Consiglio Nazionale delle Ricerche

ISMAR - ISTITUTO DI SCIENZE MARINE sede di La Spezia

MEDOCC 06

- Cruise Report -

8th June 2006 – 3rd July 2006

CNR ISMAR Institute for Marine Science

CNR IBF Institute for Biophysics

CNR IAMC Institute for Coastal and Marine Environment

NURC Undersea Research Centre

University of Genova

University of Siena

ENEA – CRAM

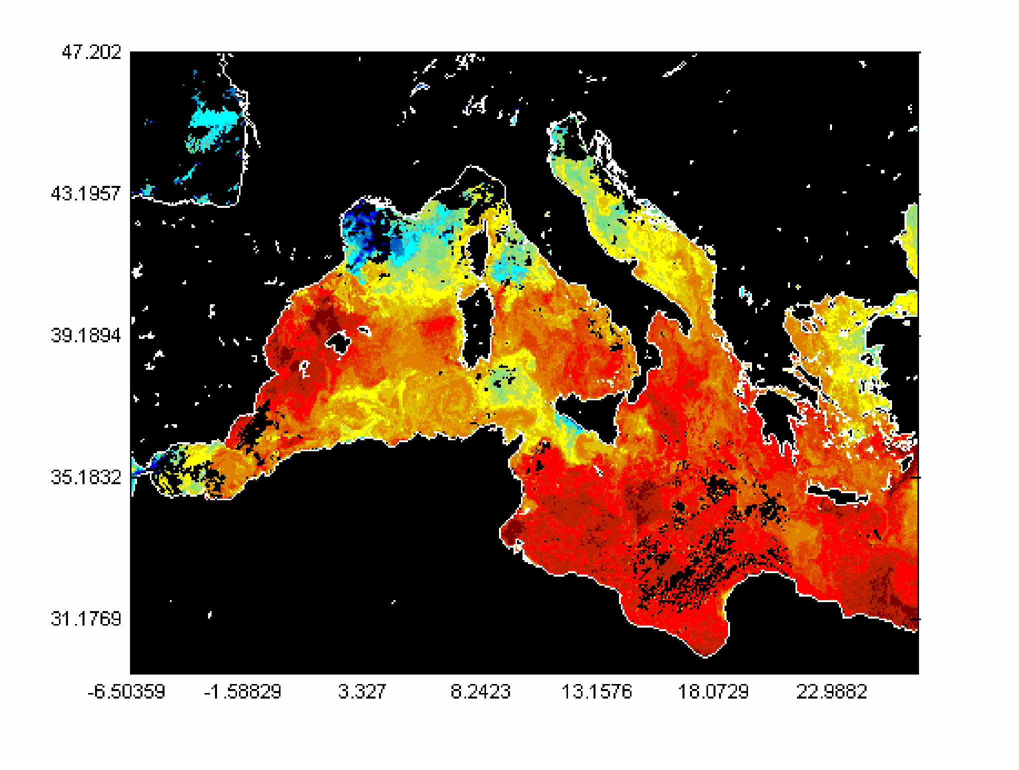
University of Tuscia

Edited by M. Borghini & K. Schröder

Table of Contents

Cruise Summary

NAME	*MEDOCC 06*
DATES	*8TH JUNE 2006 – 3RD JULY 2006*
STUDY AREA	*LIGURIAN SEA* *GULF OF LIONS* *BALEARIC SEA* *ALGERIAN BASIN* *CENTRAL MEDITERRANEAN SEA* *TYRRHENIAN SEA* *SICILY CHANNEL*
HEAD OF MISSION	*MIRENO BORGHINI, CNR-ISMAR*
PARTICIPANT INSTITUTES	*CNR – ISMAR* *CNR – IBF* *CNR – IAMC* *ENEA – CRAM* *NURC – UNDERSEA RESEARCH CENTRE UNIVERSITY OF SIENA* *UNIVERSITY OF GENOVA* *UNIVERSITY OF TUSCIA*
RESEARCH VESSEL	*URANIA*
DEPARTURE PORT	*RAVENNA*
ARRIVAL PORT	*CIVITAVECCHIA*



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Scientific objectives

This report presents the preliminary results obtained during the MEDOCC 06 cruise, carried out from 8th June – 3rdMay 2005, on board of the Italian R/V URANIA in the Western Mediterranean Sea.

The cruise was planned in order to achieve the following objectives:

1. **Water mass properties and circulation features**
   - **to define the principal circulation paths and the physical-chemical-biological properties (temperature, salinity, oxygen, nutrients, dissolved organic carbon, colored dissolved organic matter, etc) of the superficial, intermediate and deep water masses in the central part of the Western Mediterranean Sea, through measurements along key sections located in the interior and at the boundaries of the basin;**
2. **Carbon cycle**
   - **to investigate the linkage between the quantities and qualities of DOC and CDOM (e.g. specific absorbance, spectral slope and specific spectral slope) and to study the interactions of these parameters with the spectral irradiance in the water column;**
   - **to study the optic characteristics of the water column in the visible and UV solar bands, to measure UV-B, UV-A and PAR radiation on the water surface, to evaluate reflectance on the water surface;**
3. **Cetacean Research**
   - **to study cetacean communities and to map the distribution of mesopelagic fauna related both to the presence of cetaceans and to hydrology in the Ligurian–Provencal Basin;**
4. **Methodological development**
   - **to compare different chlorophyll quantification methods and to calibrate the fluorimeters coupled with the CTD-probe with different photochemical techniques.**

Scientific Background

General description

This cruise has been planned to investigate the central part of the Western Mediterranean Sea. We will try to better define the pathway and the properties of the water masses involved in the circulation of this basin and to assess the carbon export from the photic zone to the deep layers. The focus was on defining the characteristics of:

- the **water masses**, involved in the dense water formation processes (Modified Atlantic Water from the Ligurian Sea; Levantine Intermediate Water and Tyrrhenian Deep Water, coming from the Tyrrhenian Sea);
- the **newly formed water masses** (Winter Intermediate Water and Western Mediterranean Deep Water);
- the **Algerian current** (Modified Atlantic Water and re-circulated Levantine Intermediate Water) which apparently are not involved in the above mentioned processes.

Furthermore the processes involved in the dense water formation allow the replenishment of nutrients into the upper layer, followed by a bloom with locally high primary production rates and high carbon export from the photic zone to the deep layers. Another important aspect is the difference in carbon export between a mesotrophic area (Gulf of Lions in spring) and the oligotrophic ones in the rest of basin. The role of oligotrophic areas in overall export production is probably not very important, because the greatest part of photosynthesised carbon is recycled in the surface layer and raplidy re-excanged with the atmosphere.

The cruise approach takes into account a possible reiteration of the survey in the following years in order to evaluate the interannual variability of the basin's conditions and its role in climatic processes. Therefore we have defined a series of key section, both in the interior of the basin and on its boundaries. The sections have been chosen to be able to intercept every inflowing and outflowing water mass. Previous studies have indicated that the most suitable section for this purpose are:

- the **Sardinian Channel**
- between **Corsica and France**
- between **Majorca and Sardinia**

} these sections are crossed by the water masses that are involved in the dense water formation processes

- through the **Gulf of Lions**

} the dense water formation area

- between **Majorca and Spain**
- between **Majorca and Algeria**

} these sections are crossed by the newly formed water masses

A long term survey in these sections could provide significant information to understand the evolution of the trends observed in the deep waters of this basin (increased salinity and temperature): climatic processes (dense water formation), anthropogenic processes (damming of the main rivers) and/or physical processes (warmer water originated in the Eastern Mediterranean Sea).

A further relevant question is if there is a related trend even in the chemical and biological characteristics of the involved water masses.

The central part of the Western Mediterranean Sea plays an important role in the circulation of the whole Mediterranean Sea, because of the presence, in its northern part, of dense water formation areas.

The **Ligurian–Provençal–Balearic Basin**, (along with the **Gulf of Lions** and the **Balearic Sea**) forms the North-western Mediterranean Basin. This region is characterized by a general cyclonic circulation involving both the surface layer of Modified Atlantic Water (MAW) and the Levantine Intermediate Water (LIW) layer below. In winter, these basins are sites of important dense water formation processes capable of triggering convective flows within the water column. The processes are particularly intense in the Gulf of Lions (MEDOC Group, 1970; Leaman and Schott, 1991), even though they have also been reported in the Balearic Sea (Salat and Font, 1987) as well as in the central part of the Ligurian Basin (Sparnocchia et al., 1995 ; Gasparini et al., 1999). In these basins, however, due to the less severe weather conditions, cooling and mixing are less intense and only involve the MAW layer. They lead to the formation of a Winter Intermediate Water (WIW), which is a cooled and mixed MAW that reaches the buoyancy equilibrium between the MAW and the LIW layers. The WIW formation was observed both in the basin interior along the coastal zone and different sinking mechanisms have been proposed (Gasparini et al., 1999 ; Salat and Font, 1987).

The **Gulf of Lions** is mainly characterised by a permanent cyclonic circulation and manifests strong seasonal variations of the physical and biochemical properties due to convective movements and deep mixing during the wintertime (Millot, 1999). In winter, the deep convection sets the homogenisation of the water column bringing saline water from the intermediate layer close to the surface. In the Gulf of Lions, the highest surface phytoplankton biomass develops in winter and spring due to the violent mixing and vertical injections of nutrient rich deep waters in the open-sea convective region.

In the **Algerian Basin** the MAW flow forms what is now commonly named the “Algerian Current” (Millot, 1985). This current is relatively narrow (30–50 km) and deep (200–400 m at the coast) near 0°E, but it becomes wider and thinner while progressing eastward (Benzohra and Millot, 1995). Its unstable character sometimes leads to the generation of meanders a few tens of km in wavelength, but the current continues flowing along the Algerian slope till the Channel of Sardinia (Morel and Andre, 1991). The mesoscale eddies in the Algerian Basin induce intense currents over the whole deeper layer and even close to the bottom (Millot et al., 1997).

The **Central Mediterranean** is characterised by a very complicated bottom topography, which directly affects the water exchange between the two Mediterranean basins (western and eastern Mediterranean Sea). The most salient features are the unequal depths of the boundary sections (Astraldi et al., 2002). In the Sardinia Channel (section D13-D21 in Figure 1), the silldepth is at about 1900 m, allowing the free exchange of the deep waters with the WMED, but in the Sicily Strait (section 410-432), the deeper sill is at about 430 m, thus imposing strong constraints on the exchanges with the EMED. In between, a wide area of very shallow waters off Tunisia provides a further obstacle to a direct connection between the two basins. All water masses outflowing at depth, both from the WMED (Krivosheya and Ovchinnikov, 1973; Hopkins, 1988) and from the EMED (Astraldi et al., 1996), are conveyed into the **Tyrrhenian Sea**, an intermediate basin whose southern part strongly interacts with the central Mediterranean. Section 212-291 is substantially formed by two main channels with a wide plateau in between. The deeper one, in the central part, directly connects the Tyrrhenian Sea with the Sardinia Channel and the WMED, and the other, adjacent to the Sicilian slope, connects, with an increasing depth, the Sicily Strait with the Tyrrhenian Sea.

Hence, this study area is a very complex system, with even extreme climatic conditions in its northern part and an almost sub-tropical climate in its southern part. It sustains one of the most productive areas of the whole Mediterranean Sea, with the vastest marine mammals and large fish community.

Further interesting aspects regard the hydrological properties (temperature and salinity) of the deep and intermediate layers, which have presented a positive trends for some decades. The reasons of this trend are not yet known. Furthermore, the water masses coming from this area constitute the principal source of the outflowing Mediterranean water at Gibraltar.

An increased knowledge about all these aspects will permit a more complete understanding of the role and the functioning of the Western Mediterranean Sea.

State of the knowledge

Previous studies in this area have focused on the dense water formation process and on the extension and evolution of the eddies in the southern part, while they have neglected the circulation features and the variability of the water masses induced by such processes. Even if the principal characteristics and the general circulation scheme are known for this area, it is necessary to clarify many aspects of the path and of the regulating mechanisms for each water mass.

Some important detailed studies of the basin concerned only the specific events. For instance, the dense water formation processes occurring in winter in the Gulf of Lions and in the Ligurian Sea have been extensively studied, both experimentally and through models.

Only recently more attention has been given to the productivity of the area and its relationship with the prevailing circulation processes. Also the southern part of the basin has been intensely studied. This area is characterized by anticyclonic eddies which move along the African coast toward the Sardinian Channel.

Further, some important Spanish studies have regarded the Catalan Sea.

Nevertheless, the circulation of the water masses and the variability of their physical, chemical and biological properties are substantially unidentified, because till now no wide-ranging approach has been adopted.

Cruise Plan

The following table summarizes the parameters that have been measured and the sampling group involved in the operation, while table 2 lists the sampling equipment and the methods of analysis.

Parameter/Instrument	Sampling Group
CTD/O2/rosette	CNR-ISMAR
LADCP	CNR-ISMAR
SADCP	CNR-ISMAR
XBT	CNR-ISMAR
Dissolved Oxygen	CNR-ISMAR
NO3, P04, SiO4	CNR-ISMAR – ENEA
Chlorophyll	CNR-ISMAR – ENEA – NURC
Mesopelagic fauna	University of Genoa
DOC	CNR-IBF
Spectroradiometer	University of Siena, CNR-IAMC -ME
Primary Production	CNR – IAMC -ME
Fluorescence	NURC – University of Tuscia

Table 1 Measured Parameters

Small-Volume Sampling	General Oceanics 24-place rosette with 10-liter bottles
CTD System	CTD SBE 911 plus
XBT	Deep Blue (Sippican Inc.)
Oxygen	Winkler titration
LADCP - SADCP	RDI WH SENTILEL OS
Nutrients	Samples only, no on board analyses
Chlorophyll	Filtration and analysis with Spectrofluorimeter
Mesopelagic fauna	ISAACS KIDD trawl
DOC	Filtration
Solar spectra transmission	Spectroradiometer EPP2000C (StellarNet Inc)
Primary Production	Incubation and filtration
Fluorescence	SeaTech, Aquatraca (max depth 6000 m), Aquatraca (max depth 2000 m), SCUFA, PrimProd

Table 2 Sampling equipment and analysis methods

The track is shown in Figure 1-2. We planned to spend 26 days at sea. The geographic boundaries of the survey are 37.00 °N - 43.75 °N latitude and 1.93 °E - 18.33 °E longitude.

