

The PIT AGEM Project: an example of integrated, continuous, and punctual coastal monitoring in the Gulf of Manfredonia, adjacent to the Gargano National Park

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Abstract - The PIT AGEM project includes bi-monthly water monitoring, platform monitoring, and primary production and biogeochemical characterization of the Gulf of Manfredonia (southern Adriatic Sea). The bi-monthly monitoring consists of continuous, horizontal tracking of surface physico-chemical parameters (temperature, salinity, dissolved oxygen, pH, in vivo fluorescence and turbidity), and vertical physico-chemical profiles and sub-surface and bottom water sampling for suspended solid and nutrient (N-NH₃, N-NO₂, N-NO₃, P-PO₄, Si(OH)₄) analyses. The platform provides meteorological data and high frequency monitoring of temperature, salinity, dissolved oxygen, fluorescence, turbidity and compounds of N and P at 5 depths. Two oceanographic cruises are planned to provide information on primary production and biogeochemical cycles of nutrients in sediment and in the water column. At this stage, the boat monitoring and the platforms are still being tested, however, the first of the two cruises was completed on October 2002. This paper shows the program and some preliminary results.

1. Introduction

The PIT AGEM project (Integrated Methodologies for the Study of Marine Trophic Processes and Deployment and Management of Oceanographic Platforms for Marine Monitoring) is one of eleven projects participating in plan CLUSTER 10 (Marine Program).

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The overall goal of CLUSTER 10 is to provide new infrastructures and implement new marine programs in the southern areas of Italy. An efficient control system aimed at monitoring pristine or impacted coastal areas requires near real time high quality data, providing information on the status of the area of interest. The overall goal of PIT AGEM is to set up an automatic and continuous monitoring system in the area Gargano-Manfredonia, which can estimate in near real time the status of the system and the perturbation entity, in order to develop a baseline characterization and allow prompt intervention.

1.1. Study area

The Gulf of Manfredonia, on the Apulian coast, is situated just south of the protected area and tourist resort of the Gargano promontory (Gargano National Park). The gulf is characterized by limited circulation and high sedimentation rate (Bianchi et al., 1984; Damiani et al., 1988). Little is known about the ecological assets of the gulf. Recent investigations about surface circulation and current measurements in the Adriatic Sea confirm a cyclonic circulation in the southern sub-basins (Kovacevic et al., 1999; Poulain, 2001) characterized by seasonal variability (Poulain, 1999). A cyclonic gyre is often observed in the Gulf of Manfredonia, but may reverse depending on wind direction (Signell, pers. comm.). Studies about the distribution of heavy and light minerals indicate that the sediments supplied by the Ofanto River (the main sediment supplier of the Gulf of Manfredonia) are distributed to N-NW by longshore drift and by nearshore currents belonging to a clockwise eddy system (Oeltzschner, 1973).

Sedimentological investigations in connection with current measurements show that the distribution of bottom sediment types is essentially the result of wave influence, grain-size decrease with increasing water depth (Fabbri et al., 1972; Fabricius et al., 1972; Sigl, 1973). A high anthropogenic load characterizes the gulf, which is subject to high industrial, urban and agricultural inputs.

1.2. Project objectives

One objective is to develop techniques and instrumentation for near real-time environmental monitoring and ecological assessment in coastal waters. An 8- m vessel has been equipped for automatic, continuous, horizontal recording of physico-chemical parameters. In addition, an oceanographic platform for high frequency (hourly) collection of meteorological and water column data has been built and has been deployed in the Gulf of Manfredonia.

An other objective of PIT-AGEM is the execution of two multidisciplinary oceanographic cruises aiming at studying primary production and biogeochemical processes in the Gulf of Manfredonia.

2. Bimonthly monitoring

Bi-monthly water monitoring will be performed in the Gulf of Manfredonia using a boat equipped with an on-board pumping system and a keel-mounted IDROMAR probe for automatic, horizontal, continuous tracking of surface physico-chemical parameters (temperature, salinity, dissolved oxygen, pH, in vivo fluorescence and turbidity). In addition to the horizontal tracking, the program includes fixed station sampling along transects perpendicular to the coast (Fig. 1). Such sampling will provide vertical multiprobe profiles of temperature, salinity, pH, dissolved oxygen, fluorescence (SBE 19 Plus) and sub-surface and bottom water sampling for suspended solid and nutrient (N-NH_3 , N-NO_2 , N-NO_3 , P-PO_4 , Si(OH)_4) analyses. The grid plan of fixed stations has been based on bathymetry, topography and river inputs of the gulf. In fact, bathymetry and topography are the features that dominate the circulation structure inside the gulf, while rivers modulate the natural and anthropic inputs in the gulf.

