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Civil Engineering in the Eastern Part of the Mediterranean Sea. Syrian Coast

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Abstract. In recent decades, there were sharp changes in the global climate, acceleration of the global sea level rise, high population density and investment in coastal areas. This led to improve the knowledge of hydrodynamic processes and morphological conditions in the coastal zone of the seas and oceans. In this article, hydrodynamic characteristics of the coast of the eastern part of the Mediterranean Sea, in particular, the Syrian coast are discussed. Despite the lack of historical data, but recently there have been detailed empirical studies of this coast, applying periodic monitoring and using of modern technologies for modeling and forecasting changes in the shoreline over time. This article describes the hydrological characteristics of the sea water, characteristics of prevailing winds, specification of sea waves, currents and vortexes, properties of marine bottom soil and the analysis of the results of topographic survey of the bottom. Thus, we got the necessary basis for understanding the dynamics of this beach, assessing its degree of stability, identifying the areas under threat of erosion or accumulation, determining the optimal method of coastal protection and the optimal investment and planning for the future.

1. Introduction

Recent decades have witnessed sharp changes in the global climate, a significant rise in the global sea water levels, and a large increase in the population density and investments in the coastal areas. This led to the need of deepen coastal studies, monitoring the changes of shorelines over time and creating new patterns of coastal protection, whether structural or non-structural. Based on the fact that the available information about the Syrian regional water dynamic is few, the need for detailed spatial studies has emerged. This study was conducted between 1992 and 1994. This study was followed by a series of periodic observations and the application of modern techniques for studying and modeling changes in the coastal area.

The studied area in this research represents the eastern part of the Mediterranean Sea, In particular, the coast of the Syrian Arab Republic. Figure (1).


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Figure 1. The coast of the Syrian Arab Republic

The Mediterranean Sea is the body of water that separates Europe, Africa and Asia. It covers around 2.5 million km². The typical Mediterranean climate is hot, with mild, rainy winters and dry summers. It is considered as a semi-closed water mass, because of its small water exchange with the neighboring seas and oceans.

The Mediterranean Sea is connected to the Atlantic Ocean through the Strait of Gibraltar, which lies between the northern coast of Morocco and the southern coast of Spain. Two currents are formed in the strait because of the flow of water into and out of the Mediterranean. The upper flow is from the Atlantic water, which flows eastward into the Mediterranean Sea, while the lower is from the Mediterranean water flowing westward into the ocean. It is connected to the Red Sea by the long man-made Suez Canal. Suez Canal was opened in 1869, it is 163 km long. In the present time, the canal is a significant transport link, and one of the most important waterways, supporting about 8% of the shipping traffic in the world. By the Bosporus and the Dardanelles, it connects to the Black Sea and the Sea of Marmara.

Blow on the east coast of the Mediterranean Sea western and southwesterly winds between April and September annually, northern and northeastern winds during the period from October to March annually [1]. Figure (2). The prevailing waves in the region mostly wind waves and tidal waves. The middle heights of these waves vary between summer and winter (0.5-4.5) m. There are also marine currents in this region. According to the 1992-1994 study, the average speed of the marine currents on the Syrian coast is (13-17) cm/sec. The most probable speed is (30-40) cm/sec. The greatest speed has reached (60-70) cm/sec [2]. Figure (3).