The cruise began on the 08th June from Ravenna to Naples. During the navigation we launched XBTs probe. On the 12th June after leaving from Naples the cruise began with XBTs transect, after with a CTD/rosette section across the Sardinia-Sicily Channel (291-212) and in

Sicily Channel (438-405), we moved toward the next CTD/rosette section across the Sardinian Channel (D13-D21), doing the section in the Sardinian Channel (S1-S21), in the Algeria section (D1-D12), in the Balearic Sea (B1-B8), in the section (L1-L14) across the Gulf of Lions. In the Ligurian Sea the operations included subsurface tows using an ISAACS KIDD Midwater Trawl (IKMT) for mesopelagic fauna sampling in the same region of station section, (54-63; 64-53; 900-913). In the Corsica Channel we made section (111 – 100) and mooring recovery and re-deployment.

We arrived on the 03th July in the port of Civitavecchia.

The station list is shown in table 3.

Cruise Maps

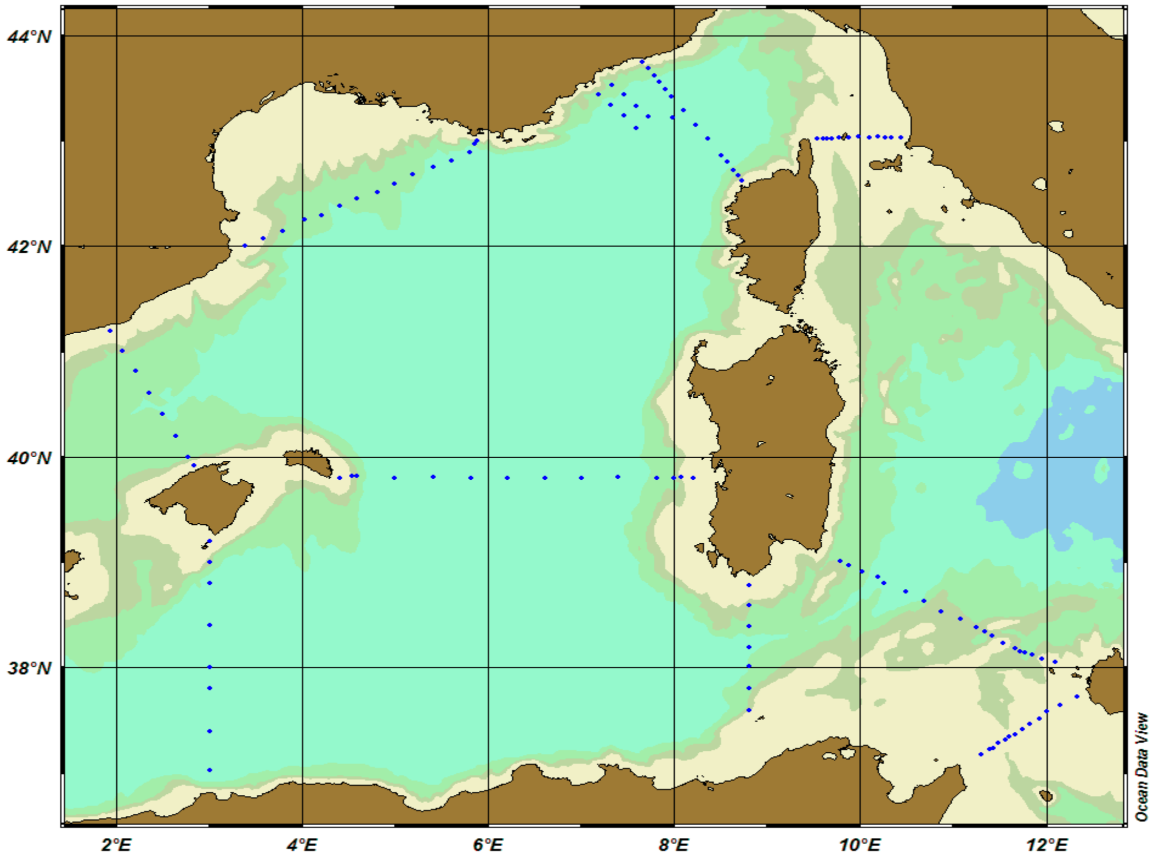


Figure 1 CTD map

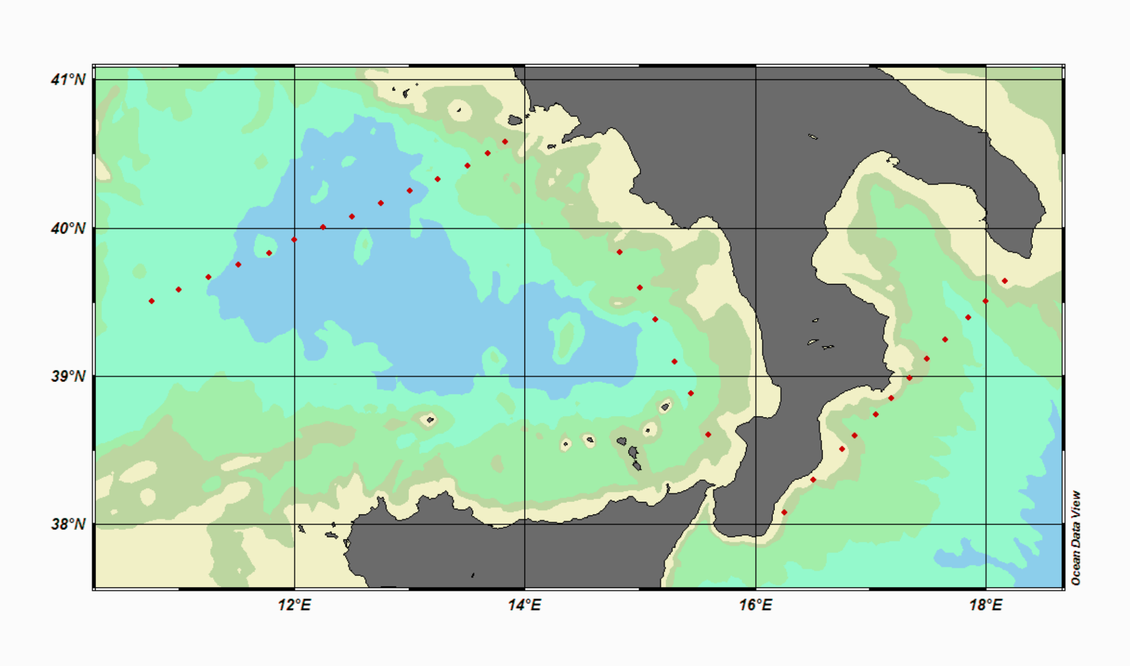
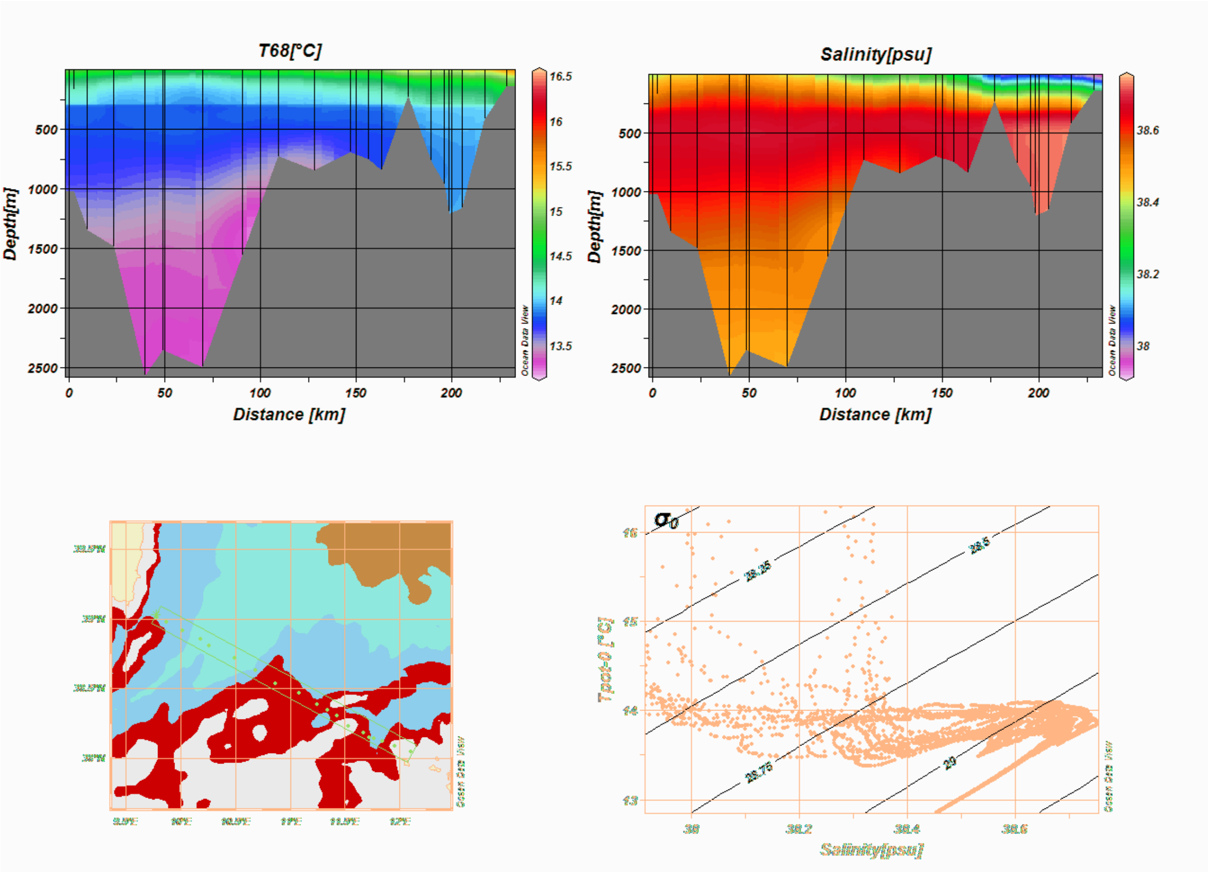


Figure 1 XBT map



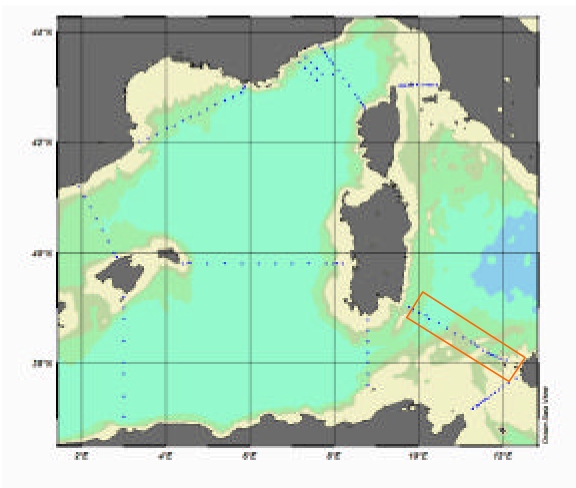


Figure 3 Sardinia – Sicily section (Central Mediterranean Sea)