Quality control of nutrient data will be performed through analyses of samples that include blanks, certified reference materials and duplicate samplings. We will also participate in an intercalibration exercise with the IAMC-CNR of Messina (Italy), responsible of the SAM project. The accuracy of physical parameter data measured with the on-board system will be verified by comparing it with the in situ measurements from the SBE 19 Plus. In turn the data of SBE 19 Plus will be verified with an intercalibration exercise made in conjunction with the participants of an international monitoring and modelling project, the ADRICOSM project.

3. Platform monitoring

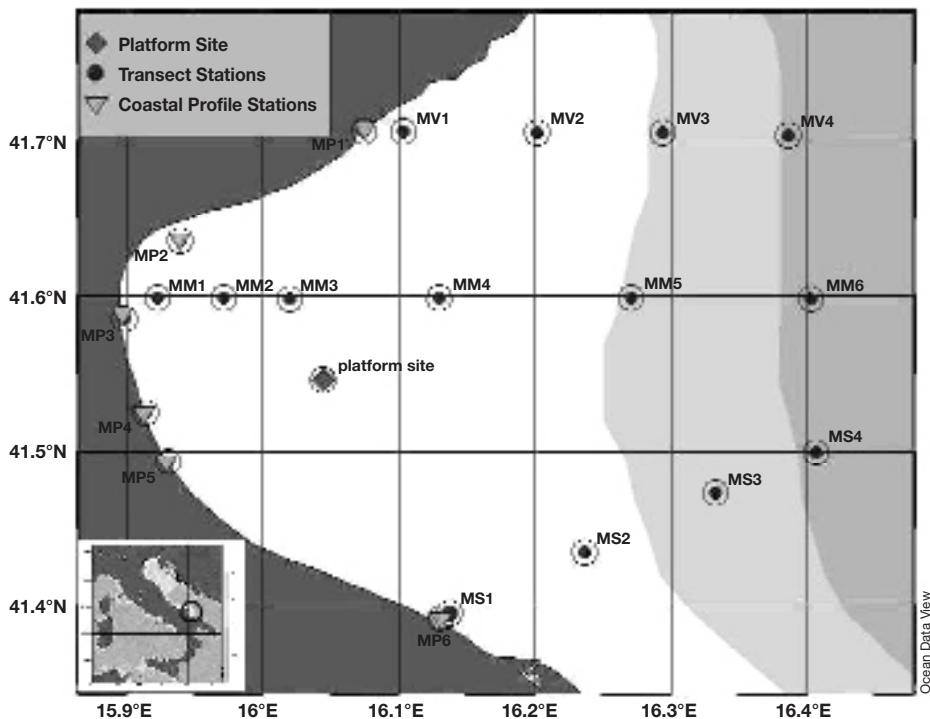


Fig. 1 - Map of bi-monthly sampling and platform stations in the Gulf of Manfredonia.

The platform in the Gulf of Manfredonia is equipped with a meteo station, recording temperature, pressure, irradiance, wind speed and wind direction at hourly (1) frequency; five in situ temperature sensors at five selected depths (1 m, 4 m, 9 m, 11 m, 13.5 m); a pumping system that collects water samples at these depths and carries them over the platform for analysis; an IDROMAR multiparametric probe on the platform with temperature, conductivity, dissolved oxygen, fluorimeter and turbidimeter sensors, and a SYSTEVA automatic colorimetric nutrient analyser for N and P compounds, also mounted on the platform to analyse water sampling. Physico-chemical parameter measurements will be performed every 6 hours and nutrient measurements once a day at all five depths (note that sampling frequency can be modified). The data collected will be transmitted via a mobile phone (SMS) to a data bank associated with the SAM (Sistemi Automatici di Monitoraggio) project.

Physico-chemical data from the platform will be verified with data from a simultaneous deployment of the SBE 19 Plus probe, this will allow comparison of the physico-chemical data of the five depths with in situ values, while the nutrient data from the platform (NP analyzer) will be compared in the laboratory with the analyses of samples collected at the same depths.

