

A central Tyrrhenian Coastal Area as a dynamical test site

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The central Tyrrhenian coastal area extending from the gulf of Naples to the gulf of Gaeta up to Capo Circeo faces a highly urbanized zone, receives industrial pollutant discharges and the runoff of important rivers and includes a variety of coastal and bathymetric features. For these reasons such an area appears to be an ideal test site for coastal dynamical and diffusion studies.

In 1987, on the occasion of the "European Year of the Environment" a Sea Truth operation was carried out in this area, which was surveyed by the LANDSAT satellite, and led to the acquisition of chemical, physical (DE MAIO *et al.*, 1988, 1992) and biological parameters by means of in situ samples taken by ships. More recently, in 1991 two oceanographic cruises were devoted to CTD and direct surface current measurements. As a result a coherent vision of the local hydrology and dynamics has been obtained whose main characteristics will be briefly presented below (they refer to a typical autumn situation).

A homogeneous upper layer of water 20-70 m thick is present, with a temperature of 17.8-18°C (decreasing down to 14°C) and a salinity of 37.80, in which vast regions of less saline water (34-32) due to the Garigliano and Volturno river runoff are observed. The shape of the thermocline and its link with the Levantine Intermediate Water are indicative of baroclinic motions.

The horizontal σ_t distribution in the upper layer shows clearly the transport directed toward the Circeo, between the isles of Ischia and Ventotene. Moreover, the gradual variation between coastal waters ($\sigma_t < 27.5$) and Tyrrhenian waters ($\sigma_t > 27.5$) is modified by the intrusion of a tongue of dense water in the area between Circeo and Gaeta. Between Ischia and the mouth of Volturno a lens of denser water with $\sigma_t > 27.5$ reveals a dynamic dependence on exterior waters. On the other hand the gulf of Naples appears isolated with respect to this situation, in that it contains less dense waters, especially in its innermost part.

Dynamic calculations based on the hydrological data are in good agreement with the surface currents measured from ship. The northward flow along Ischia and Ventotene turns abruptly to anticyclonic rotation in correspondence to the sill between Ponza and Gaeta, which in fact produces anticyclonic relative vorticity according to the conservation of potential vorticity. More south, NW of the island of Ischia a slow gyral motion is observed. It appears related to the dynamics of the gulf of Naples with which the area is connected through the channels of Ischia and Procida.

Numerical studies based on a sea-breeze model (DALU and PURINI, 1981) and on the shallow water equations for a one-layer and a multi-layer ocean are under way, aimed at reaching a deep understanding of the local dynamics and its dependence on local forcings and on the larger scale circulation. The advection-diffusion equation is also being used for modelling the intrusion of fresh waters from the rivers runoff.

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Liquid and sediment inputs of the Danube River into the North-Western Black Sea

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Black sea represents an ecological system whose evolution is impossible to be understood all the less prognosticated without a complex, multidisciplinary research, systematically and homogeneously accomplished by all riparian countries in cooperation or at least in a permanent exchange of informations. Unfortunately, up to now these desiderata have not fulfilled, the performed research having rather a local character and marked specificity. Thus, at present it has been ascertained the existence of a heterogenous data fund both as measurement methodology and as systematisation style or as processing level of the measurements for almost any discussed parameter.

For these reasons an analyse in the knowledge level of the Black Sea in all respects appears to be necessary, the knowledge of its liquid and sediment inputs being one of the most important. Since the highest quantity of river water which flows into the Black Sea there is in the North-Western part - 81%, the Danube being responsible for about 64% from the total supply (about 200 km³/year), in the present paper a concise review on the quantitative and qualitative estimations concerning the liquid and sediment inputs of the Danube River will be made. In order to prepare this synthesis it was used the results obtained by the scientific staffs from the National Institute of Meteorology and Hydrology - which carried out the synthetic measurements of the liquid discharge of the Danube and its main tributaries on the Romanian territory; Institute of Geology and Geophysics - the producer of the synthetic studies concerning the solid discharge of the Danube and the evolution of the deltaic and the Romanian nearshore zones; Romanian Institute for Marine Research - the author of systematic studies regarding the quality of the Black Sea waters on the Romanian shelf and the evolution of ecological system constituted by these.

The first part of the paper refers to the liquid input of the Danube. Its first chapter presents the informations regarding the liquid discharge of the Danube into the sea : the multiannual mean values for various periods (the longest one being 1858-1988); the extreme values of the variation range and the multiannual monthly means. A comparison between the evolutions of annual means of Danube discharge at the inlet into the Danube Delta and at the outlet into the Black Sea is made.

The second chapter refers to the chemical characterize of the Danube Waters. Thus, the variation range of the main chemical parameters of the Danube waters before the building of the Iron Gates dams (1970) is presented. Then, a review of the annual means of the major chemical parameters after 1970, for various points of the Danube route along the Romanian territory simultaneously and at the outlet into the Black Sea make evident the progressive increase of the total ionic content. After that, a comparison between the ionic and liquid annual discharges, before and after 1970, for the nitrogen, phosphorus and silicon ions, is given. Further on, a comparative table of percentage content of main ions for the Danube waters at the outlet into the sea and that of the sea waters in the same zone is presented. Finally, there are the values of the main statistical parameters characterizing the major chemical constituents own of the marine coastal waters at Constantza, evolving the pollution indices of them.

In the framework of the second part of this paper, the solid input of the Danube is discussed. Its first chapter include the informations concerning the solid discharge of sediments : the multiannual mean values, the extremes of variation domain and the percentage repartition of the sediments transported among the three branches of Danube. A comparison between the situation existing anterior the building of the Iron Gates dams and the subsequent one is given.

Also, a comparison between the evolution of the annual mean values of the solid discharge at the inlet into Delta and at the outlet into the sea is describe.

The second chapter has in view the chemical, mineralogical and textural characteristics of bed and suspended load of the Danube at the outlet into the Black Sea. The mean values and the variation domains of the main chemical parameters of the sediments as well as the percentage mineralogical composition are presented, pointing out the heavy minerals. Afterwards, the granulometric characteristics of the major lithologies types in the transported sediments both on the main Danube branches and on the canals are evinced.

The third part of the paper refers to the Danube solid and liquid inputs on the marine deltaic zone and on the littoral morphodynamics. Thus, recent research (1990 and 1991), spotlighting Danube as the main pollutant agent of the marine environment in the North-Western shelf, where the majority of the trace elements appear in higher concentrations compared with those of older pre-industrial sediments, are presented. Further on, the modifications of deltaic zone configuration are discussed and a few littoral morphodynamic processes which are going under the obvious influence of Danube sediment input are enumerated : the general trend of progradation of the Danube Delta; the modifications of the Delta front slope and of sea bottom and inshore zone configuration.

In the last part of the paper, there are presented the recent direct measurements of the liquid and solid discharges in the various sections of the Sf. Gheorghe branch. Also, there are enumerated the critical problems and the major desiderata concerning the research of the ecologic system constituted by the Danube River, Danube Delta and the North-Western part of the Black Sea.