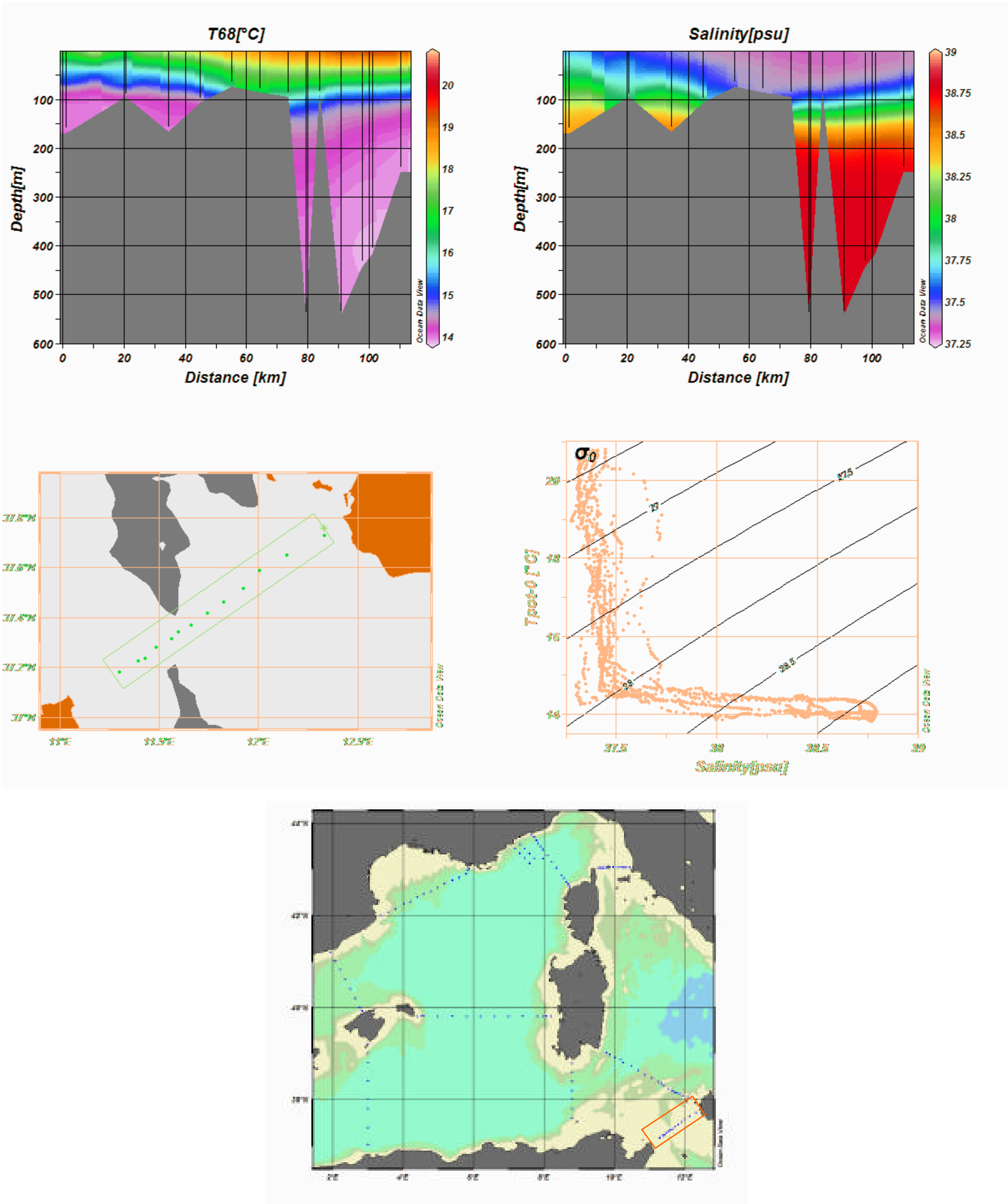


Figure 4 Tunisia – Sicily section in the Sicily Channel

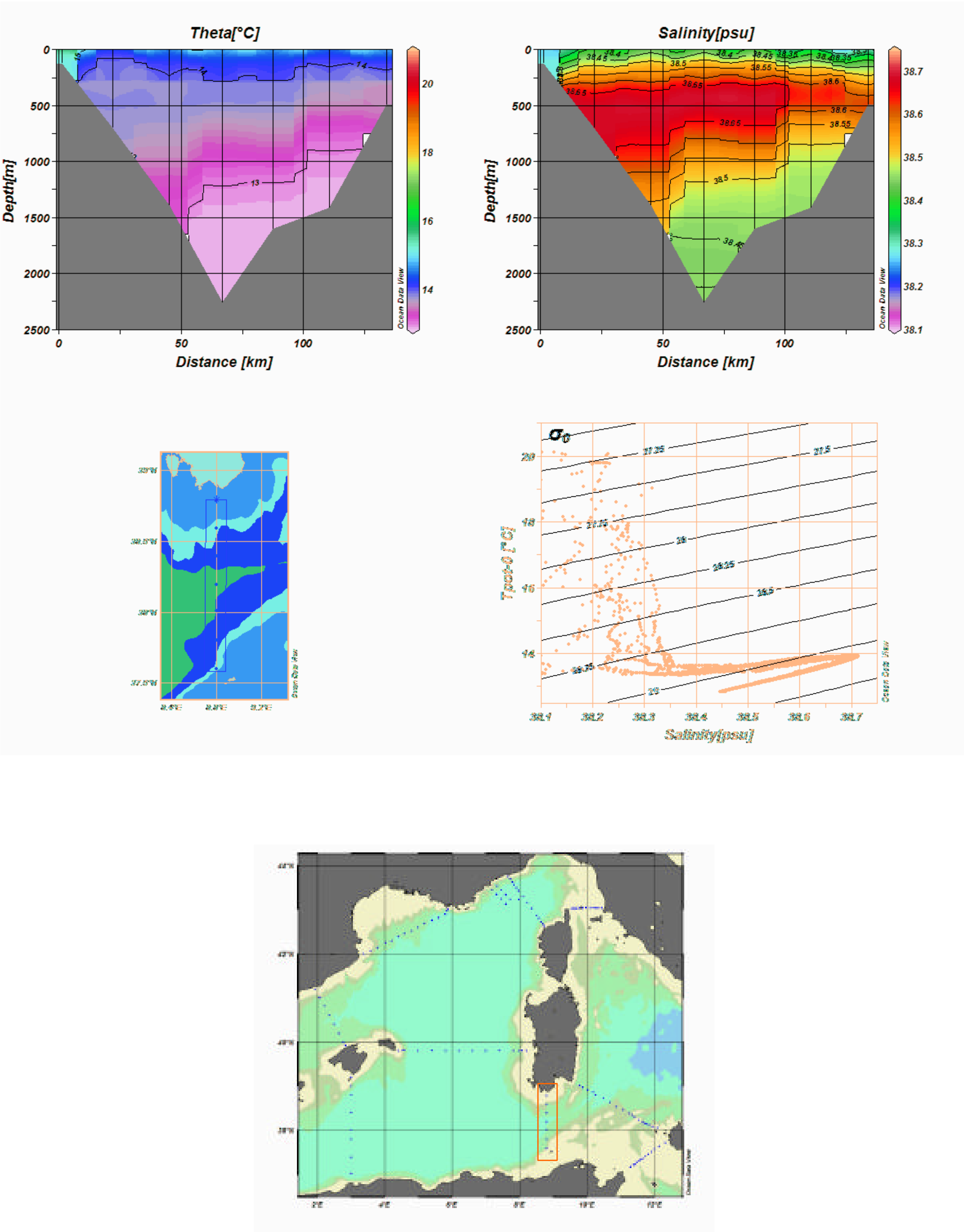
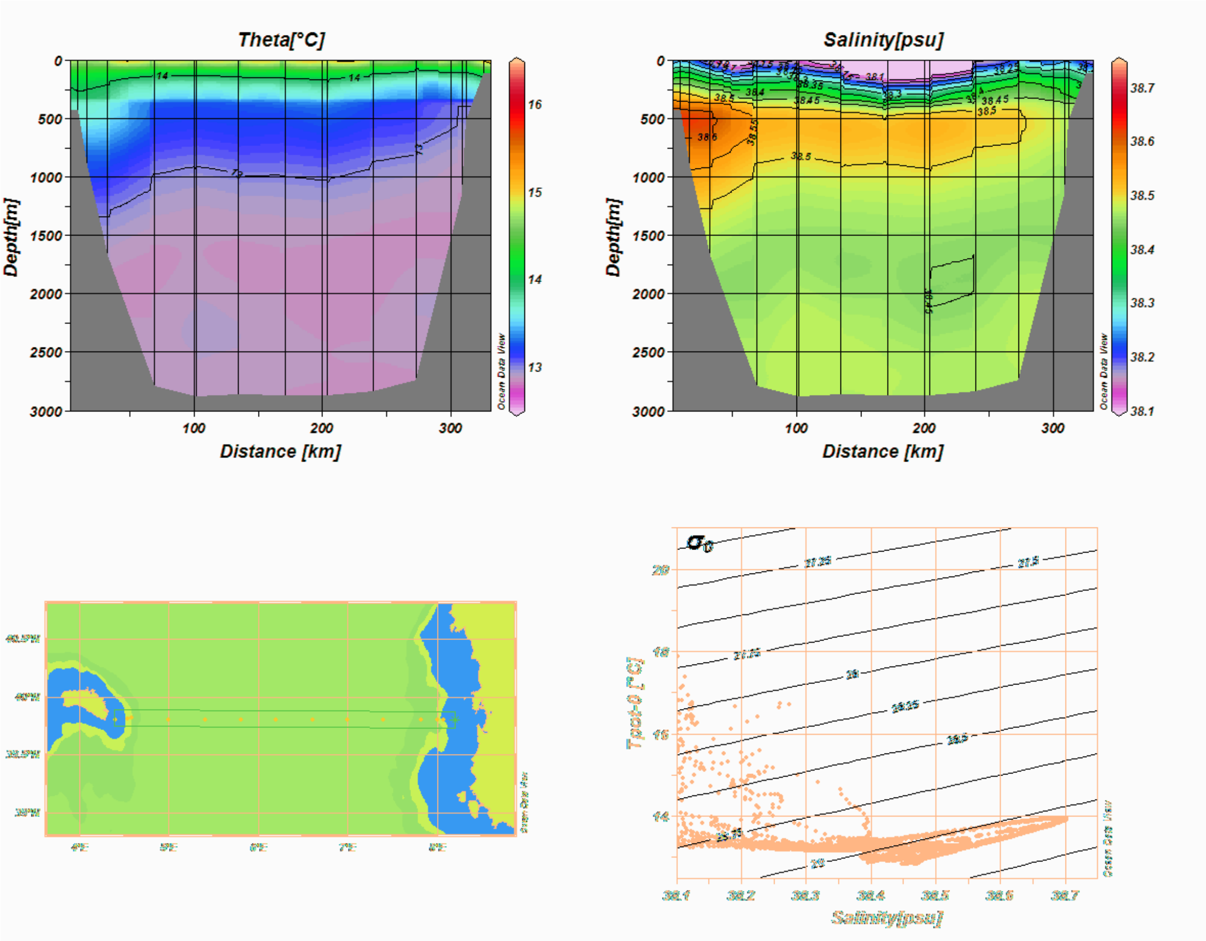


