NATIONAL RESEARCH COUNCIL OF ITALY
INSTITUTE OF MARINE SCIENCES
PHYSICAL OCEANOGRAPHY GROUP (LA SPEZIA)
MARINE GEOLOGY GROUP (BOLOGNA)

JOINT RESEARCH PROJECT "MFSTEP2"

REPORT ON OCEANOGRAPHIC AND GEOPHYSICAL INVESTIGATIONS DURING CRUISE MFSTEP2 (APRIL 2005) WITH R/V URANIA, NORTHERN THYRRHENIAN AND LIGURIAN SEA.

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ISMAR Bologna TECHNICAL REPORT N. 96

Bologna, May 2005

ISMAR-CNR Cataloging-In-Publication data: ISMAR Bologna TECHNICAL REPORT N. 96

REPORT ON OCEANOGRAPHIC AND GEOPHYSICAL INVESTIGATIONS DURING CRUISE MFSTEP2 (APRIL 2005) WITH R/V URANIA, NORTHERN THYRRHENIAN AND LIGURIAN SEA.

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Includes bibliographical reference and index.
1. Meteorology 2. Atmospheric dynamics 3. Air-Sea fluxes 4. Oceanography 5. Meteoceanographic buoy

Abstract - A summary of the methodologies, technical details and ship-board results of a meteorological, oceanographical, geophysical survey in the Northern Thyrrhenian and Ligurian Sea is presented. The cruise utilized the CNR's R/V Urania. Physical Investigations were carried out on the water column by direct measurements and sampling

Sommario - Vengono presentati le metodologie e l'insieme dei risultati ottenuti durante una campagna di rilievi oceanografici, e geofisici nella zona del Tirreno del Nord e del Mar Ligure. E' stata utilizzata la nave da ricerca R/V Urania del CNR.

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Production Notes - The document was edited with standard text editors, typeset with L.Lamport's LaTeX, translated to `PostScript` with `dvips` and printed with an A4 laser printer. The full production was done on a Linux box with `GNU-GPL` software. Converted to HTML by N.Drakos's LaTeX2HTML and to `PDF` by Alladin Ghostscripts's `ps2pdf`. Most of the maps included were produced by Wessel and Smith's `GMT` package. Some drawings were produced by `xfig` (www.xfig.org). Non `PostScript` images were converted by John Bradley's `xv` or other public-domain packages, among them `convert`.

ACRONYMS

ACRONYM	DESCRIPTION	URL-email
CNR	Consiglio Nazionale Delle Ricerche	www.cnr.it
ISMAR	Istituto di Scienze Marine	www.bo.ismar.cnr.it
ISSIA	Ist.Studi Sist.Intelligenti per l'Automazione	www.issia.cnr.it
ISAC	Ist.Scienze Atmosferiche	www.isac.cnr.it
IBF	Istituto di Biofisica	www.ibf.cnr.it
ENEA	Ente per le Nuove Tecnologie, Energia e Ambiente	www.enea.it
MFSTEP	Mediterranean Forecast.System Toward Environ.Pred.	www.bo.ingv.it/mfstep/
MERSEA	Marine Environ. and Security for the European Area	strand1.mersea.eu.org
ODAS-Italia1	Oceanographic data acquisition System Italia 1	www.odas.ge.issia.cnr.it
MAW	Modified Atlantic Water	stommel.tamu.edu
LIW	levantine Intermediate Water	stommel.tamu.edu
NAO	North Atlantic Oscillation	www.met.rdg.ac.uk/cag/NAO
LDR	Longwave Downward Radiation	www.science.gmu.edu/
PIR	Precision Infrared radiometers	
PSP	Precision Spectral Pyranometers	
SBP	Sub Bottom Profiling	
RESON	Reson	www.reson.it
COMM-TEC	Communication Technology	www.comm-tec.com
UNESCO	United Nations Scient. and cultural org.	www.unesco.org
IOC	Intergov.Oceanogr.Comm. of UNESCO	www.ioc.org
IHO	Int. Hydrographic Organization	www.iho.org
SEG	Soc. of Exploration Geophysicists	www.seg.org
GNU,GPL	GNU is not Unix,General Pub. License	www.gnu.org
GMT	Generic Mapping Tool	gmt.soest.hawaii.edu/gmt
GEBCO	General Bathym.Chart Oceans	GEBCO
MBES	MULTIBEAM ECHOSOUNDER SYSTEM	
GPS-DGPS-RTK	Global Positioning System	samadhi.jpl.nasa.gov
DTM	Digital Terrain Model	

Table 1: Acronyms of Organizations, Manufacturers, Products

AUTHORSHIP

Giovanni Bortoluzzi compiled and finalized the main body of this report. M.Borghini, chief of expedition, R.Bozzano and E.Schiano, as co-chief scientists, contributed to the oceanographical, technical and scientific backgroundd All the participants to the cruise contributed to this report with their work and discussions aboard the R/V Urania.

