Settlements in the Nile delta

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The Nile River is the longest river in the world. It is 6,500 km long and it drains an area of 287 million km. It starts in central Africa and flows north towards the Mediterranean (Fig. 2).
Its discharge is 84 billion m³ per year. Prior to the construction of the High Dam in Aswan in Upper Egypt in 1964, the Nile carried between 120 to 140 million tons of sediments per year and the delta front progressed seaward at an average rate of 15 m/year. It used to be the main source of sediments in the circulation cell of the southeastern Mediterranean. After the completion of the dam, most of the sediments have been trapped. Consequently, the transported sediments have decreased to a very significantly to an amount of about 2 million tons per year. Also from that time, the delta front has undergone major erosion of about 200 m/year.
The dominant direction of winds in this region is northwest. These winds force water and sediments to move from the delta region eastwards. Additionally, the geostrophic circum-Mediterranean anticlockwise gyre is an effective mechanism in the eastward transport of the Nile sediments. The estimated longshore sediments transport ranges between 2 million tons per year east of the delta, to less than 80,000 tons per year in northern Israel. As a result of the sediment depositions east of the Nile delta, the continental shelf of Sinai is relatively wide, 42 to 50 km and off Israel, it is between 10 to 26 km.
The best and most meaningful tool for studying the spatial and temporal variations of suspended sediments in the upper water layer is offered by satellite imagery. The satellite NIMBUS-7 was launched in October 1978 to orbit at an altitude of 955 km. The scanner CZCS (Coastal Zone Color Scanner) installed on board was a multi-channel scanner devoted specially to measuring the ocean color (*Hovis et al. 1980*). The instrument was operational by NASA for 7.5 years between late 1978 and mid-1986. The system included 6 spectral channels. Four channels in the visible region, were centered at 443, 520, 550, 670 km and used for detecting chlorophyll, suspended sediments or yellow substances. The fifth channel in the near infrared region, was centered at 750 nm for monitoring the surface vegetation or delineating the sea-land boundary. The sixth channel in the thermal infrared region was designated for measuring the sea surface temperature.
A few hundred images of the Southeastern Mediterranean which had been produced by this scanner were analyzed at the Remote Sensing Laboratory of the J. Blaustein Institute for Desert Research (Ben Gurion University of the Negev, Israel). Among the goals of this research were the definition and understanding of the spectral properties of this region.
An experimental cruise was undertaken off the coast of the southern part of Israel, in July 1992, along a 25 km transect perpendicular to the coastline. Laboratory results from the water sampled during this experiment provide evidence that the study area is characterized by relatively high concentrations of inorganic fine grained sediments (between 9 mg/l near the shore to about 2.5 mg/l offshore), very low concentrations of chlorophyll (between 0.36 μg/l near the shore to 0.028 μg/l offshore) (Fig. 1). The dissolved organic matter was found to be negligible. The optical models which were found to be suitable for estimating suspended sediment concentrations from CZCS data has the form of

$$Xs = [Lu(550)-Lu(670)]a/[Lu(443)/Lu(550)]b$$
and $Xs = Lu(550)-Lu(670)$

where Xs is the sediment retrieval variable and Lu is the upwelling radiance for the various wavelengths (*Morel and Prieur, 1977; Tassan and Sturm 1986; Gordon et al. 1988*). These models meet the fundamental requirements for suspended sediments monitoring, e.g., low sensitivity to both chlorophyll and atmospheric correction. Based on the experimental cruise, values of a = 1 and b = 1 were found to be the most relevant for the study area since the region is characterized by relatively high suspended sediments and very low chlorophyll concentrations. The satellite image in Fig. 3 is an example of the spatial distribution of suspended sediments along the Egyptian and Israelian coastlines, analyzed from CZCS data by using the above algorithms. To conclude, the CZCS data and the proposed algorithm used to interpret these data were found suitable for the study area and the concentrations ranges found in it. They enabled us to determine, with adequate sensitivity, the parameters of water quality of the southeastern Mediterranean and the coastal zone of Israel. Even though the scanner is no longer operative, the experience accumulated in this study is a basis for future studies with spectrally compatible systems using the same algorithms*.