Figure 5 Tunisia – Sardinian section



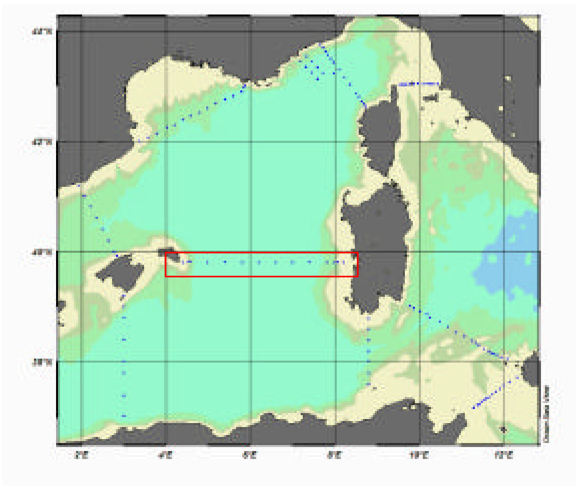


Figure 6 the Balearic-Sardinia section

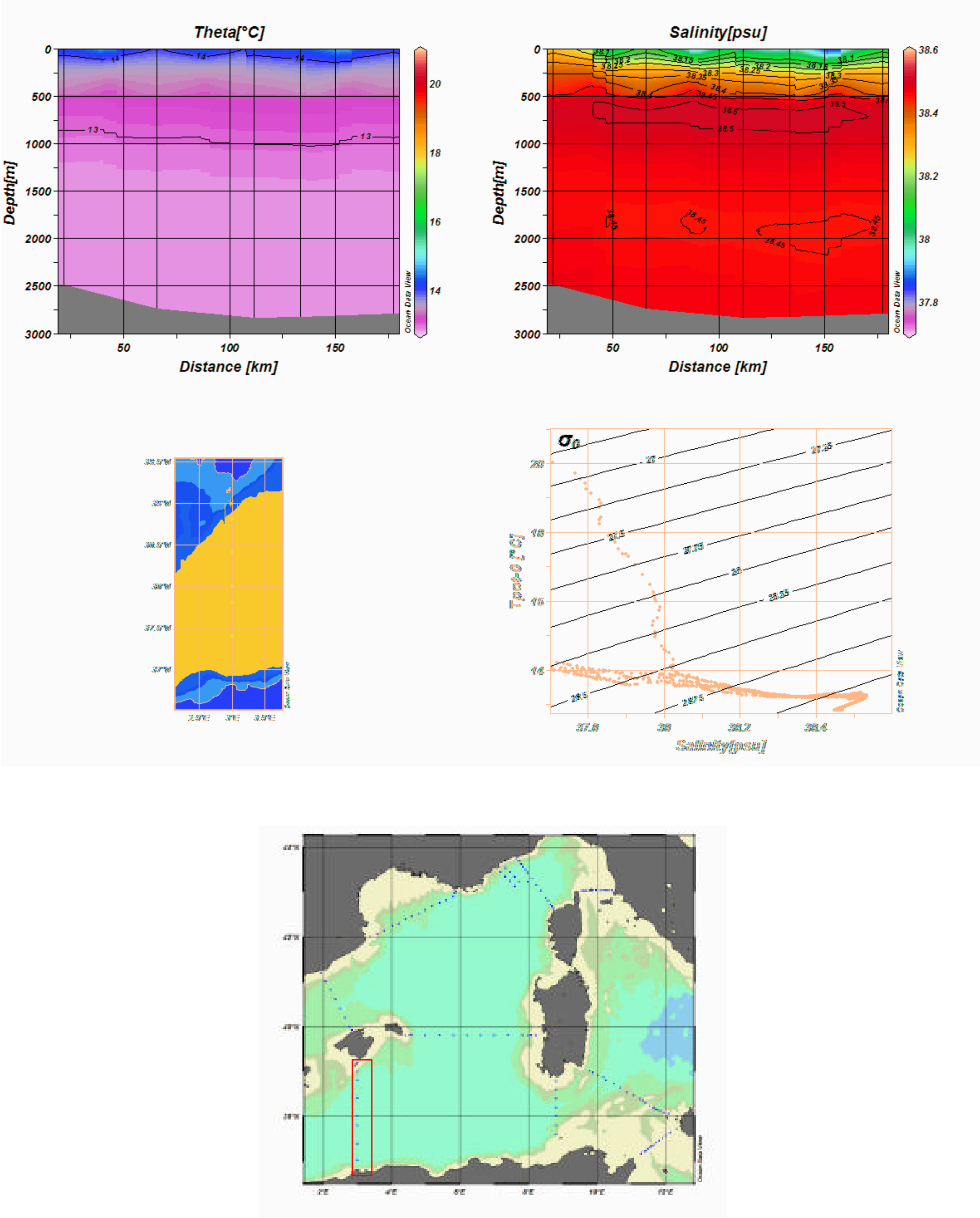


Figure 7 Balearic - Algerian section

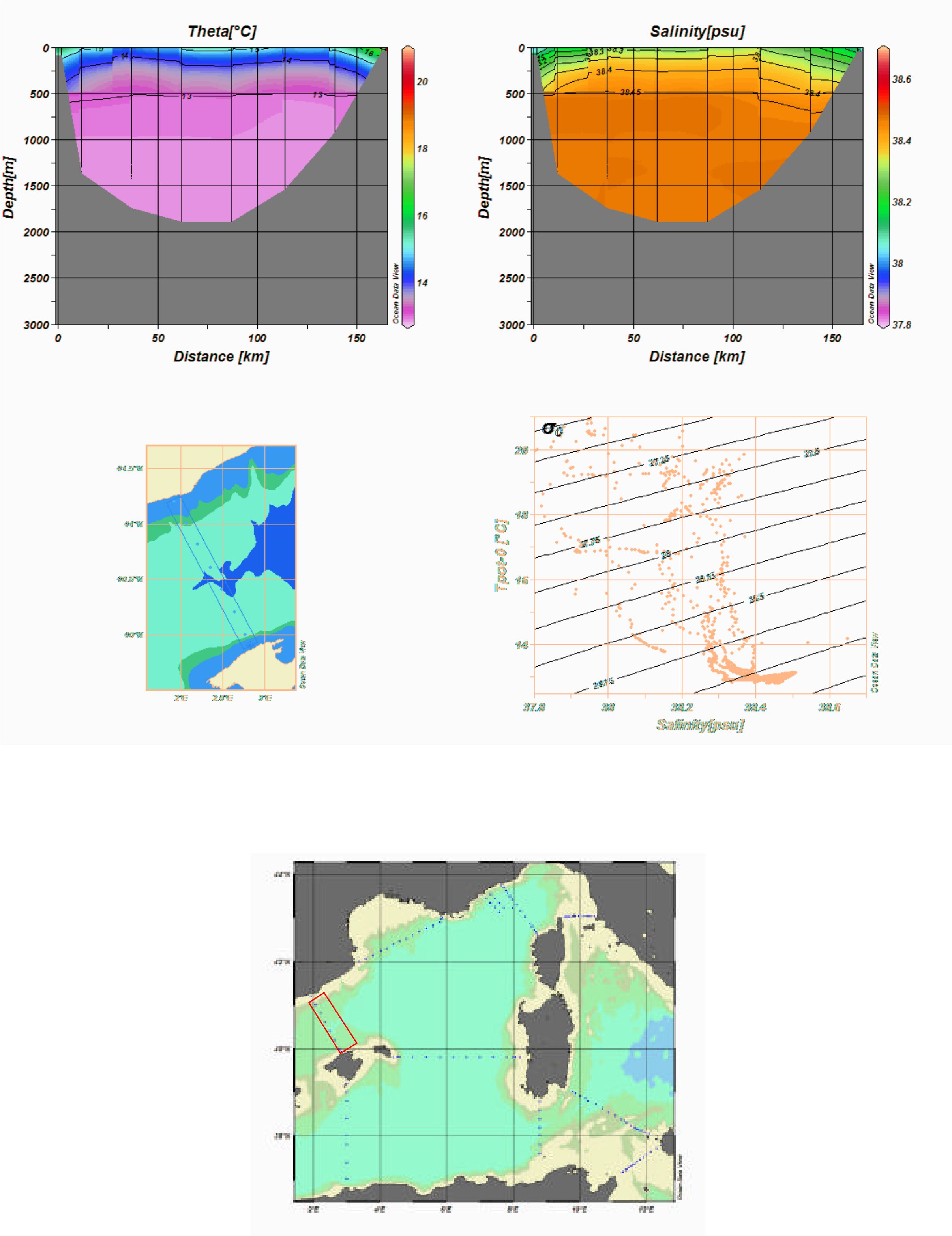


Figure 8 Balearic Sea section

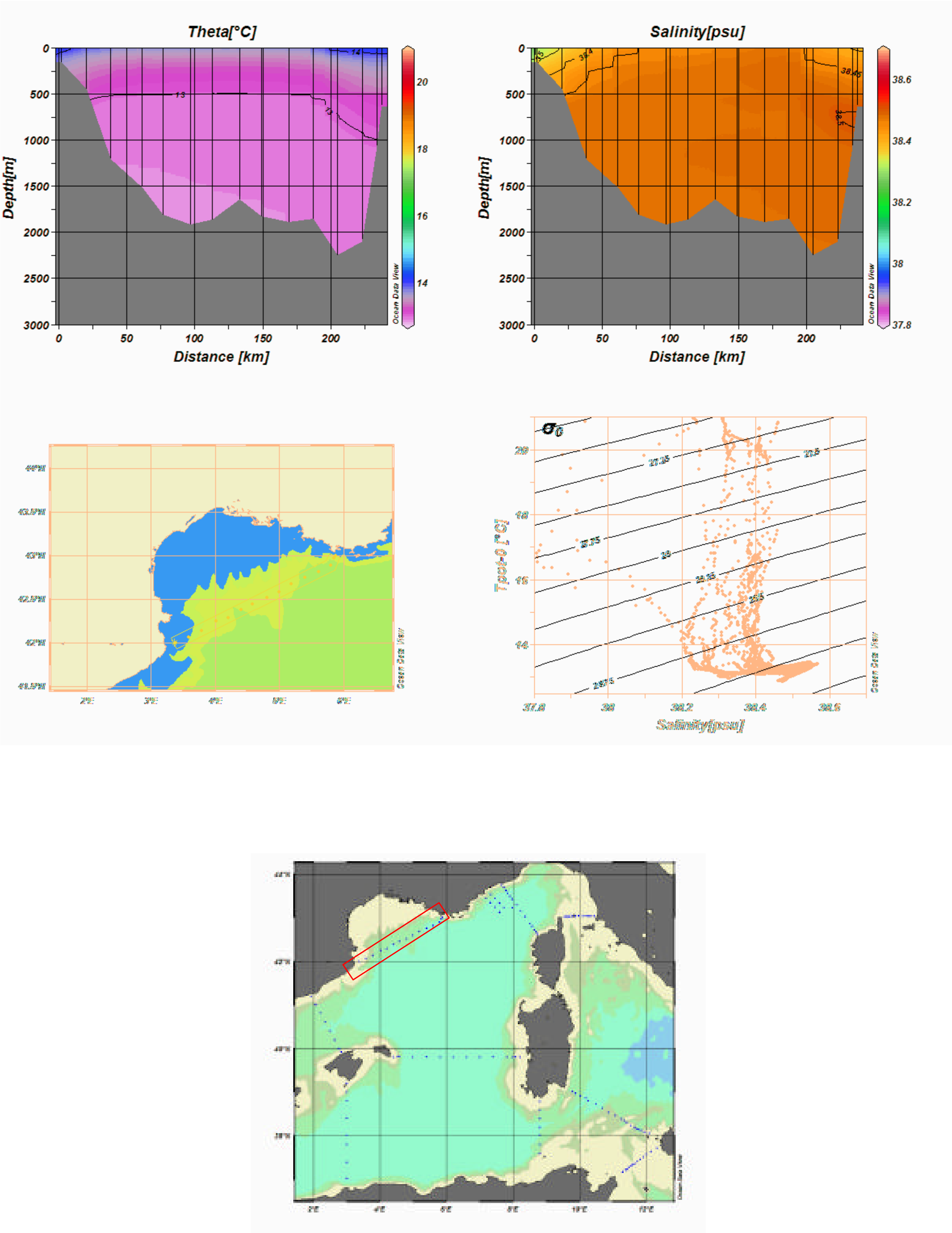


Figure 9 Gulf of Lions section

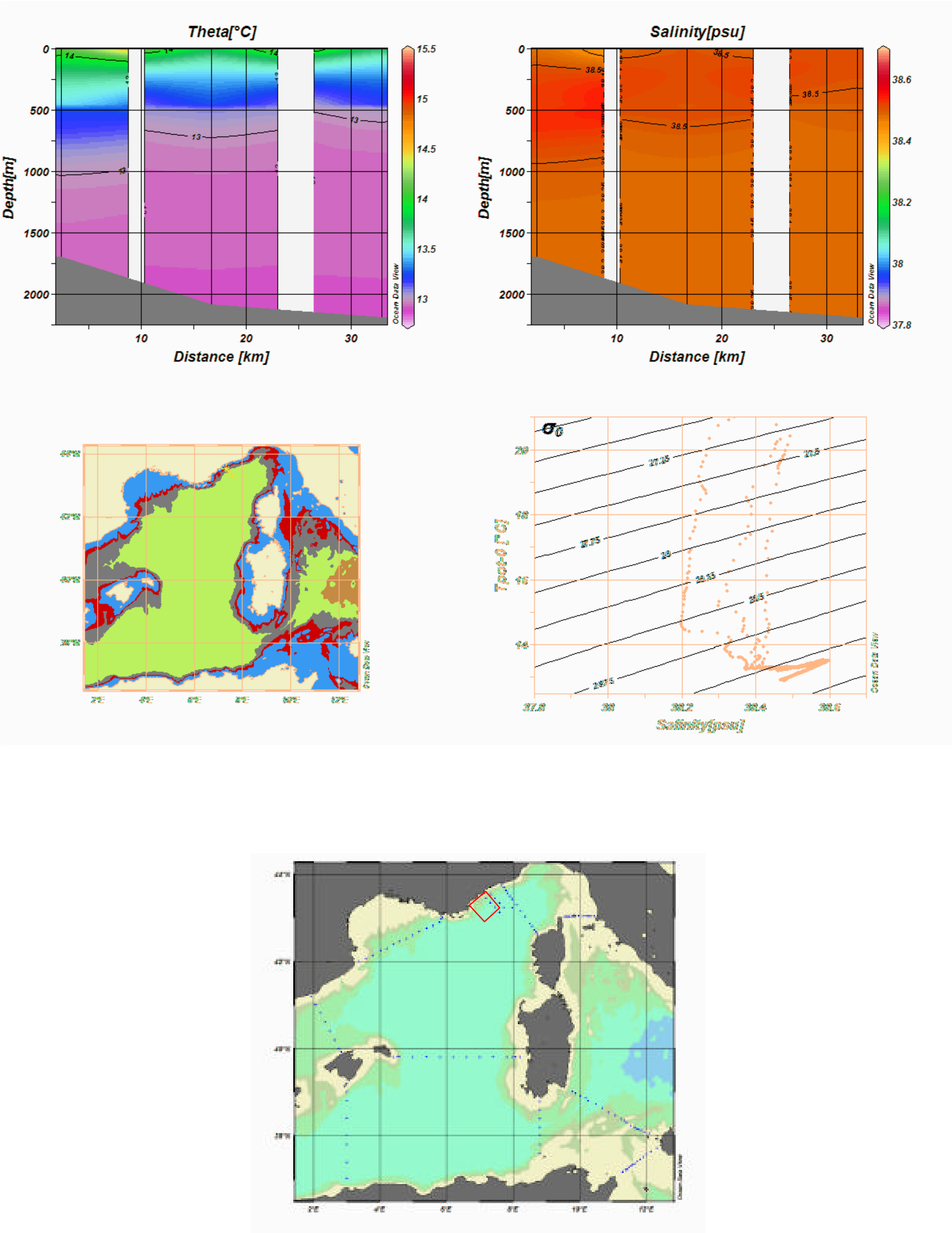


Figure 10 Ligurian Sea section

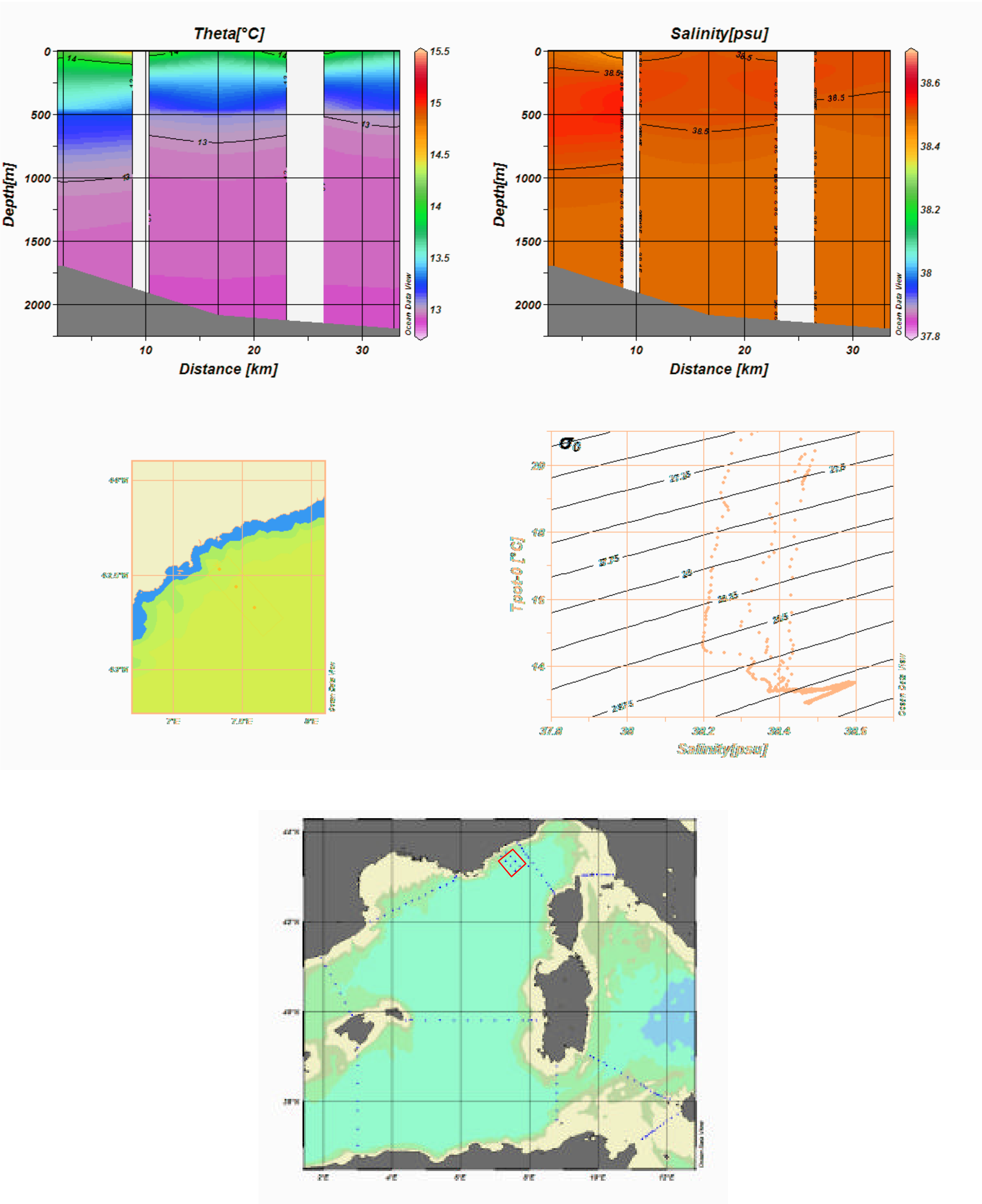


Figure 11 Ligurian Sea section

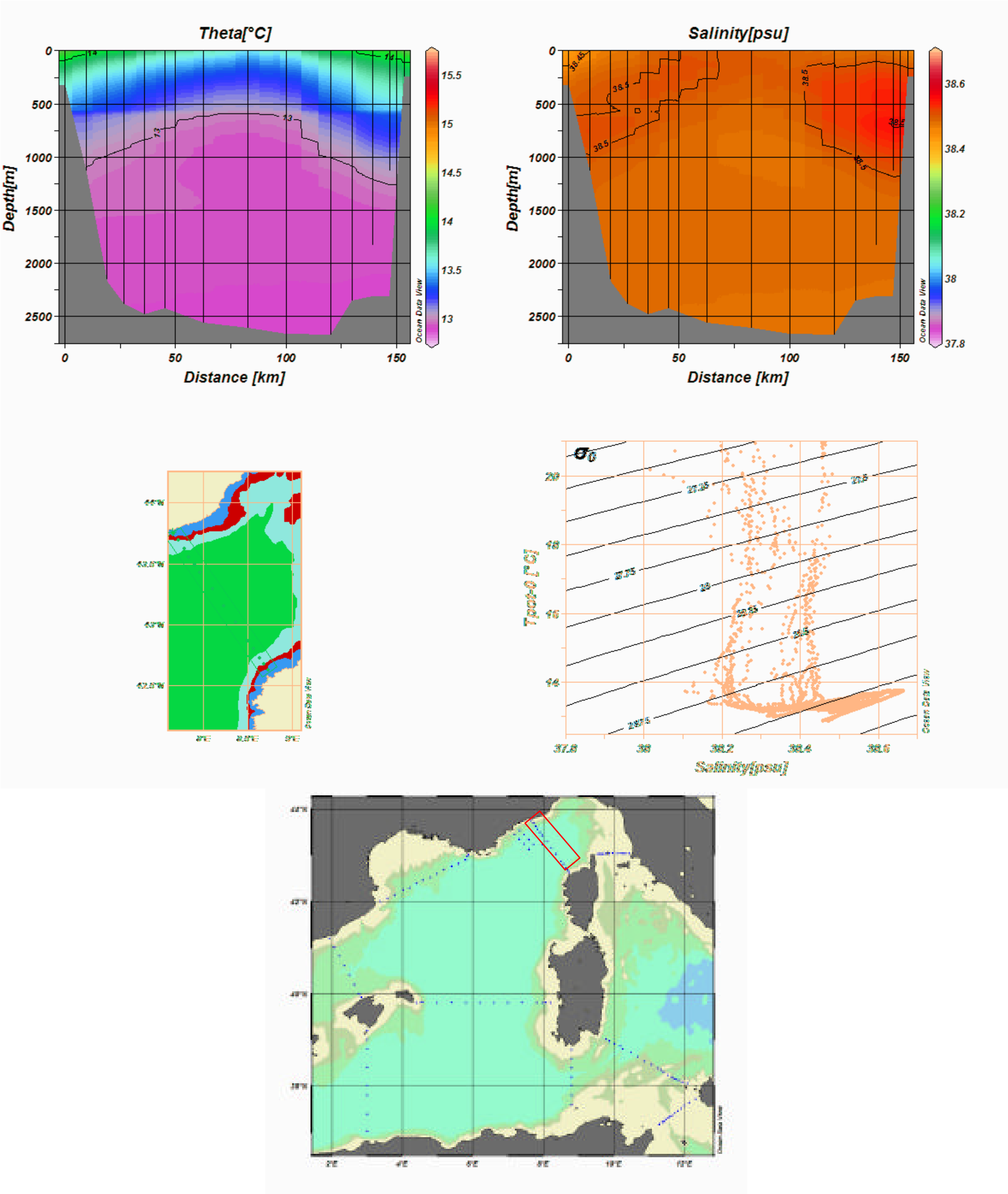


Figure 12 **Ligurian Sea section**

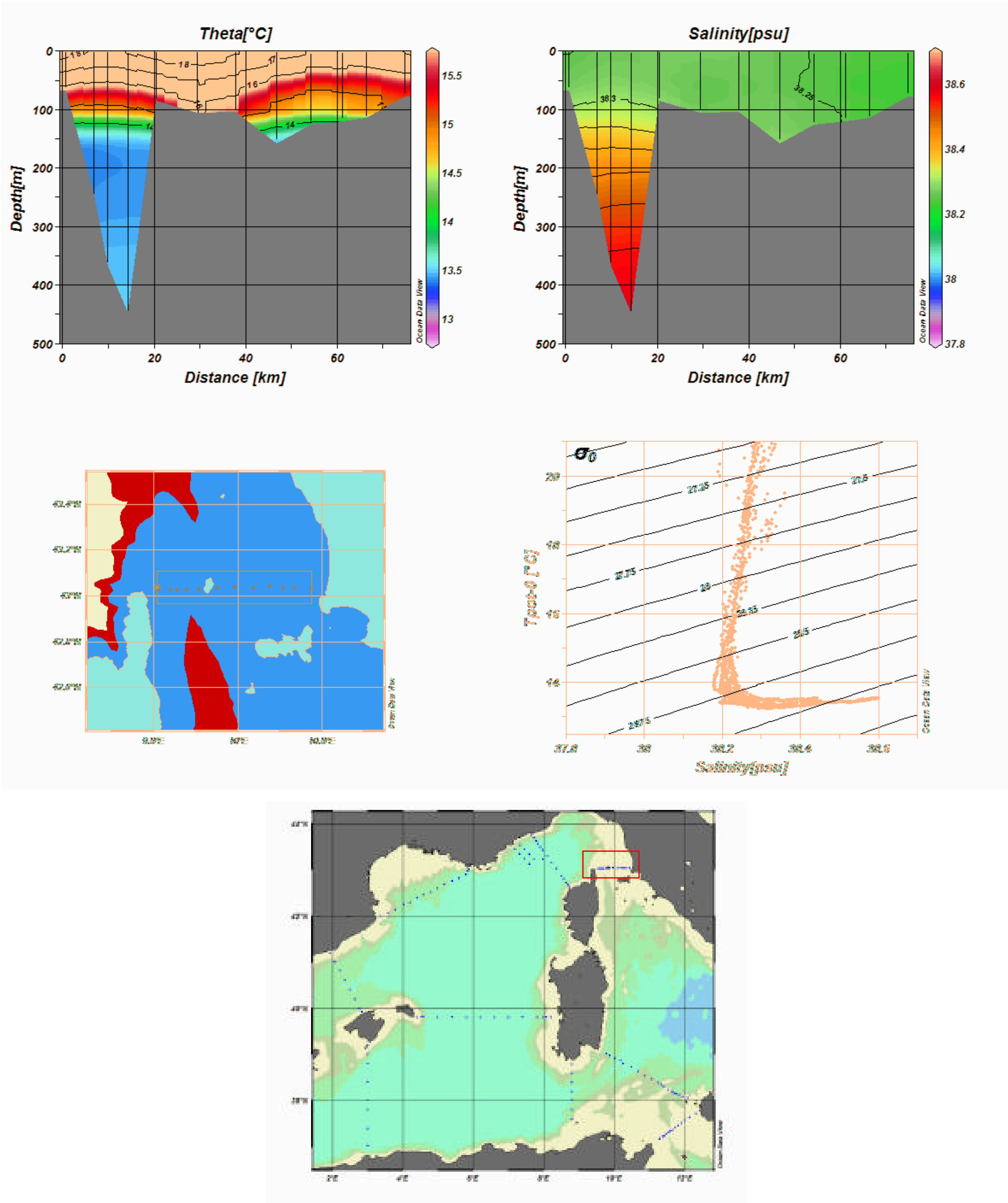


Figure 13 Corsica Channel section

Cruise Stations

Station	Date	Lat (°N)	Long (°E)	Depth (m)	Type
913	28/06/2006	42.621	8.726	245	CTD
912	28/06/2006	42.674	8.682	1040	CTD
911	28/06/2006	42.725	8.634	1703	CTD
910	28/06/2006	42.797	8.567	2273	CTD nutrients- chlorophyll- DOC light
909	28/06/2006	42.861	8.501	2610	CTD
908	27/06/2006	43.015	8.367	2645	CTD
907	27/06/2006	43.15	8.234	2546	CTD- oxygen- nutrients-chlorophyll- DOC
906	27/06/2006	43.29	8.099	2500	CTD
905	27/06/2006	43.425	7.966	2419	CTD-oxygen- nutrients- DOC
904	27/06/2006	43.488	7.9	2423	CTD
903	27/06/2006	43.554	7.836	2366	CTD
902	27/06/2006	43.62	7.783	2148	CTD
901	26/06/2006	43.692	7.715	1106	CTD - nutrients - DOC
900	26/06/2006	43.753	7.657	327	CTD
64	24/06/2006	43.225	7.724	2483	CTD
Dyfamed	24/06/2006	43217	7.983	2557	CTD- nutrients- chlorophyll- DOC
63	24/06/2006	43.129	7.591	2550	CTD
62	24/06/2006	43.235	7.454	2360	CTD
55	24/06/2006	43.343	7.31	2272	CTD
54	24/06/2006	43.445	7.192	361	CTD
53	25/06/2006	43.516	7.333	1690	CTD
56	25/06/2006	43.437	7.459	2080	CTD
61	24/06/2006	43.328	7.59	2177	CTD
L0	23/06/2006	42.969	5.847	1108	CTD
L2	23/06/2006	42.892	5.802	2083	CTD- nutrients- chlorophyll- DOC
L3	23/06/2006	42.814	5.609	2216	CTD
L4	23/06/2006	42.747	5.405	1846	CTD- nutrients- chlorophyll-DOC- net cast
L5	23/06/2006	42.68	5.19	1860	CTD
L6	23/06/2006	42.604	4.996	1829	CTD- nutrients- chlorophyll
L7	23/06/2006	42.517	4.804	1630	CTD
L8	23/06/2006	42.297	4.672	2011	CTD-nutrients
L9	23/06/2006	42.383	4.403	1890	CTD
L10	22/06/2006	42.297	4.2	1794	CTD nutrients- chlorophyll-DOC
L11	22/06/2006	42.249	4.016	1502	CTD
L12	22/06/2006	42.143	3.791	1160	CTD- nutrients-chlorophyll- DOC
L13	22/06/2006	42.076	3.588	444	CTD-TSS

L14	22/06/2006	41.999	3.384	151	CTD
B1	22/06/2006	41.197	1.929	42	CTD- TSS-light
B2	22/06/2006	41.007	2.068	910	CTD- nutrients- DOC
B3	22/06/2006	40.815	2.203	1540	CTD
B4	21/06/2006	40.603	2.355	1885	CTD- nutrients- chlorophyll- DOC
B5	21/06/2006	40.403	2.494	1883	CTD- nutrients- DOC
B6	21/06/2006	40.201	2.64	1740	CTD
B7	21/06/2006	40	2.77	1324	CTD- oxygen –nutrients- DOC
B8	21/06/2006	39.914	2.834	85	CTD
D1	19/06/2006	39.198	3.004	40	CTD
D2	19/06/2006	38.996	3.005	1145	CTD
D3	19/06/2006	38.805	3.004	2482	CTD- oxygen- nutrients-chlorophyll- DOC
D5	20/06/2006	38.403	3.003	2660	CTD-nutrients- chlorophyll- DOC
D7	20/06/2006	38	3.004	2802	CTD
D8	20/06/2006	37.797	3.006	2775	CTD- oxygen- nutrients- chlorophyll- DOC
D10	20/06/2006	37.395	3.006	2768	CTD-nutrients- chlorophyll- DOC
D12	20/06/2006	37.058	3.003	2634	CTD- chlorophyll
S1	19/06/2006	39.803	4.403	105	CTD- chlorophy
S2	19/06/2006	39.804	4.607	1142	CTD
S4	19/06/2006	39.811	4.995	2712	CTD- nutrients- chlorophyll- DOC
