Marine coastal monitoring in the Gulf of Manfredonia (Southern Adriatic Sea)

Consiglio Nazionale delle Ricerche

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OBJECTIVE

In the Gulf of Manfredonia little information about the hydrochemical assessment was available so that an extensive real time oceanographic buoy and near real time vessel monitoring programme (from 2002 to 2005) were carried out in the context of the PITAGEM Project. Preliminary results and conclusions of this monitoring programme are described and discussed in this work.

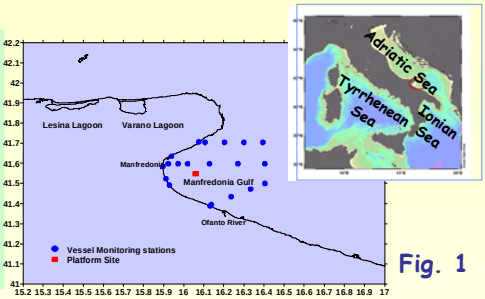


Fig. 1

STUDY AREA

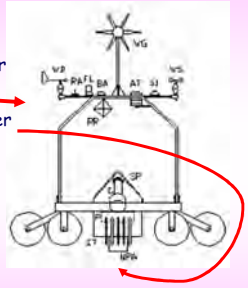
The Gulf of Manfredonia is a shallow area located in the South Western Adriatic Sea (Fig. 1). In the Gulf a cyclonic or anti-cyclonic gyre is observed, depending on wind direction. The offshore area of the Gulf is influenced by the coastal current flowing Southward along the Western coast of the Adriatic basin (Artegiani et al., 1997) .
The main rivers flowing into the Gulf are the Ofanto River, with an average flow of 13.9 m3/sec, and the Candelaro River, average flow of 0.9 m3/sec, lower in Summer (Simeoni, 1992). Other rivers are negligible.

METHODS

The integrated monitoring programme (from 2002 to 2005) consisted of oceanographic and atmospheric measurements, performed by a coastal multiparametric buoy, and periodic oceanographic surveys carried out by a coastal vessel.

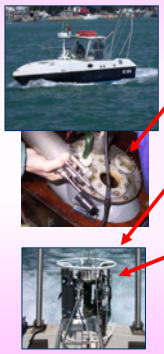
The coastal platform was equipped with (Zappalà and Azzaro, 2004):

- a meteorological station, collecting temperature, pressure, solar radiation, wind speed and direction each hour;
- 5 sensors for in situ temperature measurements, at the same water sampling depths of the pumping system.



Data processing and publication

- Data acquired by platform instrumentations were automatically transmitted in real time, via GSM e-mail, to the computer server of the IAMC-CNR of Messina and inserted in a data bank.
- Data obtained by the coastal vessel monitoring are manually inserted in the same data bank.
- Data are validated by a quality check procedure, the database are accessible on Internet through a web page (www.fg.ismar.cnr.it/progetti/pitagem).



The coastal vessel was equipped with:

- a multiparametric probe for horizontal and continuous tracking of temperature, turbidity, salinity, dissolved oxygen, pH, in vivo fluorescence;
- a rosette to collect water samples at different depths for ammonia, nitrite, nitrate, phosphate, silicate, total nitrogen and phosphorous, chlorophyll *a* and suspended solids analyses
- a multiparametric probe for vertical profiles of temperature, salinity, pH, dissolved oxygen and fluorescence.

RESULTS

Buoy data (from august 2004 to april 2005)

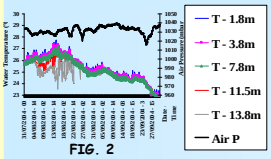
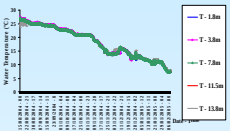


FIG. 2

Water temperature at the five depths describes the mid-summer, autumn, winter and early-spring cycle due to seasonal cooling and heating. At the beginning of August 2004 good atmospheric conditions allowed the set up of a water column stratification (Fig. 2). The stratification was interrupted by a weak perturbation showed, in this case, by an air pressure gradient (Fig. 2).



From mid-August 2004 to the beginning of February 2005 the water column appeared homogenous and well mixed with a gradual water column cooling (Fig. 3). In this period some inverse stratification events, following good whether conditions and interrupted by atmospheric perturbations, were present.