4. The RIMA Network

An added value of the PIT AGEM is its coordination with another CLUSTER 10 project, the SAM project, to form the RIMA network. On the whole the RIMA network consists of seven similar marine platforms, five around Sicily and two along the Apulian coast, and three boats to perform the bi-monthly monitoring in north-eastern Sicily, in the Gulf of Taranto and in the Gulf of Manfredonia. At the moment all RIMA platforms have been deployed but need more adjustment.

5. Multidisciplinary cruises

In addition to the monitoring program, the PIT AGEM project includes two oceanographic cruises with the aim of measuring phytoplanktonic primary production in the Gulf of Manfredonia and the influence of sediments on the chemistry of the water column. These cruises aim to obtain detailed information on water mass circulation and phytoplankton processes in the Gulf of Manfredonia during two seasons, fall and spring. The fall cruise was carried out in October 2002, the spring cruise will be carried out in March 2003. Physical, chemical and biological measurements will be made with a multiparametric probe equipped with a Seapoint chlorophyll fluorometer and a turbidity meter. The water column will be sampled at different depths to determine salts of N and P, photosintetic pigments (chlorophyll-a and feopigments), particulate organic carbon (POC) and particulate organic nitrogen (PON). At selected stations size-fraction phytoplanktonic biomass and carbon assimilation rates will be measured. Optical measurements of photosynthetically available radiation (PAR) will be carried out to measure

S_PAR and profiling UW_PAR and natural fluorescence.

Vertical tows (0-200 m) at seven stations with a BIONESS multi-net (mesh 250 μm), in conjunction with a CTD and an Optical Plankton Counter (size-fraction 200-3000 μm), will provide information on the quality and quantity of the secondary trophic level in the Gulf of Manfredonia.

At two selected stations (Fig. 2) nutrient (N-NH₃, N-NO₂, N-NO₃, P-PO₄, Si(OH)₄, CO₂, O₂) and some metal (Fe, Mn, Ca, Mg) fluxes will be measured at the water-sediment interface with benthic chambers, to estimate the influence of the benthic system on the water column chemistry. At the same stations, a sediment core will be collected to study early diagenesis processes leading to the nutrient and metal release or sinking.

In addition, an extensive surface sediment sampling (Fig. 3) will be carried out in the Gulf

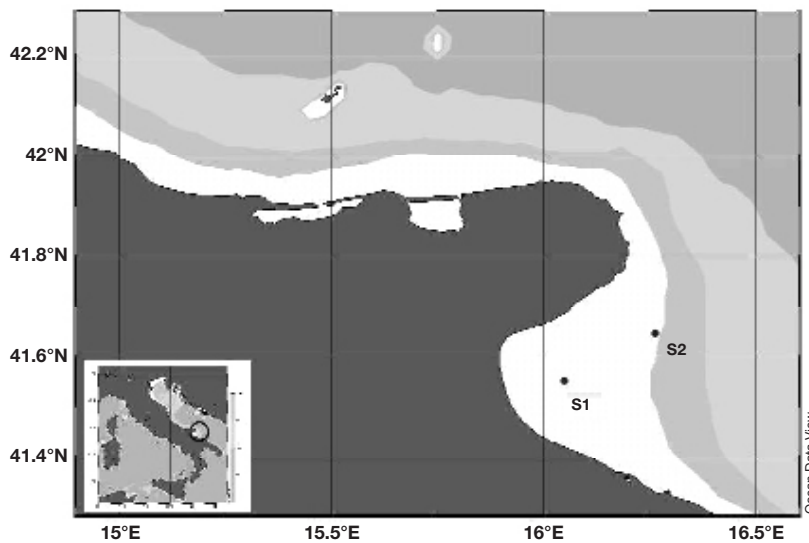


Fig. 2 - Position of the two stations for nutrient flux measurements at the water-sediment interface.

of Manfredonia to study sedimentological (grain size) and biogeochemical (organic and total carbon, total nitrogen, organic, inorganic and total phosphorous, trace element) parameters.

6. Preliminary results

In Fig. 4 an example of the May preliminary bi-monthly monitoring cruise is shown. The results indicate water column stratification during this month, both for salinity and temperature. Dissolved oxygen reaches minimum values in the top 2 meters and increases downwards. Chlorophyll-a concentrations are low at the surface and increase steeply near the bottom.