S6	18/06/2006	39.802	5.405	2825	CTD- nutrients- chlorophyll- DOC
S8	18/06/2006	39.803	5.810	2850	CTD- nutrients
S10	18/06/2006	39.803	6.201	2850	CTD- chlorophyll
S12	18/06/2006	39.803	6.61	2855	CTD-nutrients- DOC
S14	18/06/2006	39.803	6.997	2811	CTD- nutrients- DOC
S16	17/06/2006	39.804	7.396	2742	CTD-nutrients- DOC
S18	17/06/2006	39.803	7.817	1650	CTD- nutrients- DOC
S19	17/06/2006	39.803	8	903	CTD
S20	17/06/2006	39.803	8.204	100	CTD
D13	17/06/2006	38.786	8.801	125	CTD- chlorophyll
D14	17/06/2006	38.594	8.8	703	CTD- nutrients DOC
D15	17/06/2006	38.394	8.8	1388	CTD
D16	16/06/2006	38.192	8.8	2234	CTD- nutrients DOC
D17	16/06/2006	38.01	8.8	1660	CTD- nutrients DOC
D18	16/06/2006	37.798	8.8	1400	CTD
D19	16/06/2006	37.6	8.802	499	CTD nutrients- chlorophyll- TSS- light
410	16/06/2006	37.18	11.304	248	CTD- nutrients- chlorophyll- DOC- TSS
436	16/06/2006	37.226	11.396	413	CTD- TSS
437	16/06/2006	37.233	11.432	439	CTD-TSS
460	16/06/2006	37.278	11.486	543	CTD-TSS

462	15/06/2006	37.314	11.562	90	CTD- TSS
451	15/06/2006	37.339	11.6	540	CTD- nutrients chlorophyll- DOC- light
463	15/06/2006	37.365	11.661	92	CTD
434	15/06/2006	37.416	11.743	85	CTD
438	15/06/2006	37.46	11.83	75	CTD
433	15/06/2006	37.515	11.922	105	CTD nutrients chlorophyll DOC
406	15/06/2006	37.581	12.003	149	CTD
405	15/06/2006	37.648	12.144	97	CTD- nutrients- chlorophyll- DOC
432	15/06/2006	37.733	12.333	168	CTD- nutrients- DOC
212	15/06/2006	38.05	12.09	140	CTD-TSS
213	15/06/2006	38.088	11.957	410	CTD-TSS
214	15/06/2006	38.12	11.846	1160	CTD-oxygen- nutrients- TSS
215	15/06/2006	38.146	11.765	1200	CTD- nutrients-chlorophyll- light
216	15/06/2006	38.148	11.717	951	CTD
217	15/06/2006	38.181	11.666	762	CTD- nutrients - chlorophyll-DOC-light
218	14/06/2006	38.232	11.531	233	CTD- light
219	14/06/2006	38.306	11.428	890	CTD- nutrients-light
220	14/06/2006	38.3445	11.338	747	CTD- nutrients-light
221	14/06/2006	38.384	11.248	686	CTD- nutrients- light
223	14/06/2006	38.467	11.077	840	CTD- nutrients- chlorophyll- DOC
225	14/06/2006	38.533	10.868	730	CTD- nutrients
227	14/06/2006	38.632	10.682	1541	CTD- nutrients
229	14/06/2006	38.722	10.494	2460	CTD- nutrients- chlorophyll-DOC
231	14/06/2006	38.805	10.257	2316	CTD- oxygen - nutrients
241	14/06/2006	38.856	10.183	2525	CTD
261	14/06/2006	38.914	10.015	1500	CTD- nutrients- light
281	13/06/2006	38.973	9.868	1330	CTD- nutrients- chlorophyll- DOC- light
291	13/06/2006	39.008	9.783	1004	CTD- nutrients-TSS-light
100	01/07/2006	43.03167	10.43767	78	CTD- nutrients
101	01/07/2006	43.0316	10.34783	115	CTD- nutrients
102	01/07/2006	43.035	10.27033	121	CTD- nutrients
103	01/07/2006	43.03833	10.18867	127	CTD- nutrients
104	01/07/2006	43.035	10.0945	158	CTD- nutrients
105	01/07/2006	43.03833	9.9805	102	CTD- nutrients
106	01/07/2006	43.035	9.882667	106	CTD- nutrients
107	01/07/2006	43.02883	9.768167	85	CTD- nutrients
108	01/07/2006	43.025	9.7	449	nutrients- TSS- light
109	01/07/2006	43.025	9.641666	365	CTD- nutrients-TSS-light
110	01/07/2006	43.025	9.6	243	CTD- nutrients-TSS- light
111	01/07/2006	43.0255	9.5255	68	CTD

Table 3 Station list

Sampling Strategy

The stations have been selected mainly based on previous knowledge and available literature. The sections have been chosen to be able to intercept every inflowing and outflowing water mass.