HOW TO READ THIS REPORT

Section 1 gives the introductory and background information, together with some technological and scientific issues of the organization and execution tasks. Section 2 presents the cruise planning, where section 3 summarizes the cruise. Section 4 provides the technical details that were involved in the data acquisition and processing, whereas sections 5 and 6 discuss some results, the on-going data processing and usage, and give concluding remarks.

Some data processing procedures that were used in the production of this Report along with further technical details and data are presented in Appendix.

ACKNOWLEDGMENTS

Many people contributed to the success of this cruise.

Firstly, we wish to thanks the Captain, Vincenzo Lubrano Lavadera, the officers and crew of R/V Urania for their great professionalism and big efforts in assuring the success of the cruise. The project was mainly funded by EU's MFSTEP project, with a substancial amount given by Italian CNR for ship time.

G.Bortoluzzi thanks Dr. Schiano and Mr. Borghini for the hospitality on board.

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1 INTRODUCTION

This work is a multidisciplinary research carried out by several CNR Institutes (ISMAR, ISSIA, ISAC, IBF) and ENEA and it is supported by the European projects MFSTEP and MERSEA.

The project aims to study the influence of the atmospheric variability on the mesoscale oceanic structures and on the response of the surface stratification with respect to the atmospheric forcing by means of measurements acquired from fixed and moving platforms. The Ligurian Sea is a very suitable working area for this type of research. The main hydrodynamic feature of this basin [Astraldi and Gasperini (1992), Vignudelli et al.(1999)] consists in a well defined cyclonic circulation that is affected by a strong variability at different time and space scales depending on the air-sea interaction. Thus, it is necessary to analyse if this variability may be ascribed only to the atmospheric forcing or also to possible horizontal advection phenomena. On the other side, the sea surface affects the overhanging atmosphere, especially for what relates the principal thermodynamical mechanism of the hydrological cycle. The joint use of a fixed and a moving platform allows the investigation of the interaction processes at all the different time scales in the basin. The fixed platform is the ODAS Italia 1 meteo-oceanographic buoy [Bozzano (2003)] located at the centre of the Ligurian Sea (Fig.1).

Figure 1: ISSIA-CNR's ODAS-Italia 1 Buoy.

This buoy collects the main surface meteo-marine parameters involved in the energy exchanges. An instrumental mooring placed nearby the buoy fulfils the data set by furnishing hydrological and current meter measurements at the deeper levels. The use of the R/V Urania during the winter season was requested for the in-situ data acquisition and for the servicing of the ODAS buoy and of current meter moorings in the area. The cruise would complement the one carried out on summer 2004 (MFSTEP1), when the air-sea fluxes were measured in the same area by shipborne and balloon radiosounding measurement systems, other than by several hydrological casts. In addition to the above tasks, measurements of sea radiance for satellite "sea-truth" and of the optical properties of the upper watercolumn were perfomed.

It is known that NW Mediterranean Sea and particularly the Ligurian Sea are sites of primary interest for the study and observations of Cetaceans (whales and dolphins). The area is populated by many species of marine mammals, probably due to the peculiar topography and hydrology that favour the growth of consistent prey populations and communities for cetacean predation. The use of ship-of-opportunity [Evans et al.(2004)],[Brereton and Williams (2000)] is both cost-saving and efficient, mainly for first estimates of distribution and abundance. After the MFSTEP1 Cruise of 2004, R/V Urania was employed also in this cruise for Cetacean Observations. Moreover, as a ship-of-opportunity, the transit times were used for swath bathymetry mapping.

The activities and initial results of the research cruise MFSTEP2 in the Ligurian Sea aboard CNR's R/V Urania are presented.

During 10 days in the area

- air-sea fluxes and thermal structure were investigated by continuously recording instrumentation,
- the water physical and optical properties were studied by CTD casts and profilers (water samples were filtered and stored for other physical and biological investigations), and by ADCP current meter profiling,
- the ODAS buoy and other moorings were serviced,
- and, on transit and when time was made available by scheduled operations, multibeam swath bathymetry and SBP was performed.

Cruise started in Civitavecchia 2005-04-13. Ship left the work area on 2005-04-22 morning, heading to Livorno, where it docked 2005-04-22 09:00 local time.