Examples of platform conductivity and temperature from 15 October to 28 October 2002 are reported in Fig. 5. Conductivity and temperature data at all 5 depths (1 m, 4 m, 9 m, 11 m, 13.5 m) show a homogeneous trend on a temporal sequence.

Fig. 6 shows the preliminary results of the October 2002 cruise. The thermo-haline structure

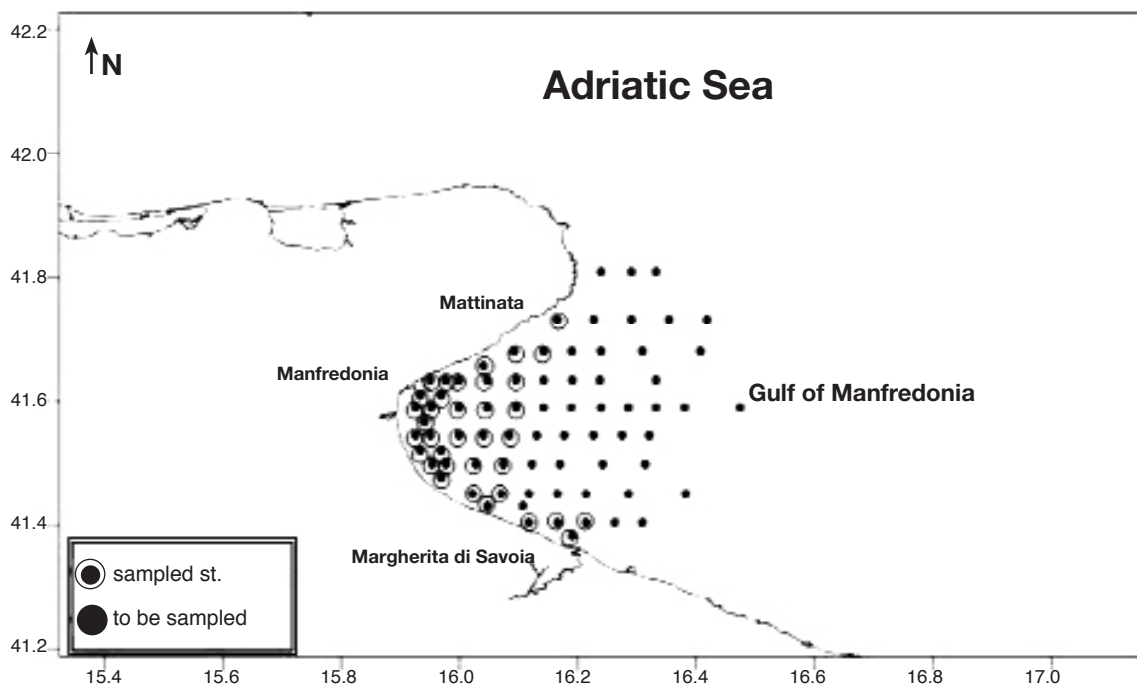


Fig. 3 - Map of extensive surface sediment sampling stations.