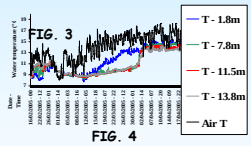


FIG. 3

FIG. 4

In mid-March surface layer temperature increased from 9 °C to 15 °C in 15 days with a thermocline presence between 2 and 7 m depth (Fig. 3), following, about 3-4 days later, the air temperature warming. At the beginning of April 2005 also the deep layer temperature increased (from 10.9 °C to 13.8 °C) for a water column mixing consequent to the arriving of a new perturbation, showed, in this case, by an air temperature decrease (Fig. 4); the water column was homogeneous until the end of April.

coastal vessel data (from may 2002 to november 2004)

Spring parameter distributions allowed to distinguish three different zones (Fig. 5): a coastal area with lower salinity and higher temperature at the top and higher fluorescence and dissolved oxygen at the bottom respect to an offshore area; an offshore area characterized by strong water column stratification with higher salinity, lower temperature and a fluorescence and dissolved oxygen peak down to 20 depth; a central area characterized by intermediate values and a bottom water mass with higher salinity and fluorescence and lower temperature. In Summer the physico-chemical and biological processes affecting the Gulf were the same of Spring, but with higher temperature, higher primary production and ipoxic events.

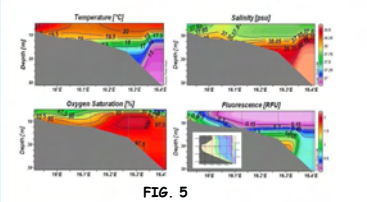


FIG. 5

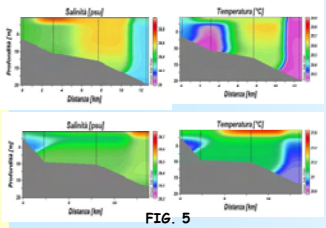


FIG. 5

In Autumn (Fig. 5) a vertical front divided an offshore area characterized by low temperature and salinity and a central area with higher temperature and salinity. Near the coast, in front of the main rivers, areas with lower temperature and lower salinity were present.
These seasonal patterns reveal the presence of the Western Adriatic Current flowing Southward in the offshore area, down to 20 m in spring and summer and on the whole water column in fall, and the influence of the river inputs in the coastal area. Finally "old" waters", with properties of the previous season, are present in the central area where also offshore and coastal waters are introduced by cyclonic or anti-cyclonic gyres.

In spring, the high values in surface distribution of temperature, fluorescence, phosphate and suspended solid and low values of salinity near the coast (Fig. 7) confirmed the inputs of the fresh, colder, nutrient rich and highly productive waters of the Candelaro River.

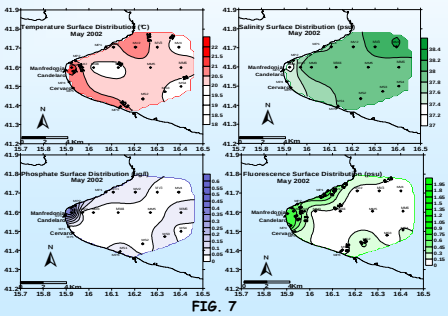


FIG. 7

In Spring, the temperature decrease and salinity, fluorescence and suspended solid increase in the bottom offshore area of the Gulf (Fig. 8) marked the presence of the Western Adriatic Current flowing Southward near the bottom (down to 20 m depth).

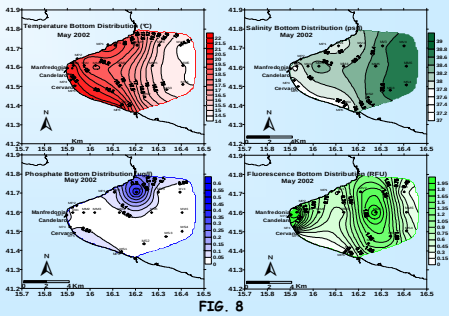


FIG. 8

CONCLUSIONS

Buoy monitoring data showed that, in the Gulf of Manfredonia, annual variations of the water column structure depend on seasonal air temperature trend, while short-term variations depend on other factors such as daily air temperature and local atmospheric perturbations. Vessel monitoring data highlighted three different zones: a coastal, a central and an offshore area.
The coastal area is affected by the river inputs (Candelaro and to a lesser extend Cervaro). The offshore area is affected by the Western Adriatic Current flowing Southward. The central area is a transitional zone with intermediate characteristics resulting from the interaction between the coastal and offshore area, in consequence of local circulations, or an older zone with memories of the previous season.

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