"Seasonal variations and Harmonic analysis of the temperature in Alexandria coastal water."

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Introduction: The sea water temperature is an important factor affecting the marine organisms and the rates of degradation of pollutants such as tarballs. In this paper the monthly mean vertical temperature profiles in the coastal water of Alexandria Fig.1,in the upper 40 meters and the amplitudes and phases of the first 6 harmonics in the monthly variations will be presented.

Data and method of analysis: Some data taken in the region from 1966 to 1978,* at depths between surface and 40 meters depth,with an inetrval 5 meters, have been used.The means and the standard deviations at each level were calculated in each month.The fourier coefficients: A_k (Amplitude of K th harmonic) and its phase a_k were determined according to the equation

$$T(t) = A_o + \sum_{K=1}^{6} A_k \cos(2\pi F_k t - a_k)$$

where T is the temperature($^{\circ}$C), t is the time(month),Ao is the mean temperature, and F_k is the frequency of K th harmonic.The amplitudes and phases of sea water temperature are compared with that of air temperature and evaporation after Hamed (1983).

Results: The mean vertical profiles of temperature in the different months,Fig2, show the lowest temperature(15.5-16.5 $^{\circ}$C)in February and the maximum(26.5-27.5°C) in August and September . The vertical temperature gradient is more pronounced in May,i.e. at the begining of intensive heating of spring.In December,temperature increases with depth, probably due to abrupt cooling associated with low surface salinity. The harmonic constants, table 1, are estimated between 0 and

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* Sources of Data are Hydrographic Data center and some by personal communication.

25 m. depth, where the data were available for 12 months.The annual mean of temperature is decreasing slightly with depth(0.78°C/25m).The first Harmonic (with period 12 months)has the highest amplitude in the case of water and air temperature(5.83 and 6.13 respectively)but the air temperature is leading that of water by about (0.4-0.9 months).The first and the third harmonics are important in the case of evaporation but phases are quite variable (Hamed 1983)

Table 1

The fourrier constants obtained from the monthly mean of Alexandria Coastal Sea Water temperature at different depth and the mean amplitudes of air temperature and evaporation over 20 years(a=phase°,A=amplitude)

Freq.	0	1		2		3		4		5		6
Depth(m)	Mean (Ao)	A	a	A	a	A	a	A	a	A	a.	
0	21.79	5.83	-39	0.31	-84	0.16	31	0.27	95	0.24	-76	0.15
5	21.47	5.83	-40	0.17	-71	0.25	38	0.24	-79	0.1	-64	0.18
10	21.31	5.75	-42	0.14	-56	0.30	27	0.31	-81	0.13	-81	0.23
15	21.18	5.74	-45	0.19	-65	0.33	21	0.37	-81	0.14	88	0.23
20	21.08	5.75	-47	0.26	-60	0.40	12	0.44	-88	0.17	76	0.26
25	21.01	5.76	-48	0.30	-66	0.45	9	0.46	-88	0.19	84	0.28
Air temp (Hamed) 1983.	20.32	6.13	-26.1 1 -110	0.66	-90 1 85.1	0.46	-43.4 1 90.0	0.27	-85 1 66	1.02	28.3 1 42.90	0.20
Evapora. (mm) Hamed 83	5.26	0.86	87.6 1 -72	0.5	57.1 1 -61.5	0.74	+60.3 1 -72.7	0.34	90 1 -81	0.29	84.6 1 -82.3	0.16

Conclusions: In the coastal zone of Alexandria,variations of air and sea water temperature are correlated with small lead of air temperature,while the evaporation has a less effect on water temperature. The vertical temperature gradient is small in winter,when mixing is effective,and in summer,when the heat has enough time to be transfered to lower 40 meters.