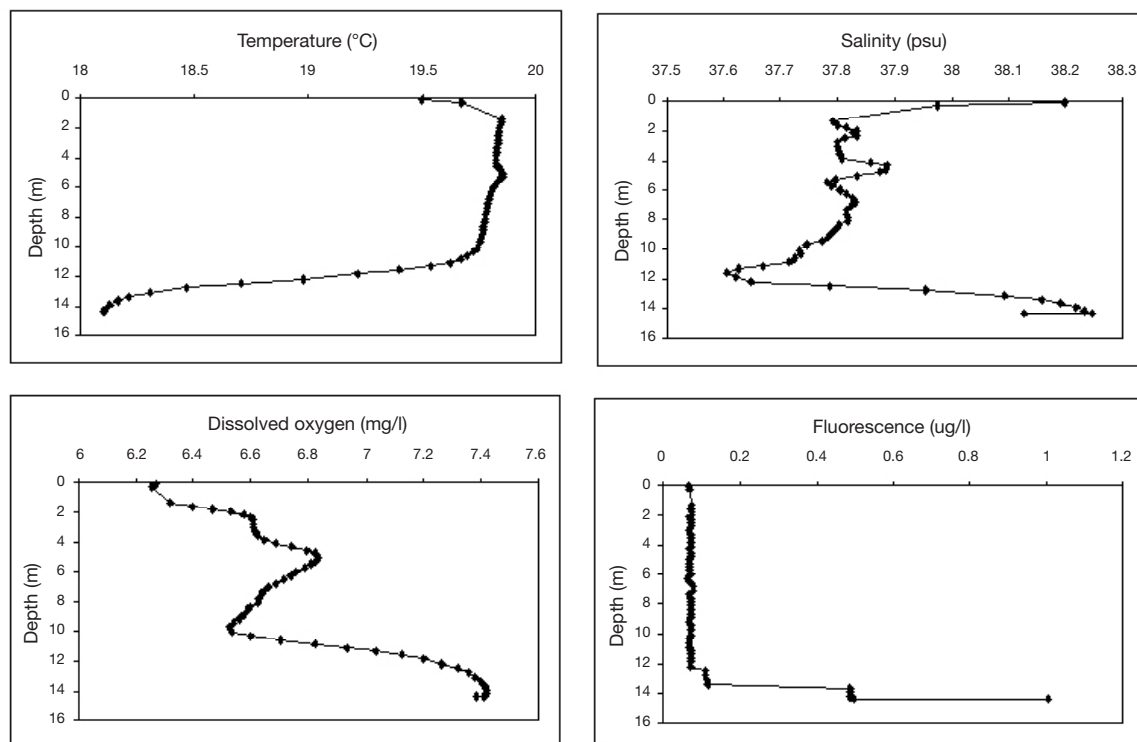


Fig. 4 - Preliminary CTD results of the station MM4 (see Fig. 1) in the central transect.

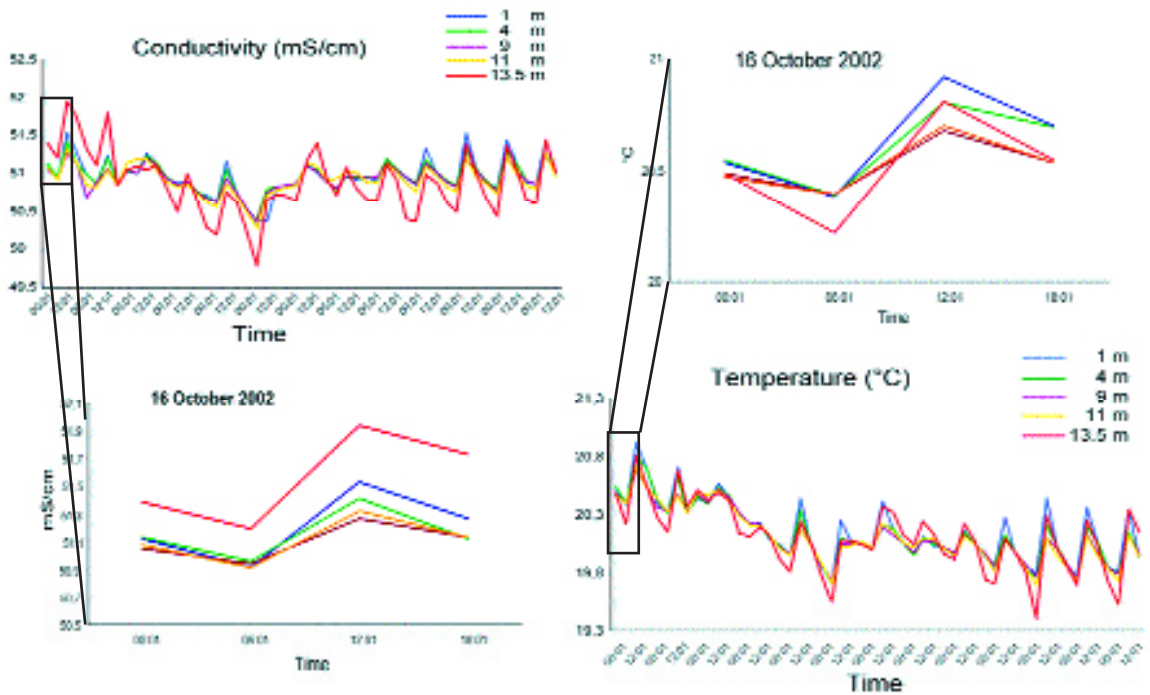


Fig. 5 - Conductivity and temperature data from the platform in the Gulf of Manfredonia (see Fig. 1).

along the main inshore-offshore transect of the gulf shows the presence of well stratified waters, whereas the fluorescence shows a deep chlorophyll maximum near the bottom (15-20 m) in coastal waters and at greater depths (about 60 m) more off-shore.

