

## Mean Rise in Sea Level

### Comparing Tidal Observations in Tunisia

The Tunisian Naval Hydrographic and Oceanographic Center (TNHOC) has since 1999 maintained a tidal database through an in situ tide-gauge network along the Tunisian coast. The data collected so collected over the period 1999 to 2006 is compared with tidal data from 1946 to 1947 and the results presented in this article.

Externe auteur; by Rachid Essouissi

The tidal network of the Tunisian Naval Hydrographic and Oceanographic Center (TNHOC) consists of floating gauges type OTTR16 and a bottom pressure-sensing instrument type YSL. The network is established mainly in the ports of Bizerte, La Goulette, Kelibia, Sousse, Sfax and Zarzis. The instruments are supervised weekly by TNHOC personnel. The tide observatory in the port of Sfax is the most important one, because tidal range here is in the order of 150 centimetres.

### Historical Background

The first tidal observation system was installed in the port of Sfax in 1946 by the French Hydrographic Service to compute tidal range, harmonic constants and to elaborate the tidal prediction tables. The analysis of the tidal data acquired between 1946 and 1947 led to estimation of a mean sea level of 99cm above the vertical chart datum, the lowest low water, 105cm below the National Levelling Network (NLN).

### Data Comparison

In 1999 the TNHOC installed a float tide-gauge in the same port, enabling the centre to collect high-quality spatio-temporal data. A comparative study consisting of monthly and yearly analysis of the data collected in the period 1946 to 1947 and that collected in the period between 1999 and 2006 has been carried out in the Geodetic Section of the Centre, and observations led to the following results.

1. Mean sea level at the port of Sfax grew by a mean value of 17cm over the sixty years between first and last collected data (1946 and 2006) to reach a value of 116cm above chart datum, indicating an annual increase of  $2.8 \pm 0.2$ mm/year, see Figure 2.

2. During a period of eight years (1999-2006), the lowest low tide twice fell 1cm below chart datum at that location; first in April 2004 and then again in February 2005, see Figure 3. As a matter of fact, when consulting meteorological bulletins for those periods at this location

(south of Tunisia) we concluded that these declines in water level below the chart datum might be related to anticyclonic systems occurring in the same periods. The same phenomenon was observed at the port of Zarzis (south of Sfax), where the lowest level of water was recorded during the same period and also fell below chart datum.

3. Seasonal variation in mean sea level has a maximum range of 25cm throughout the year, with maximum positive deflection in autumn (+15cm in October), minimum deflection in spring (?0cm in March), and maximum negative deflection in winter (-10cm in December), see Figure 4. We also observe fast rise in summer and fast decrease in winter. 4. Using the tidal harmonic constants computed by the French Hydrographic Service in 1951 from observed tidal data over the period of one year (1946 to 1947) and implemented in SHOMAR software from the same Service, a difference of generally 30cm exists between predicted and observed tide. Since mean sea level has increased during these last sixty years, and since tidal constituents drift in time, these differences in heights are justified. For this reason we used the Tide Harmonic Analysis Toolbox "T-Tide" of R.Pawlowicz, B.Beardsley and S. Lentz with the recent tidal data and observed that differences between predicted and observed heights were relatively less significant.

Further, all mentioned results agree well with the analysis of Topex Poseidon satellite observations of Mediterranean Sea Level. In fact these observations collected from January 1993 to September 2004 estimated a yearly variation in mean sea level at the port of Sfax of between 2.5mm and 5mm, see Figure 6.

### **Concluding Remarks**

From the results of the whole study we deduced that mean sea level at the port of Sfax rose to reach 116cm above chart datum. This level will be hence adopted in addition to a 1cm lower chart datum in coming surveys to be conducted by the Tunisian Hydrographic and Oceanographic Center.

### **Biography of the author**

Captain Rachid Essouissi has been director of the Tunisian Naval Hydrographic and Oceanographic Center since 2002. He graduated from the Italian Naval Academy in 1981. In 1986 he received certification as a hydrographic surveyor from the Naval Oceanographic Service of the United States of America. In 1992 he gained a hydro-engineering certificate from the Spanish Hydrographic Institute. Captain Essouissi has conducted many hydrographic surveys whilst serving in the TNHOC. In 2001 he gained a masters degree in Maritime Law and related affairs in France.