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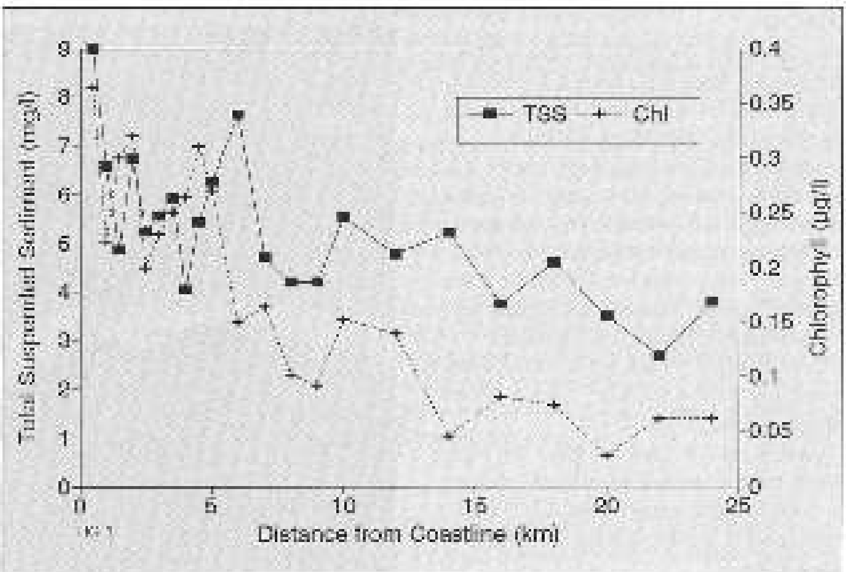
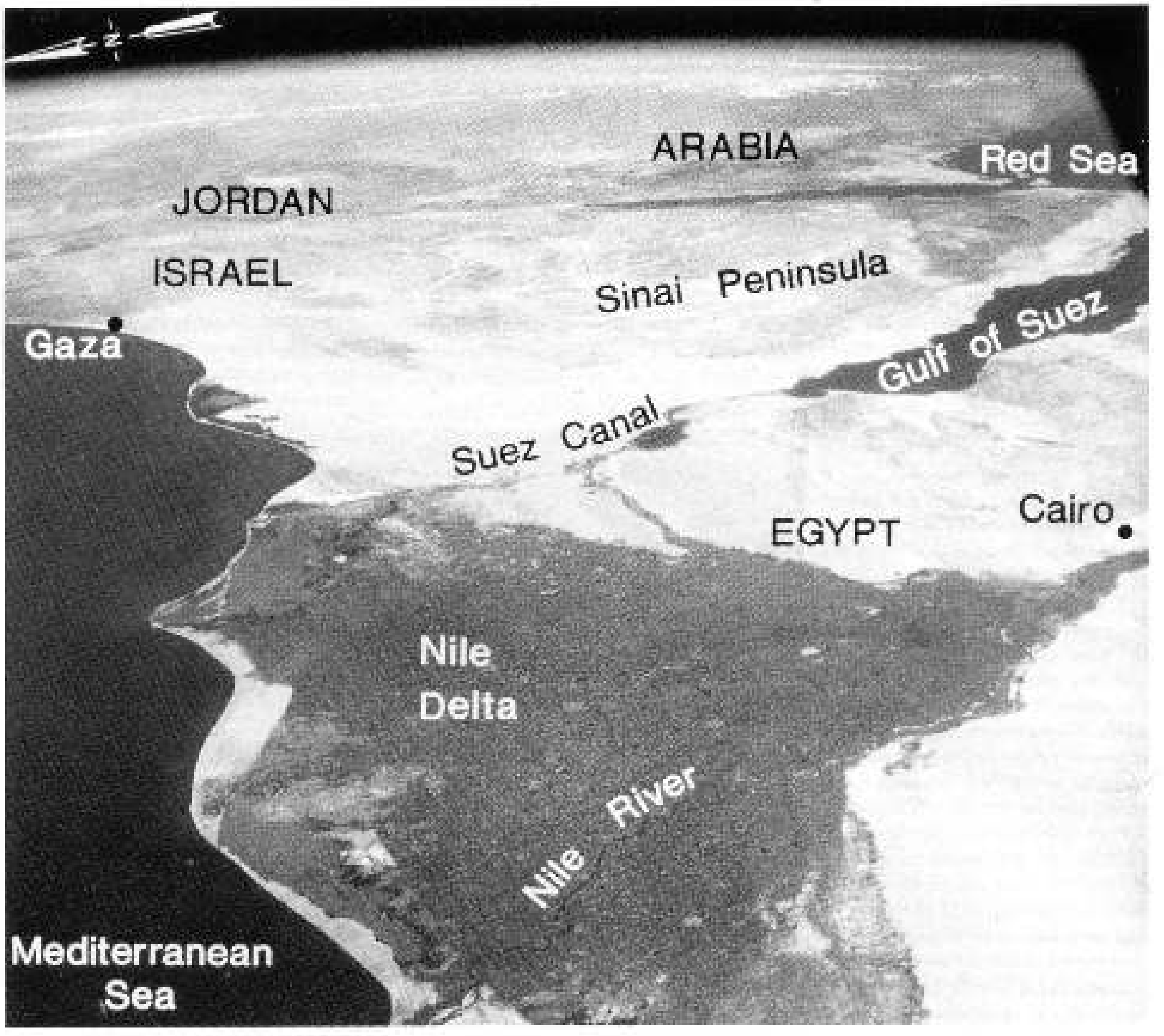


Fig. 1: Laboratory results of suspended sediments and chlorophyll concentrations along 25 km transect



KEYWORDS

RS, Oceanography, Nile Delta, Suspended Sediments Monitoring, CZCS

Above: Fig. 2: Oblique space color photography of the southeastern Mediterranean taken by Gemini astronauts

Below: Fig. 3: Spatial distribution of suspended sediments in the southeastern Mediterranean as analyzed from CZCS data, bands 1,3 and 4

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