Abnormal surge conditions at Alexandria (Egypt)

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The term "surge" is considered as describing phenomena which are normally attributed to air pressure changes and local wind stress acting on the water near the coast. Therefore, surge heights are determinated by subtracting the predicted tidal heights from the observed heigh of sea level taken from the tide gauge located in the inner part of Western harbour of Alexandria.

The main objective of this paper is to study the highest and lowest surges which are important factors in the design and construction of harbour and other coastal installations.

On the basis of 10 years observational period (1974-1983) of sea level, it can be concluded that mean sea level for Alexandria is 45,5 cm above the zero of the tide gauge. The monthly mean value are below their average during the first half of the year and the rise above their average in the second part of the year (table 1).

Table 1
Monthly average of Sea Level for the period (1974-1983)

Month	J	F	M	A	M	J	J	A	S	O	N	D
S.L cm.	43.9	43.2	37.1	37.7	38.2	46.5	54.7	53.8	48.3	47.7	47.5	51.2

The statistical method made by LENNON (1963) was applied for the hourly surge heights at Alexandria for the period (1974-1983). In this method, the logarithmic scale was used for the average number of cases per year (n/N), where (n) is the number of surges during the period of records which the surge heights (S) exceeded a given value, (table 2) and N= 10 years.

Table 2
The average number of hours during which a positive and a negative surges has been reached or passed for the period (1974-1983)

Positive Surge cm.	Average n/N	Negative Surge cm.	Average n/N
0	4127.6	-5	4040.2
5	2858.2	-10	2763.5
10	1681.3	-15	1594.6
15	775.8	-20	717.2
20	289.6	-25	239.9
25	93.8	-30	69.4
30	29.5	-35	15.4
35	8.5	-40	1.7
40	4.0	-45	0.4
45	1.3	-50	0

As a result of the above mentioned method, two empirical relations have been derived for the frequency of occurence of both positive and negative surges and the surge value were obtained for Alexandria harbour that,

$$\text{Log}\,(n/N) = -0.082\,S + 3.92 \text{ for the positive surges, after MOURSY (1989)}$$

and

$$\text{Log}\,(n/N) = 0.102\,S + 4.60 \text{ for negative surges}$$

The linear presentation of the frequencies of both positive and negative surges with the surge height value are shown by Figures 1, 2.

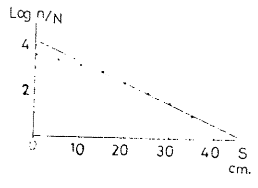

Fig. 1
Relation between the frequency of occurence of positive surge and surge value

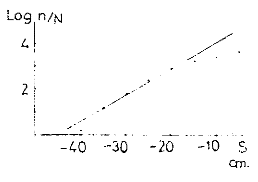

Fig. 2
Relation between the frequency of occurence of negative surge and surge value

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On the basis of the above two equations for Alexandria, the positive and negative surges contribution to be exceeded once in 100, 50, 25, 10, 5, 2 years are given in Table 3.

Table 3
The frequency of occurence of positive and negative surges

Number of years	100	50	25	10	5	2
Positive surges cm.	72.2	68.5	64.8	60.0	56.3	51.5
Negative surges cm.	-64.7	-61.7	-58.8	-54.9	-51.9	-48.0

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Upwelling in the North Tyrrhenian Sea: some physical and chemical characteristics

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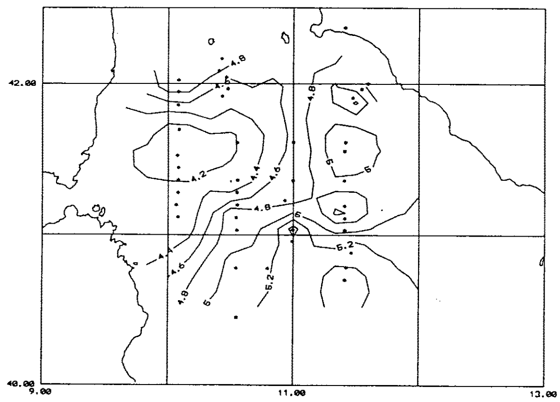
Nearly all studies (i.e. HOPKINS, 1988) pertaining to the Tyrrhenian sea show that this area is characterized by upward and downward fluxes between Modified Atlantic Water, Levantine Intermediate Water and Deep Water. BETHOUX (1981) in his estimate of the potential fertility of the Tyrrhenian Sea attributes about 2/3 of its primary production to the effect of vertical fluxes on the availibility of nutrients to phytoplankton. Additionally, these processes exhibit a large spatial variability due to the peculiar features of the circulation which is characterized by many cyclonic and anticyclonic vortices. The main forcing mechanism is the wind stress curl. The associated Ekman pumping, together with the inflow/outflow at the openings, seems to drive the circulation of the whole basin (ASTRALDI *et al.*, 1991). In particular, while the central area of the southern part of the basin appears very stable, a well developed upwelling is present in the northern part (MOEN, 1984).

The present study attempts to provide a description of the characteristics of the water masses of the North Tyrrhenian Sea utilizing not only their physical but also their chemical properties. Our data, obtained in the late summer of 1989 and in the winter of 1990, indicate, on the basis of temperature, salinity, oxygen and nutrient measurements, the persistence of a zone of upwelling during both periods. This is also seen in the Levantine Intermediate Water, whose core, observed usually below 500m, was found here at a depth lesser than 400m. The upper layer of this zone is characterized by relatively lower temperatures and oxygen concentrations (Figure) and by higher salinities and nutrients.

The structure is also evident in the distribution of nitrates and phosphates. In summer, it is possible to distinguish two areas where these nutrients occupy distinct ranges of concentration, though phosphates exhibit this spatial differentiation in a much weaker manner. The behaviour of these parameters during this period point to the presence of a well developed front that is less visible in winter.

During winter, there seems to be a marked overlapping of the observed ranges for both parameters in the two areas which may be induced by the more uniform vertical fluxes associated with winter mixing. Phosphates show much higher values in winter and the N:P ratio is therefore affected more by the behaviour of phosphorous than by that of nitrogen. This may be due to the influx of the settling products of phosphate remineralization in winter and the greater degree of mixing during this period. The enrichment of the euphotic zone through this vertical upward flux would augment the existing nutrient resources supporting probably a much higher primary production than would exist in the absence of these physical processes.



Oxygen (ml/l) at 100 m depth (Winter 1990)

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