

Abnormal surge conditions at Alexandria (Egypt)

Zeinab A. MOURSY

National Institute of Oceanography, Kayet Bay, ALEXANDRIA (Egypt)

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 determined by subtracting the predicted tidal heights from the observed height 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 occurrence of both positive and negative surges and the surge value were obtained for Alexandria harbour that,

and $\text{Log}(n/N) = -0.082 S + 3.92$ for the positive surges, after MOURSY (1989)
and $\text{Log}(n/N) = 0.102 S + 4.60$ 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.

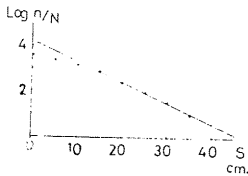


Fig. 1
Relation between the frequency of occurrence of positive surge and surge value

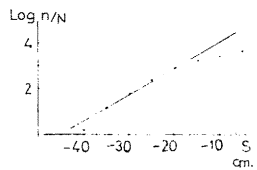


Fig. 2
Relation between the frequency of occurrence of negative surge and surge value

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 occurrence 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 |

REFERENCES

- LENNON G.W., 1963.- A frequency investigation of abnormally high tidal levels at certain west coast parts. *Proc. Inst. Civ. Engineers.*
MOURSY Z.A., 1989.- Meteorological aspects of storm surges at Alexandria coastal waters. Ph. D. Thesis, Alex. Univ. Faculty of Science.