INVESTIGATING CHANGES IN THE ATLANTIC WATERS CHARACTERISTICS ALONG THE EGYPTIAN MEDITERRANEAN COAST

M. A. Said [1]*, M. A. Gerges [1], I. A. Maiyza [1], M. A. Hussain [1] and A. A. Radwan [1]
[1] National Institute of Oceanography and Fisheries (NIOF), Alexandria, Egypt - mamsaid2@hotmail.com

Abstract
The paper investigates the changes in characteristics of the Atlantic Waters (AW) as they move eastwards along the Egyptian coast in the South-eastern Mediterranean. The study analyzed a long series of temperature, salinity and σ_t data, collected by several expeditions that were carried out by research vessels of different nationalities, including Egypt, during the period 1959-2008, averaged for the winter and summer seasons. The paper also examined the long-term (50 years) changes that occurred in the characteristics of the water masses off the Egyptian coast as a result of damming the Nile River in 1965 and the subsequent cessation of its discharge into the Mediterranean.

Keywords: Eastern Mediterranean, Temperature, Salinity, Time Series

The long-term (1912-1971) time series of data on the Nile River discharge into the Mediterranean before and after the construction of Aswan High Dam in 1964 showed that the average yearly discharge before damming was of the order of 62 km^3. The summer of 1964 witnessed the last normal Nile flood, which was exceptionally high and reached 63.73 km^3. From 1966 to 2007, the Nile discharge remarkably decreased to a yearly average of 3.92 km^3. Moreover, the annual cycle of the discharge has also changed from July or August to the winter months of December, January and February. Such a change in both the total amount and pattern of fresh water discharge to the Mediterranean would certainly affect the physical, chemical as well as the biological conditions of the southeastern part of the Mediterranean Sea.

In winter, the surface water temperature varied between 16.6 and 18.5ºC, with slightly colder or warmer spots. The surface salinity changes between 38.60 and 39.30, with a general trend of increasing eastwards. The most prominent feature of the salinity distribution at the surface is the presence of a nucleus of salinity > 39.00 that lies between longitudes 27-29ºE. This nucleus is characterized by low temperature (16.6ºC) and high density 28.7s_t. The above feature coincides with the location of the well-recognized gyre known as Mersa Matruh gyre. In summer, the surface water temperature varied between 22 and 28ºC. The area of slightly cold water is the area of the Mersa Matruh gyre. In order to study the vertical space variability of the hydrographic parameters, the average winter and summer values of each of the water temperature, salinity and density s_t were presented on a vertical section taken parallel to the Egyptian Coast along latitude 32º30'N and between 25º30' and 34ºE longitudes.

Only one surface water mass could be observed during winter in the upper 200 m layer. This surface water mass is characterized by temperature values ranging from 15º to17ºC, salinity maximum in the range of 38.90 - >39.10 and corresponding density values of 28.5-28.9 s_t. Three water masses could be observed in the upper 250 m layer in summer, as follows: The surface water mass, occupying the upper layer from 30 to 50 m depth, with temperature values of 22º to 28ºC and salinity 38.8 to 39.20. The subsurface water mass with temperature values of 16º to 22ºC and minimum salinity (<38.60-38.80). This water mass is of Atlantic origin, characterized by oxygen maximum of values >5.2 ml/l, and occupies the 50-150 m layer. Below this layer, the Levantine intermediate water mass (LIW) of temperature <16ºC and maximum of salinity (38.90-39.10) is clearly identified. These water masses were previously observed and discussed in detail by Said *et al.* [1]. Temperature and salinity anomalies indicated increasing trends for both temperature and salinity that reached 0.62ºC/dec and 0.067/dec, respectively for the Mediterranean surface waters, and 0.56ºC/dec for temperature and 0.035/dec for salinity for the Atlantic water (Fig.1).

Millot [2], using an autonomous CTD set at 80 m depth on the Moroccan shelf to monitor the inflowing AW during the period 2003-2007, found that the AW has encountered considerable salinification at the rate of about 0.05/yr, i.e. ~0.2 in the 4-year period of observation. The obtained results confirm that the increase of temperature and salinity of AW with time are attributed to both anthropogenic modifications, especially the Nile damming, and the local climatic changes, which need further investigation.

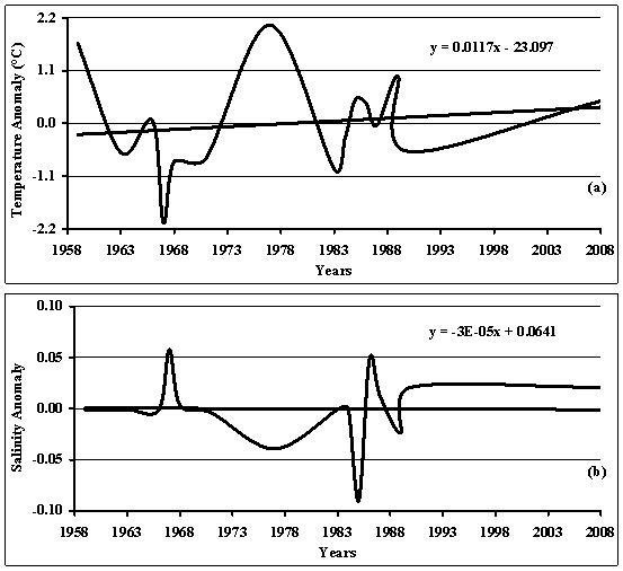

Fig. 1. **Time series from 1958 to 2008 of (a) temperature and (b) salinity for the Atlantic waters**

References
1 - Said M.A., Maiyza I. A., Hussain M. A. and Radwan A.A., 2007. Characteristics of the Egyptian Mediterranean water masses during the cold and warm winters. *J. Acta Adriat.*, 48 (2): 145-159
2 - Millot, C. 2007. Interannual salinification of the Mediterranean inflow, *Geophys. Res. Lett.*, 34, L21609, doi: 10.1029/2007GL031179.