The hydrological characteristics of the study area have been determined by **CTD cast**. The CTD profiles were analysed onboard to precisely define the sampling depth along the water column.

In order to achieve information about the spatial variability of **nutrients** and **Dissolved Organic Carbon (DOC)** a high-resolution sampling has been applied (samples involved almost 55% of the hydrological casts), at the standard depths (table 1).

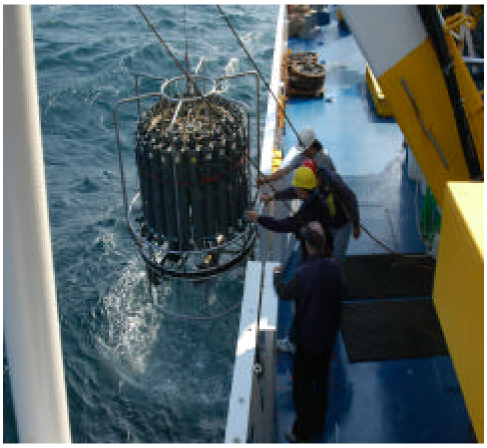
Samples for **chlorophyll** analysis were taken at 40% of the hydrological casts; generally, 2 samples were taken below the Deep Chlorophyll Maximum (DCM), detected by the fluorescence sensor on the CTD system, 1 sample at the DCM and 2 samples above the DCM.

Table 1 Standard depths

Level	**Standard depths (m)**
1	0
2	25
3	50
4	75
5	100
6	200
7	300
8	400
9	500
10	750
11	1000
12	1250
13	1500
14	1750
15	2000
16	2500
17	3000

Onboard Operations

CTD casts



At all the hydrological stations, pressure (P), salinity (S), potential temperature (?) and dissolved oxygen concentration (DO) were measured with a CTD-rosette system consisting of a CTD SBE 911 plus, and a General Oceanics rosette with 24 12-l Niskin Bottles. Temperature measurements were performed with a SBE-3/F thermometer, with a resolution of 10^{-3} °C, and conductivity measurements were performed with a SBE-4 sensor, with a resolution of 3 x 10^{-4} S/m. In addition, salinities of water samples were analysed on board using a Guildline Autosal salinometer. Dissolved oxygen was measured with a SBE-13 sensor (resolution 4.3 µM), and data were checked against Winkler titration. The vertical profiles of all parameters were obtained by sampling the signals at 24 Hz, with the CTD/rosette going down at a speed of 1 m/s. The data were processed on board, and the coarse errors were corrected.

LADCP

Two Lowered Acustic Doppler Current Profilers (LADCP) were used to measure velocity profiles. We used two RDI Workhorse 300 kHz ADCP. For data post-processing we used the LDEO LADCP (versione 8.1) software.

Team: CNR-ISMAR

Nutrients

Seawater samples for nutrient measurements were collected at different depths, when the system CTD/rosette was going up, according to the vertical profiles of salinity, potential temperature and dissolved oxygen, recorded in real time. No filtration was employed, nutrient samples were stored at –20°C and nitrate, orthosilicate and ortophosphate concentrations will be determined later in the laboratory, using a hybrid Brän–Luebbe AutoAnalyzer following classical methods (Grasshoff et al., 1983) with slight modifications.

Team: ENEA-CRAM

Chlorophyll

For chlorophyll analysis, 3 litres (in some stations 5 litres) of seawater were collected at definite depth above and below the Deep Chlorophyll Maximum (DCM), detected by the fluorescence sensor on the CTD system, and immediately filtered on 0.45 µm membrane (cellulose acetate, 47 mm) under gently vacuum. Then the filter was frozen at –20 °C. Analysis with the spectrophotometer will be performed in the laboratory on land.

Team: NURC, TUSCIA, MESSINA

Dissolved Organic Carbon (DOC)

Seawater samples for DOC measurements were collected at different depths, during the CTD/rosette up cast, according to the vertical profiles of salinity, potential temperature and dissolved oxygen, recorded in real time. They were immediately filtered on board, through sterile 0.2 µm membrane filters (Sartorius, Minisart, SM16534 K) under low N_2 pressure and stored in amber glass bottles at 4 °C in the dark until the analysis. The conditioning of the filters was performed by rinsing with a 200 ml aliquot of the seawater to be collected. DOC measurements will be carried out, in the laboratory ashore, with a Shimadzu 5000 TOC Analyser, equipped with quartz combustion column with 1.2% Pt on silica pillows of approximately 2 mm diameter (Santinelli et al., 2002).

Team: CNR-IBF

Solar spectra transmission (UV-VIS)

A submersible spectroradiometer (PUV 541, Biospherical Instruments) was used to measure upwelling and downwelling solar irradiance with depth in the water column (0-100m), at selected wavelengths (305 nm, 313 nm, 320 nm, 340 nm, PAR radiation). Sequentially, solar irradiance within the water column (0-30m) was measured using a spectroradiometer EPP2000C (StellarNet Inc., Tampa, FL, USA) able to operate in the wavelength range 290–800 nm (depth intervals of about 3 m with an uncertainty of 0.5 m). The spectral resolution was 3 nm, the instrument sensitivity was 10-4 Wm-2nm-1, and the measurements were made simultaneously with PUV 541 to inter-calibrate the spectral irradiance values. Each day, from 4 a. m. to 9 p. m., the solar irradiance at the water surface was measured using a 4 channels radiometer (Skye Instruments) positioned on the bow of the vessel. The radiometer measured the irradiance (according to the cosine law) at 381 nm, 441 nm, 589 nm and 681 nm with wavelength resolution of 12 nm, 10 nm, 10 nm and 12 nm respectively.

In collaboration with CNR-IBF group (using the identical experimental procedure), seawater samples for CDOM measurements were collected at different depths (surface to bottom). CDOM measurements will be carried out, in the laboratory ashore, with a Perkin Elmer Lambda 25 Spectrophotometer, equipped with 100 mm quartz cells, in 260-700 nm wavelength range.

Team: University of SIENA

Further Onboard Activities

SADCP (CNR – ISMAR SP)

Mooring recovery and re-deployment (CNR – ISMAR SP)

Tflap – PrinProd (University of TUSCIA)

Bacteria (CNR – ISMAR ME)

Mooring details

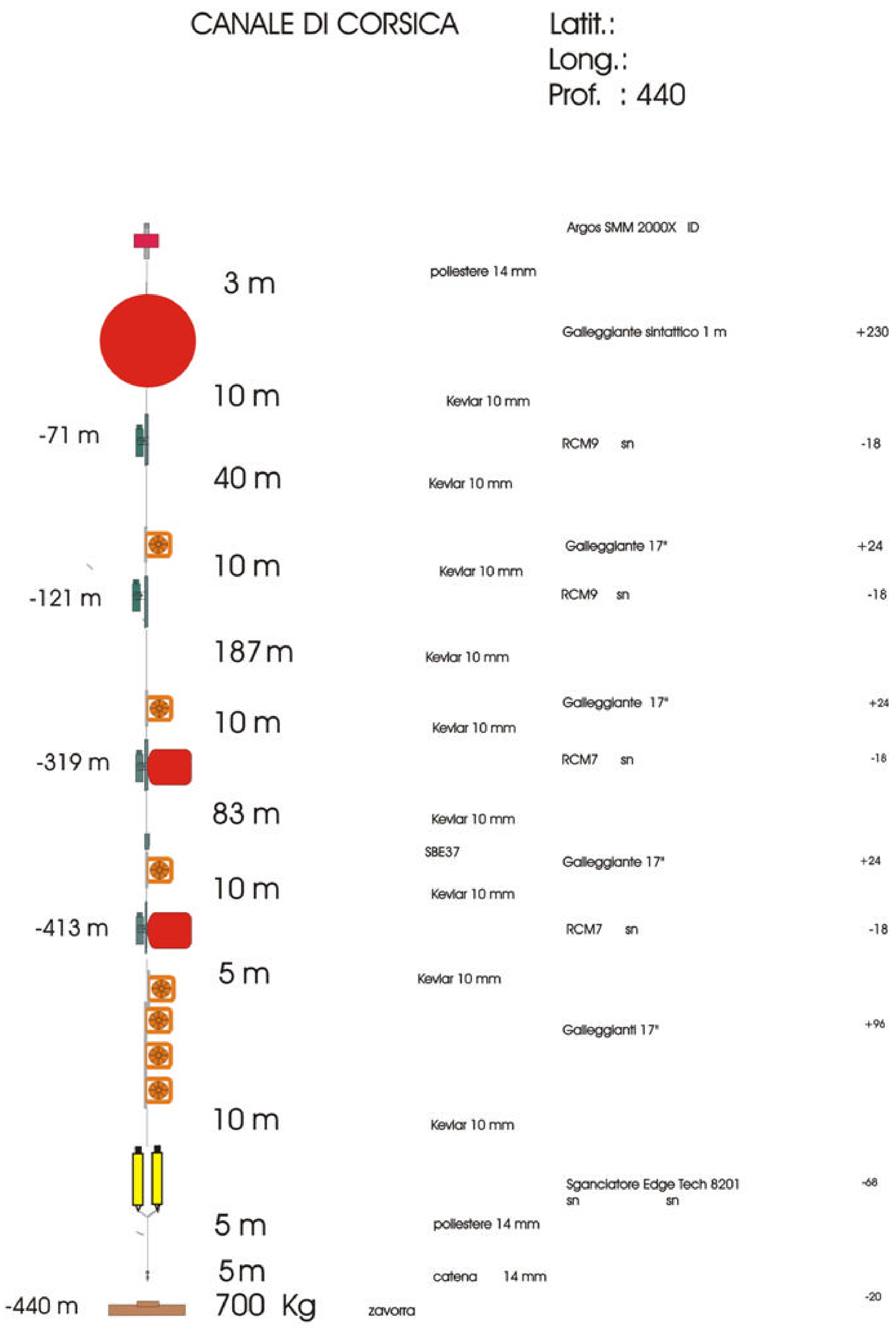


Figure 14 Mooring scheme (Corsica Channel)

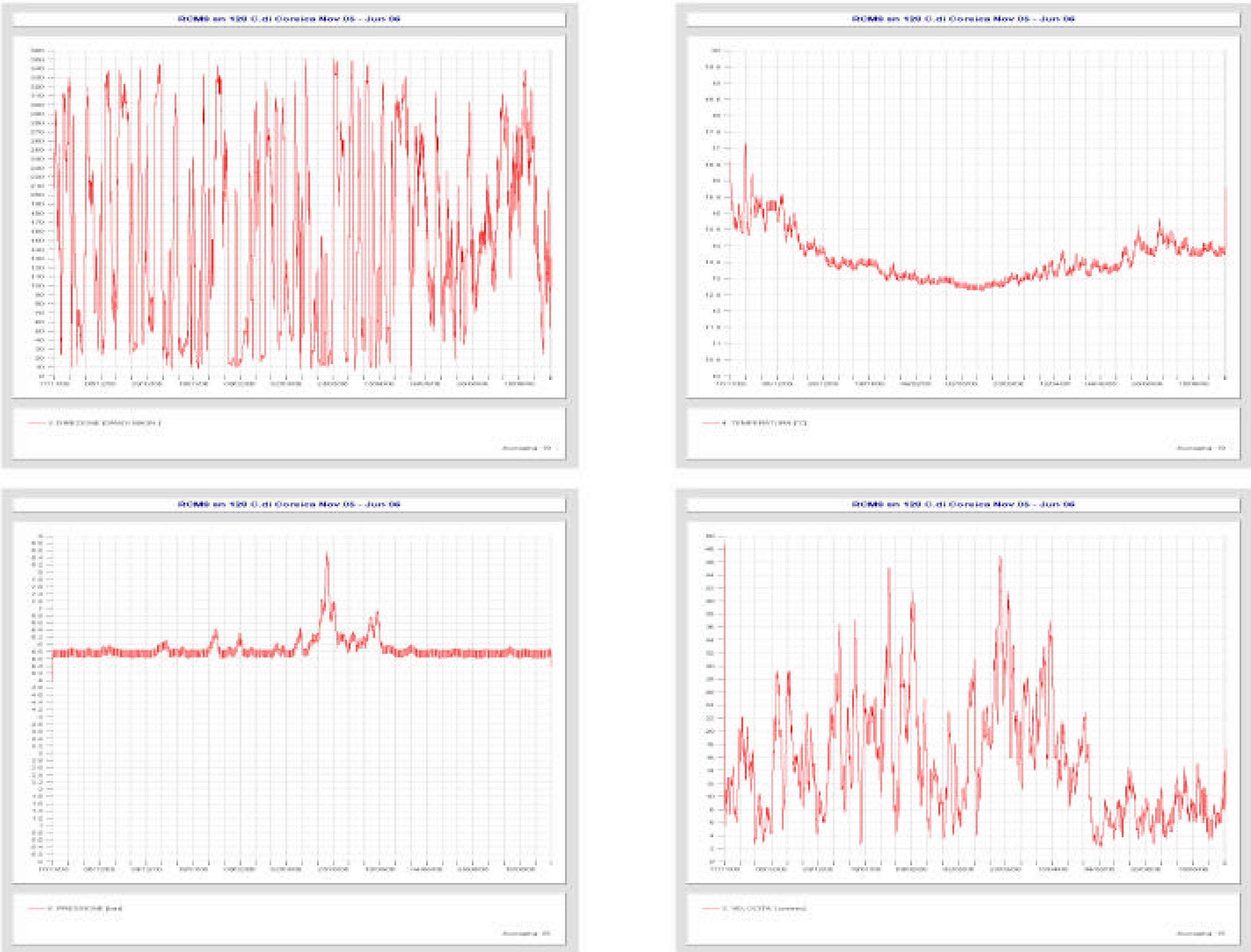


Figure 15 Plot currentmeter Aanderaa RCM9 sn 128 (60 m, Corsica mooring)