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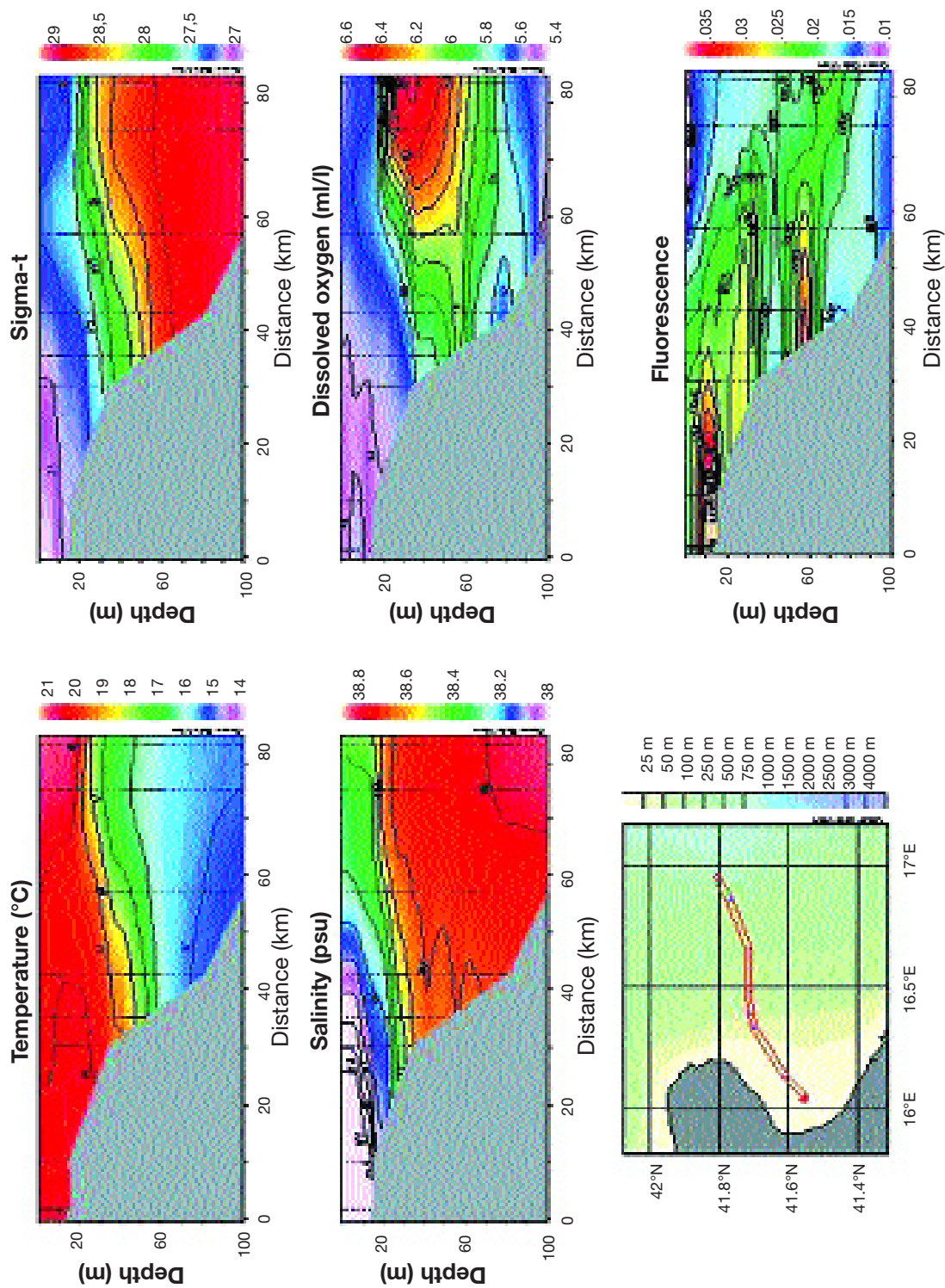


Fig. 6 - Preliminary results of the first multidisciplinary cruise (October 2002).

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