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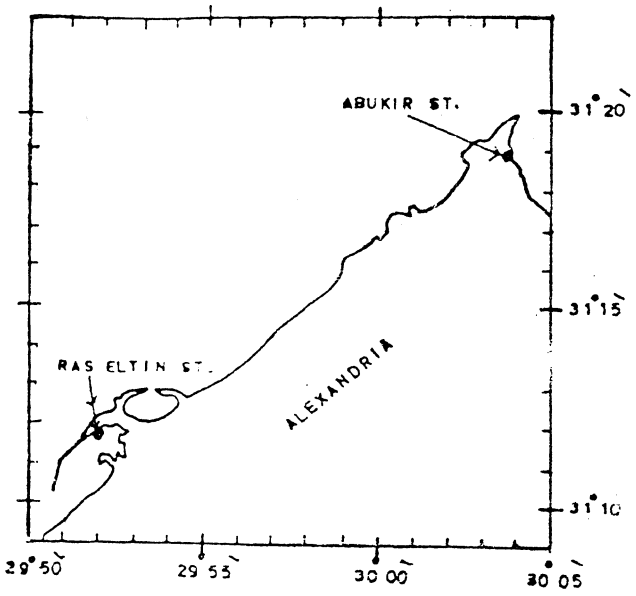

A map showing the shape of Alexandria shoreline and the position of the meteorological station.

Fig. 1

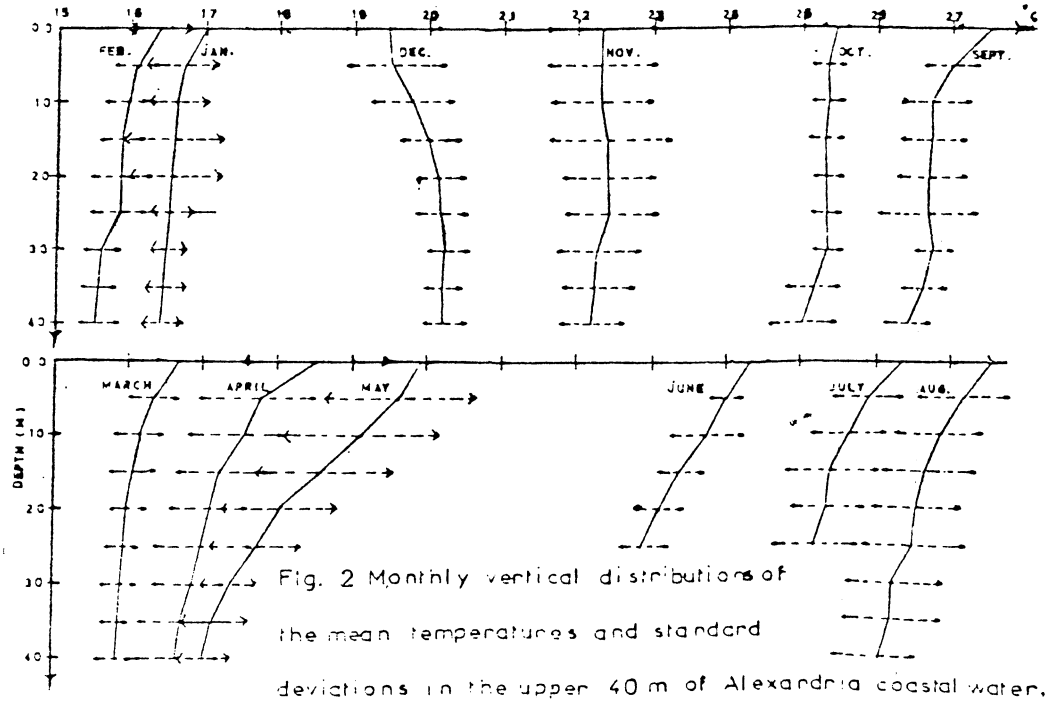

Fig. 2 Monthly vertical distributions of the mean temperatures and standard deviations in the upper 40 m of Alexandria coastal water.

References:

Hamed A.A.(1983)"Atmospheric circulation over the South Eastern part of the Mediterranean Sea in relation with the weater conditions and wind waves along the Egyptian coast"
Ph.D. thesis, Faculty of Science. Alexandria University.