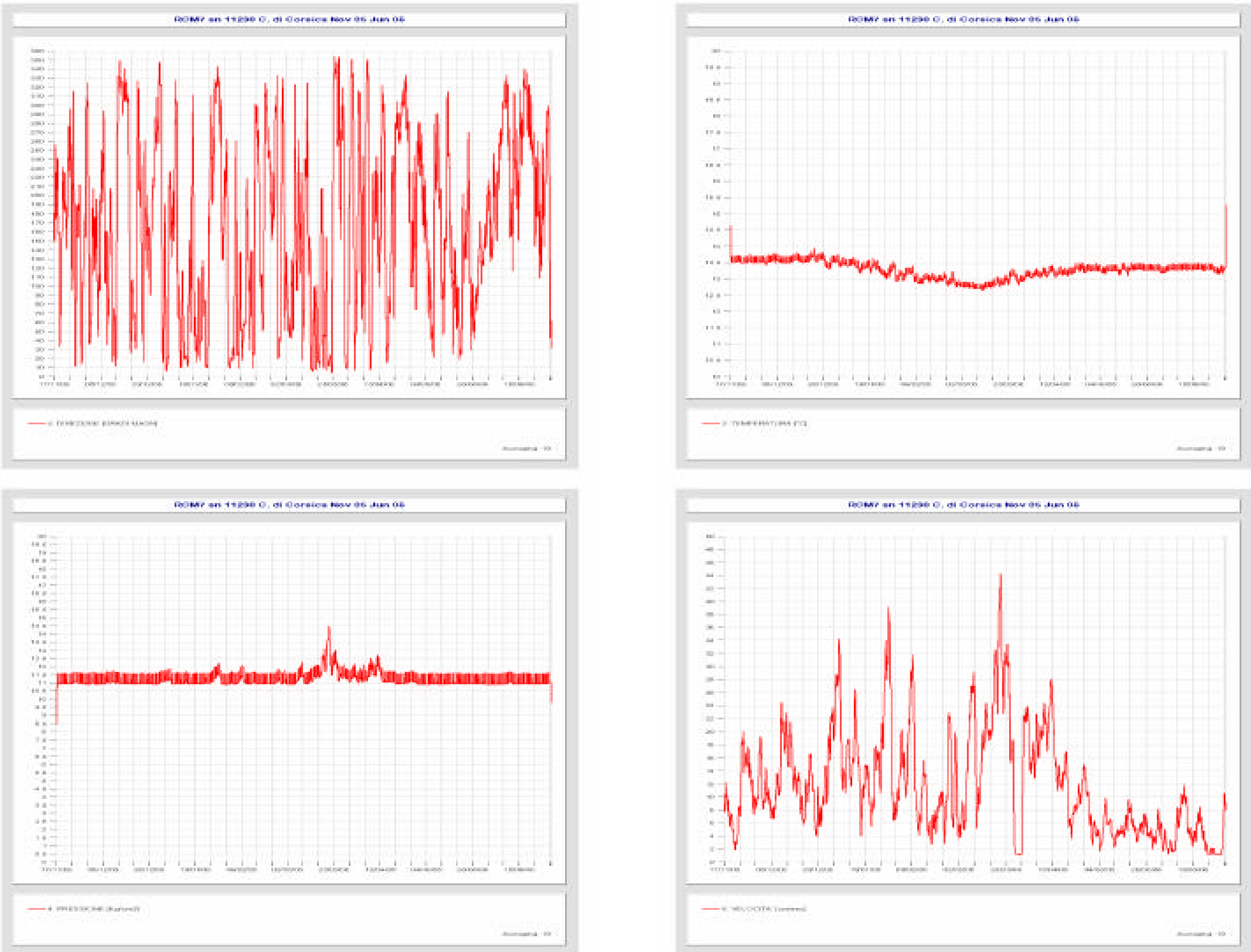


Figure 16 Plot currentmeter Aanderaa RCM7 sn 11230 (120 m, Corsica mooring)

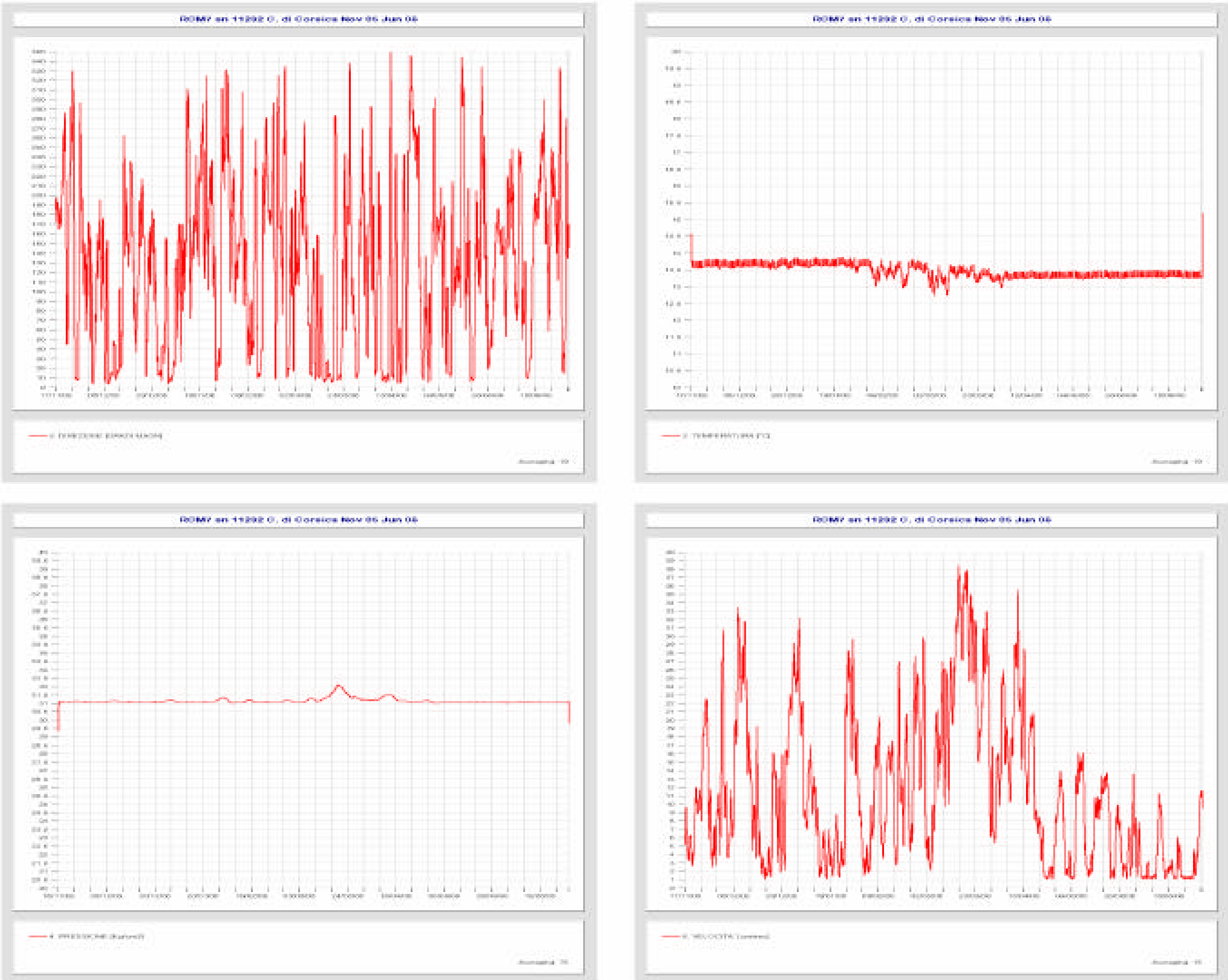


Figure 17 Plot currentmeter Aanderaa RCM7 sn 11232 (320 m, Corsica mooring)

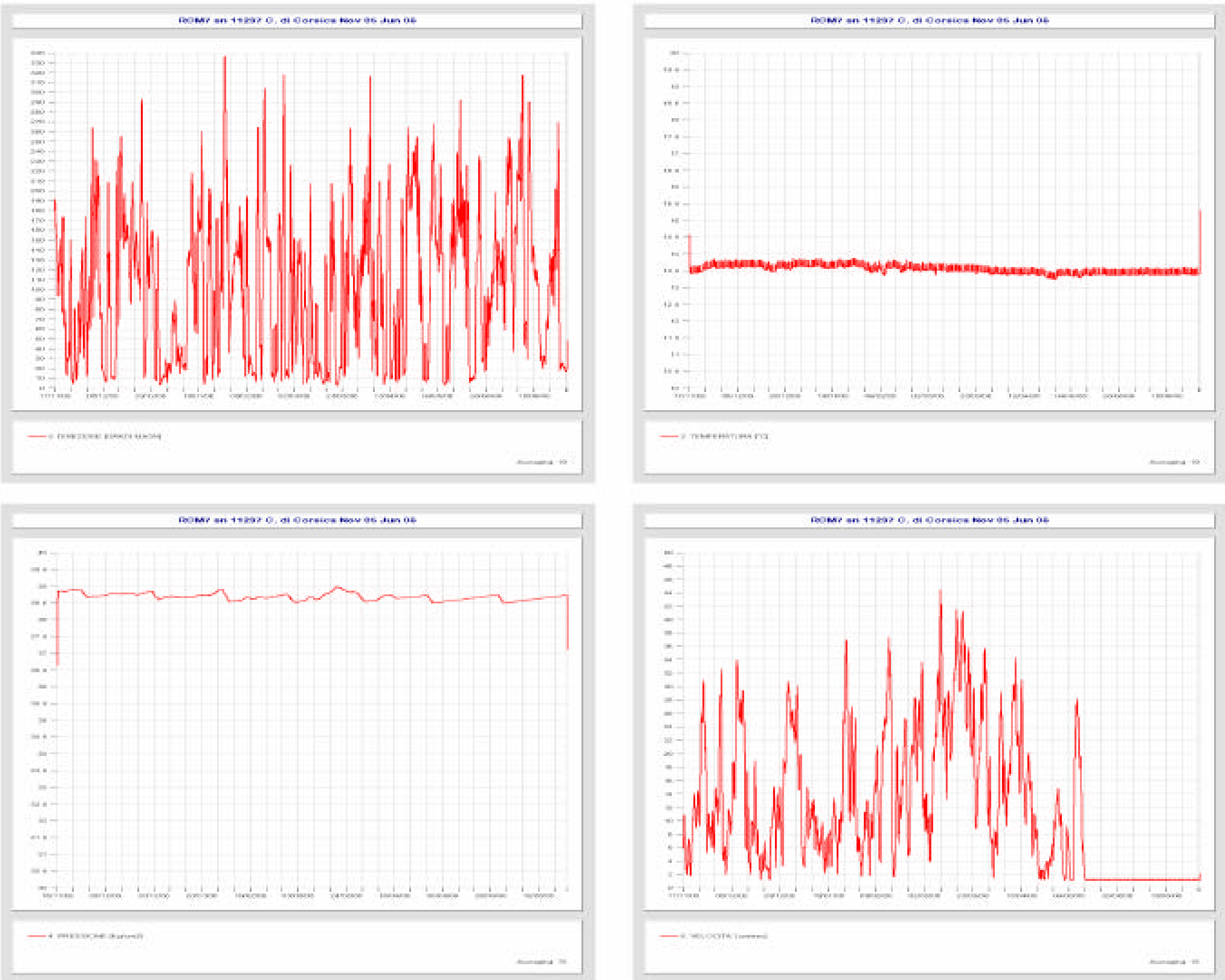


Figure 18 Plot currentmeter Aanderaa RCM7 sn 11237 (420 m, Corsica mooring)