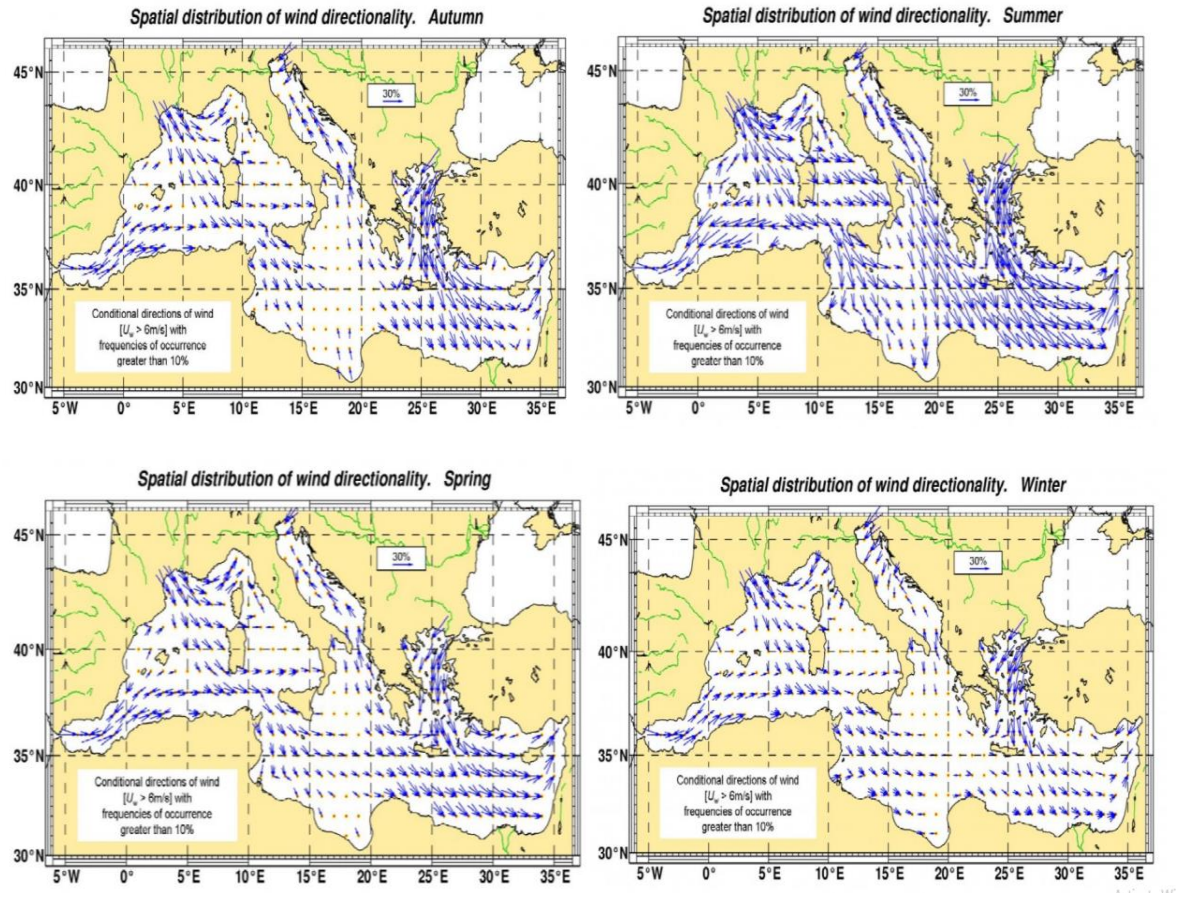
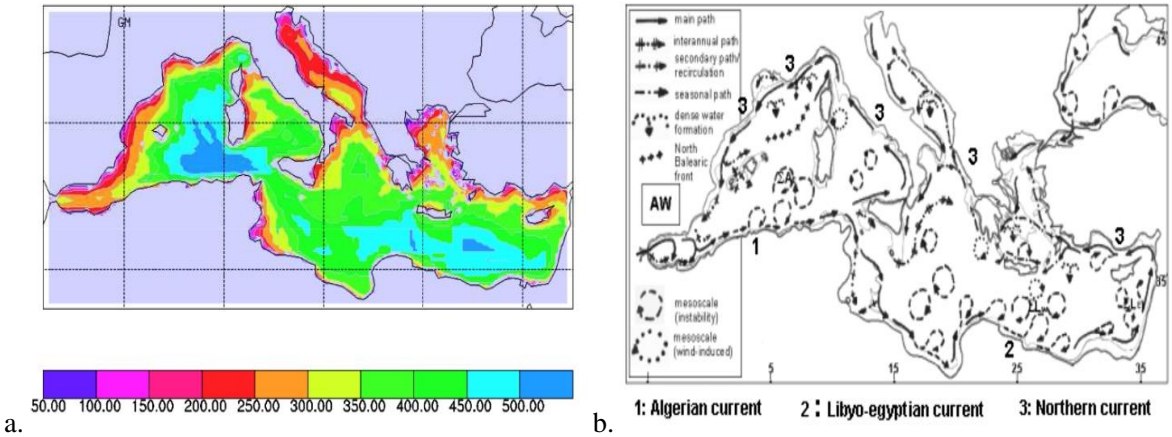


Figure 2. Characteristics of prevailing winds in the Mediterranean annually



a. b.

Figure 3. a. Middle wave's height in winter-cm. b. Currents

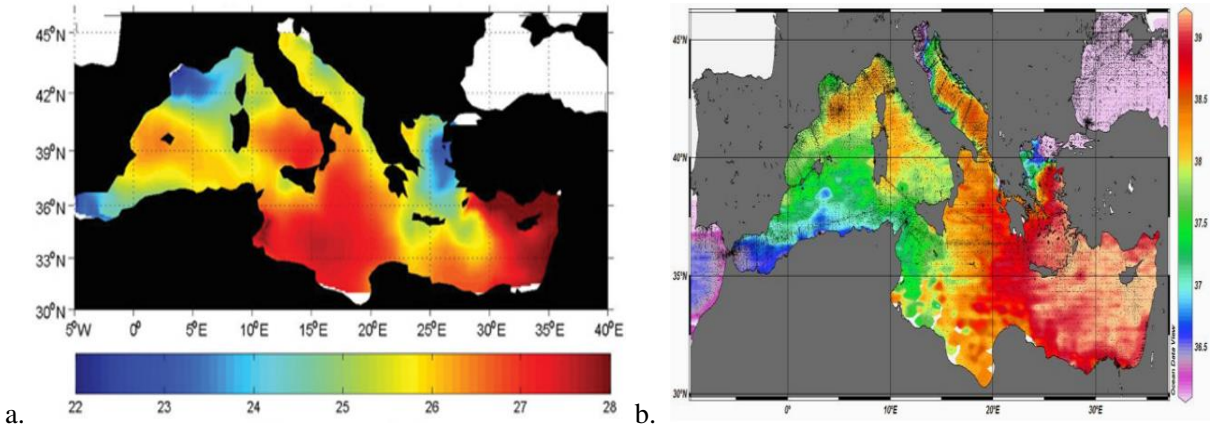
Marine topography of the eastern coast of the Mediterranean Sea contains:

