, S. (2000) Spatio-temporal structure of the pentadecadal variabilityover the North Pacific. *Progress in Oceanography*, **47**: 381– 408.

Schlesinger, M.E. and **Ramankutty, N.** (1994) An oscillation in the global climate system of period 65-70 years. *Nature*, **367**: 723-726.

Sundby, S. and **Drinkwater, K.** (2007) On the mechanisms behind salinity anomaly signal of the northern North Atlantic. *Progress in Oceanography,* **73**: 190–202

http://www.aawsat.com/leader.asp?section=3&article=537284&issueno=11258

اتجاه حيود درجة حرارة الهواء في جنوب شرق البحر المتوسط

إبراهيم أمين معيزة، وطارق محمد الجزيري، وحسين إبراهيم معيزة[١]،
ومحمد سلامة كامل

المعهد القومي لعلوم البحار والمصايد، الإسكندرية – مصر

[١] *الأكاديمية العربية للعلوم والتكنولوجيا والنقل البحري، الإسكندرية – مصر*

المستخلص. تعتبر مسألة تغير المناخ من المواضيع الهامة التي تشغل بال الجميع، والدراسة الحالية تعتبر محاولة عادلة للحصول على إجابة منطقية عن السؤال: هل يمكن اعتبار ظاهرة الارتفاع الحراري سلوكًا مستمرًا ومطلقًا؟ والدراسة اعتمدت على تحليل بيانات درجات الحرارة الجوية السطحية المستمرة (٣٣ عاما) قبالة الساحل المصري على البحر المتوسط جنوب شرق البحر المتوسط. أظهرت النتائج أن تدرج الانحدار الخطي لحيود درجة حرارة الهواء الشهرية انخفض بمقدار ٠,٤١١٦ درجة مئوية خلال ال ٣٣ عاما (أي بمعدل – ٠,٠١٢٥ درجة مئوية لكل سنة). أما تدرج الانحدار التربيعي فقد شكل قطعًا مكافئًا بانخفاض يمتد من عام ١٩٥٨ حتى عام ١٩٨١م تليها زيادة مضطردة. وبفحص تدرج درجة حرارة الهواء، وحرارة وملوحة المياه جنبا إلى جنب مع ظاهرة تكرار جفاف نهر النيل، ظهر أن هناك دورة تتكرر كل٧٠ عاما يبدو أنها واحدة من الظواهر المتعلقة بالتغير الحراري. هذا لا يظهر فقط في منطقة الدراسة، ولكن يبدو أن هناك – من خلال استقراء بعض المراجع المنشورة – تأثيرا على المستوى العالمى لإنتاج الأسماك، وقد يكون الأرتفاع الحراري فى الوقت الحالى هو الجزء الموجب من الدورة تنتهي بحلول عام ٢٠١٦م لبدء جزء الأنحدار الحراري من نفس الدورة.