LADCP details

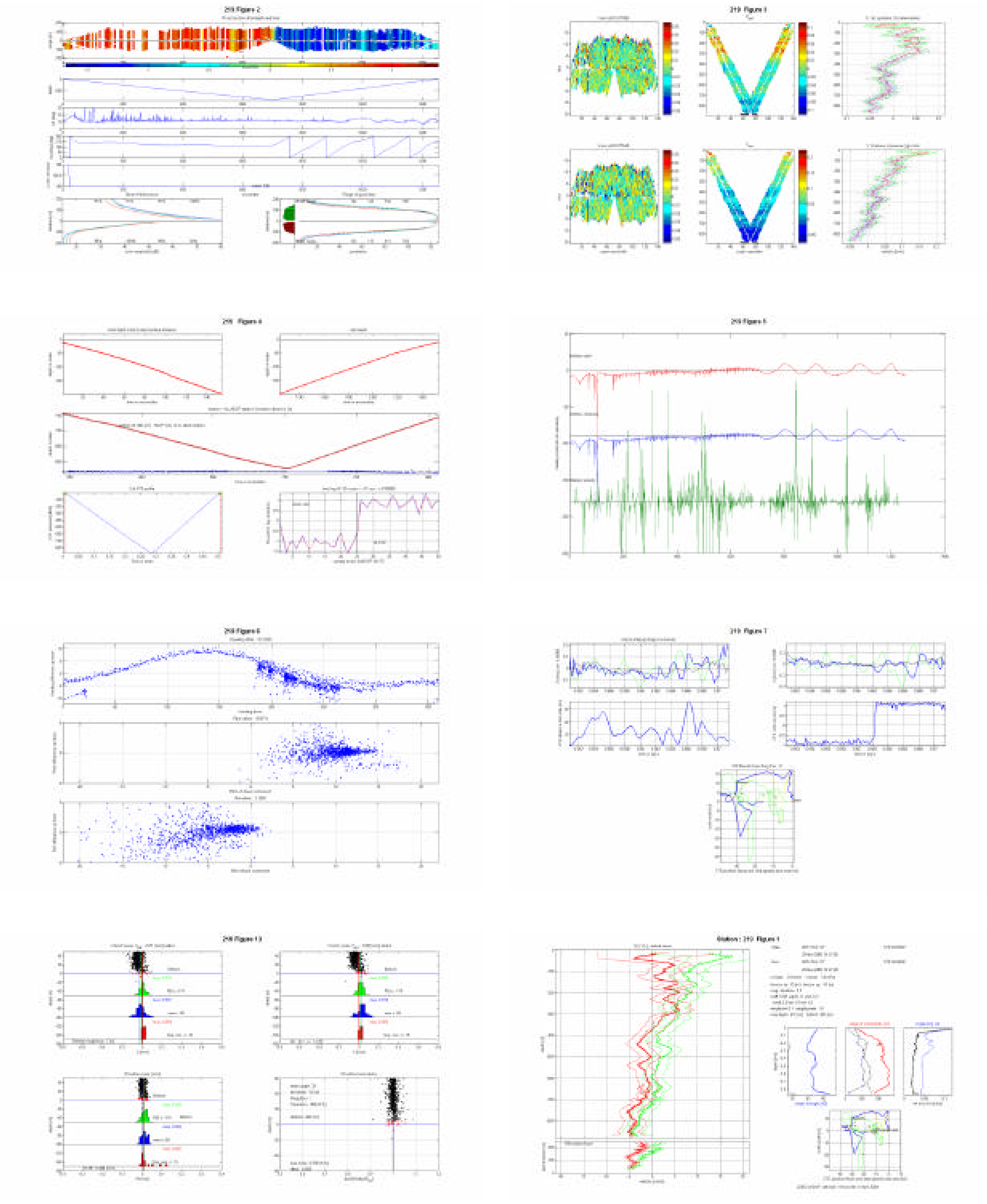


Figure 19 LDEO LADCP software ver. 8b graphic output

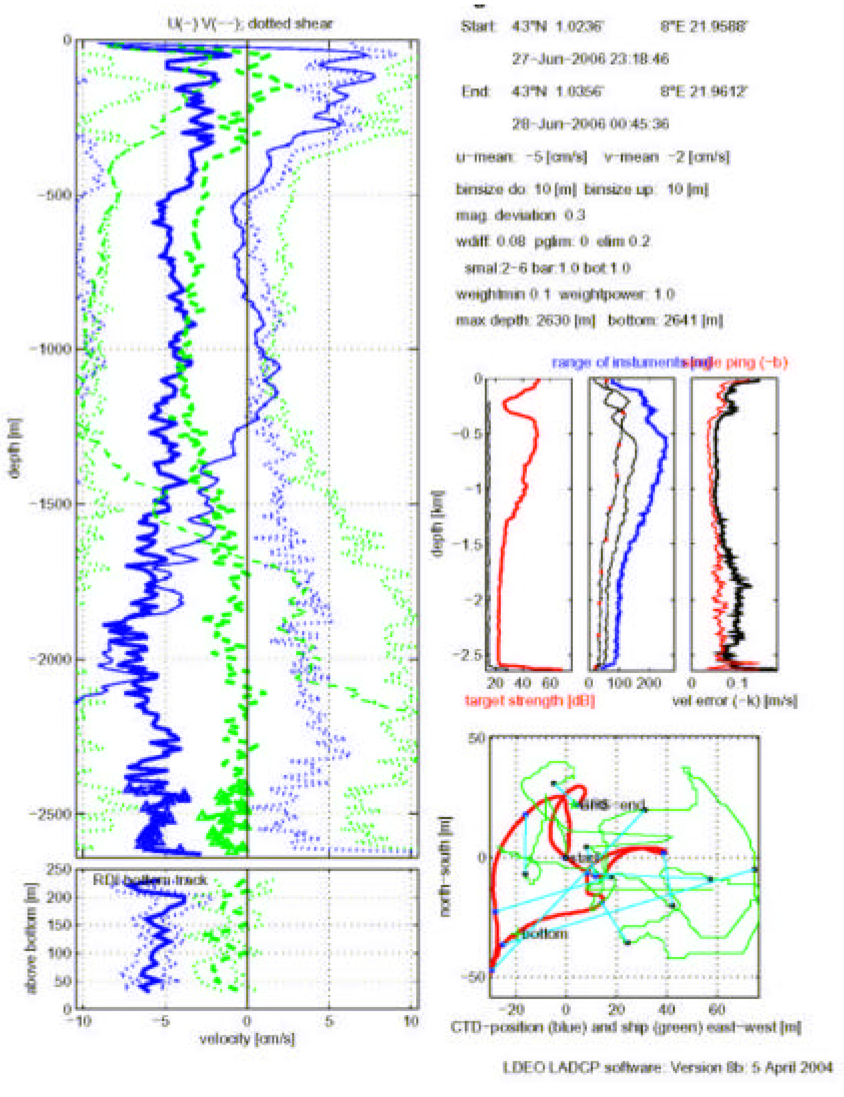


Figure 20 Profile LADCP station 908

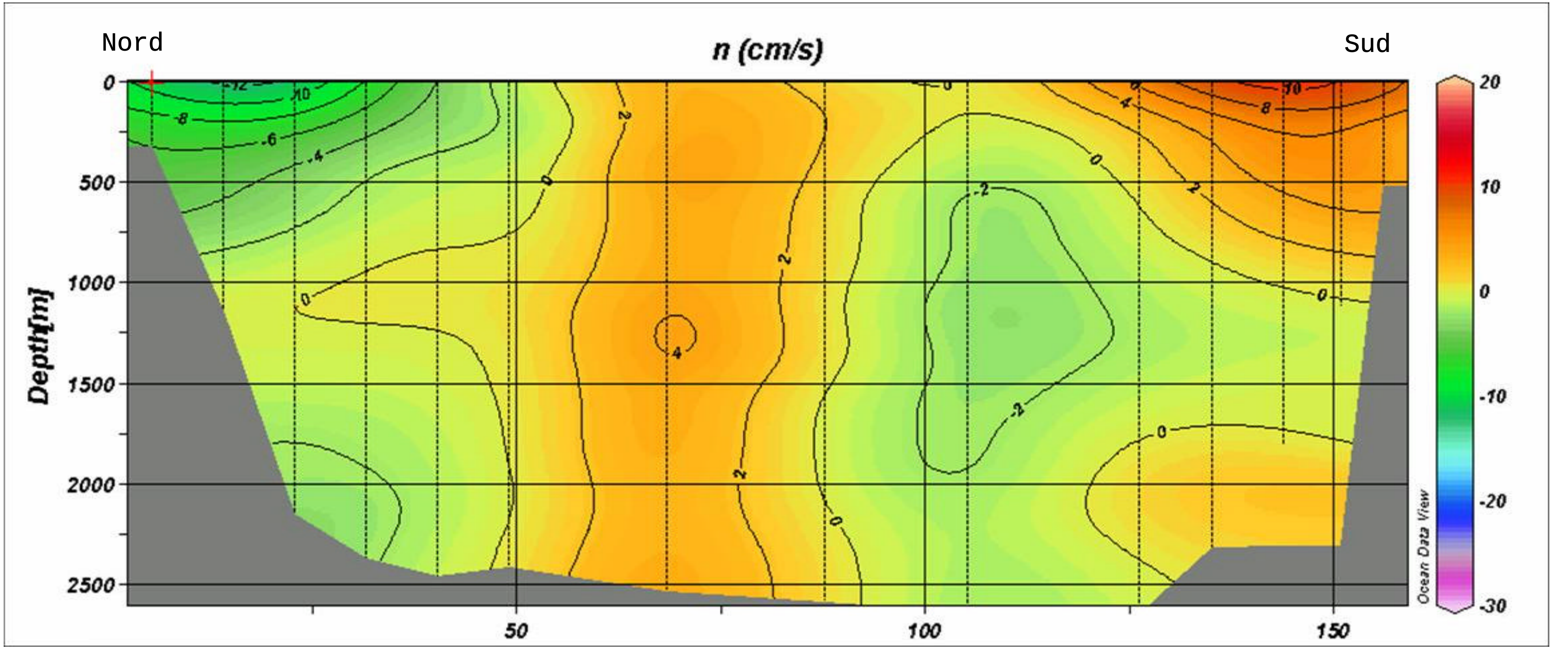
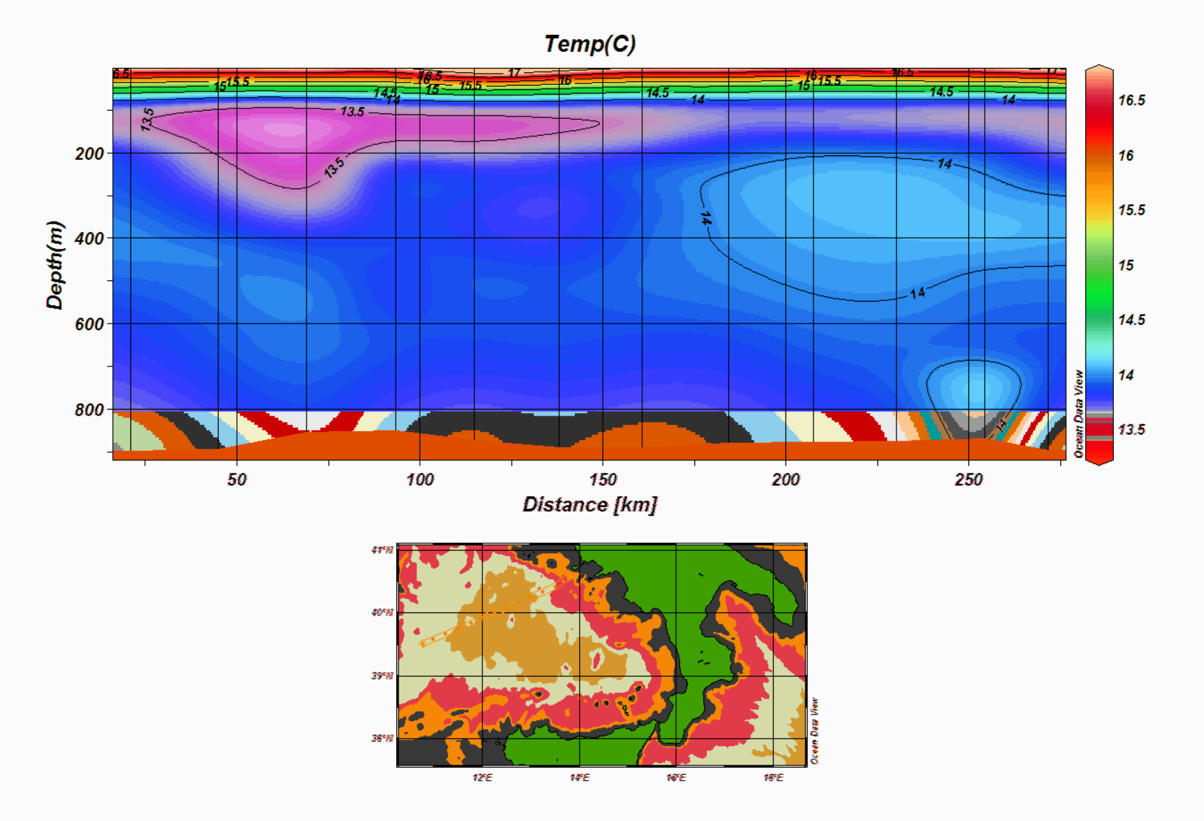


Figure 21 Normal Velocity measured with LADCP (Section 900 – 913)



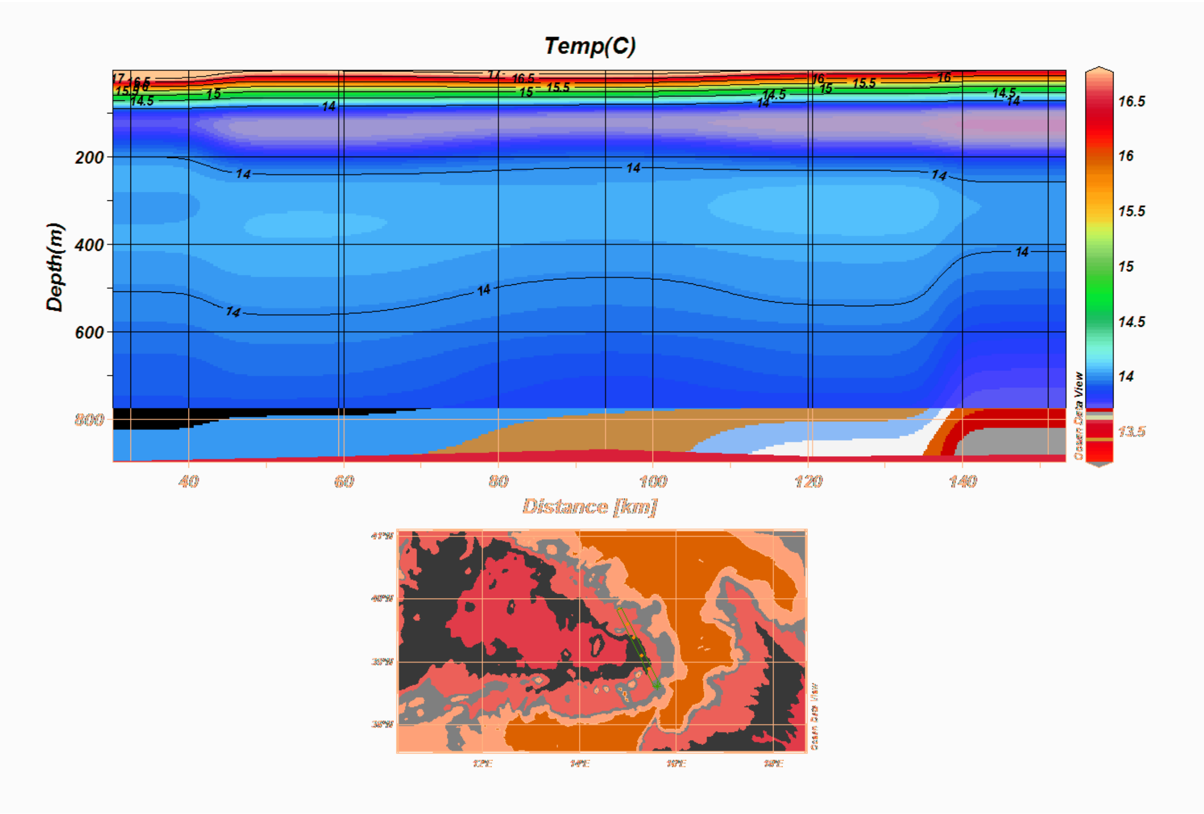


Figure 22 XBT Tyrrhenian Sections

Acknowledgements

The scientific staff of MEDOCC 06 wishes to thank the Italian National Research Council (CNR), which made the R/V URANIA available for the cruise.
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