- Continental shelf, width 2-3 miles.

- Continental slope, which located at a distance (5-8) miles from the beach and up to 1400 meters deep.

- Marine valleys up to 1886 meters deep.

The middle temperature in the Mediterranean in summer is up to 28ºc. The Mediterranean Sea is also considered salty sea. It has a high salinity up to 39 g/l [3]. Figure (4).



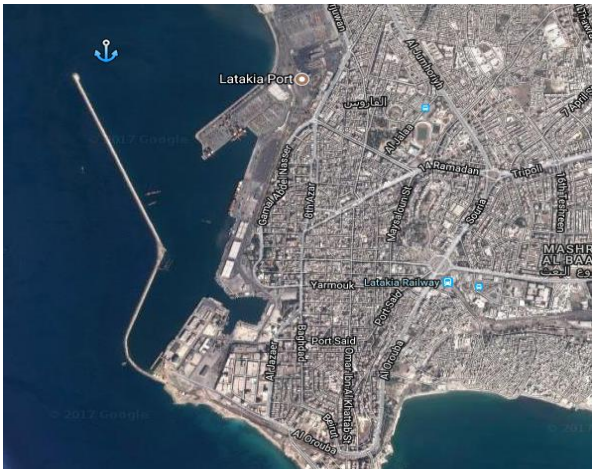
a. b.

Figure 4. a. Temperature distribution in summer, b. Salinity distribution

After this overview of the characteristics of the eastern coast of the Mediterranean, we will proceed to study the characteristics of the Syrian coast, which extends for 180 km. Two major cities (Tartous and Lattakia) are located on this coast. This coastline is invested, where many ports, coastal protection facilities, resorts and tourist complexes were established. In the same time, many areas are still on the picturesque coastal nature, which is a popular tourist destination because of their quiet coastline, soft soil and suitable water depth for swimming.

Starting from Lattakia, which is the largest city of the Syrian coast. There was built a large port to receive cargo and passenger ships in 1958. The area of the water basin of this harbor is about 135 hectares. The port consists of 15 piers; their total length is about 3200 meters and depth up to 13.3m. Figure (5,a). Many fishing and tourist ports have been established on the coast of Lattakia, the most important of which is Jebelah Port. Figure (5,b).

Tartous is the second city of the Syrian coast, occupies the southern part of the Syrian coast. Tartous port was established and invested in 1966 with an area of 3 million m2, of which 1.2 million m2 as the area of the water basin. This port is used for the transportation of passengers, dry and liquid goods and for the export of petroleum products. The water depth in it reaches 13 m. Figure (6,a). In addition, many fishing and tourist ports such as the port of Banias and the Al-Tahone port, which offers the only way to the island of Arwad. Figure (6,b).

a. 

b. 

Figure 5. a. Latakia Port, b. Jebelah Port

The Mediterranean Sea is the estuary of many Syrian coastal rivers. Their runoff is estimated at about 1290 million m3. The groundwater flow in the region is estimated at about 1044 million m3. Recently, about 18 surface dams have been constructed, with estimated storage capacity about 545 million m3 for drinking, irrigation and power generation [4].

Although the advantages of these dams, but the reservation of river water has reduced the amount of sediments, that reaches the shore. In the context of global climate change, rising global water levels and the increase of investments and construction on this coast, we got sharp changes in the shoreline, increased erosion rates in areas and deposition in others.

a. 

b. 

Figure 6. a. Tartous Port, b. The Island of Arwad

Through this narrative of the characteristics of the Syrian coast, we can form an integrated database, which helps to understand the dynamic of this coast, predict its tendency to erosion or sedimentation and identify the necessary coastal protection measures.

We conclude that there is an urgent need for deeper studies about the characteristics of this beach and continuation of periodic monitoring. Lastly, we recommend conducting rigorous studies of the impact of the construction of any facility in the future on the sediment movement in neighboring areas, to select the optimum design and location of the facility for avoiding mistakes or problems in the future.

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