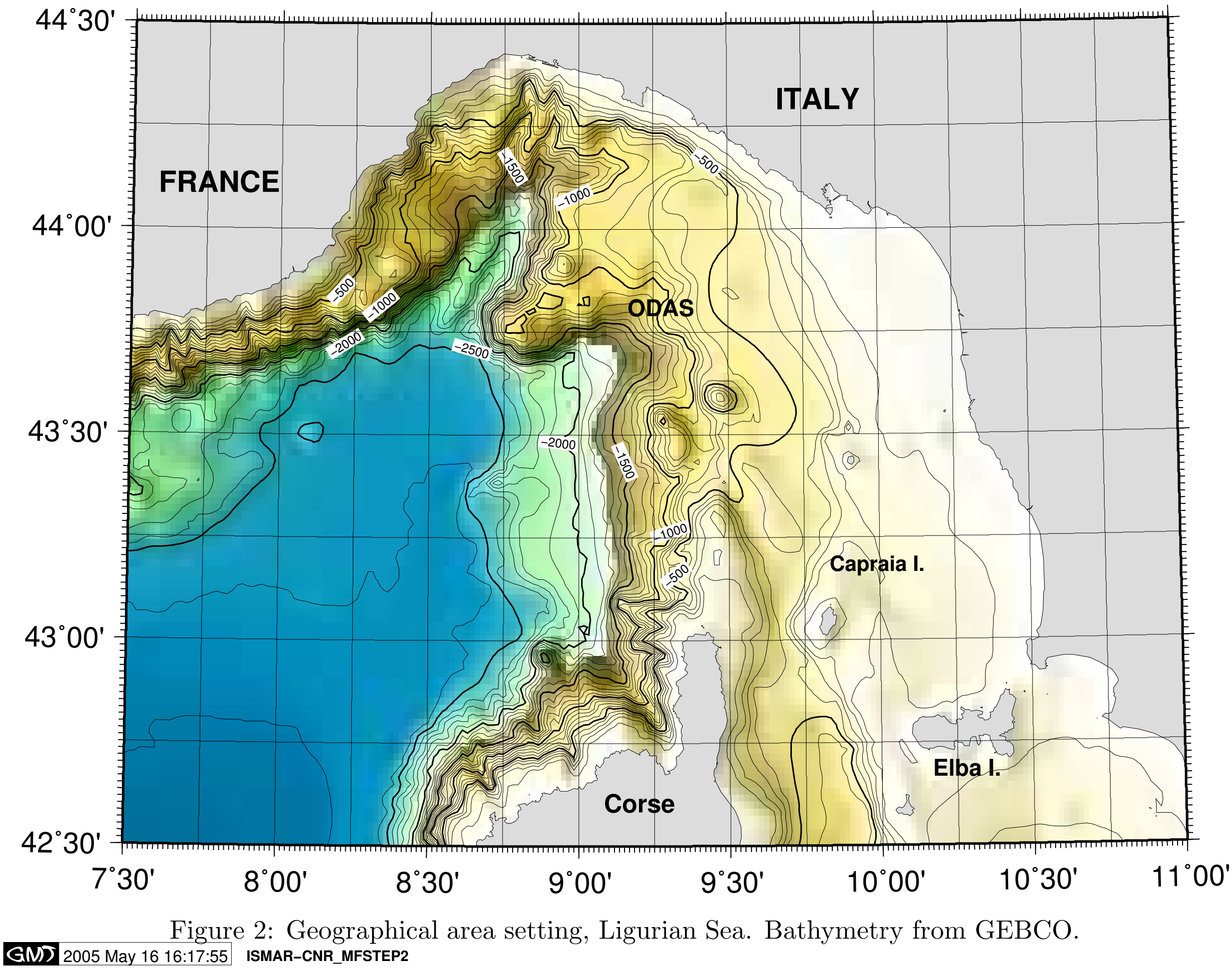

Figure 2: Geographical area setting, Ligurian Sea. Bathymetry from GEBCO.

2 ENVIRONMENTAL SETTING

The Ligurian Sea and the surrounding Gulf of Lyon of the Liguro-Provencal basin are among the most dynamic and productive areas within the whole Mediterranean Sea. It is a deep, semi-enclosed sea with a narrow continental shelf surrounded by the Alps to the North and by the Corsica Island to the South. The basin exchanges water with the southern part of the Western Mediterranean trough the Corsica channel alongside the Italian coast.

The Ligurian Sea is the more inland sea of the Mediterranean: these orographic constraints and the thermal contrast between land and sea give rise to specific local effects that influence the general circulation of both atmosphere and ocean.

The main hydrodynamics characteristics are a pronounced cyclonic circulation involving both the superficial MAW and the lower LIW layer which is fed by two main currents flowing along the Corsican coast towards North. Although this structure is almost permanent, it shows an important seasonal and interannual variability due to the variability of the Tyrrhenian current flowing through the Corsica channel.

Moreover, the Ligurian basin is very important for many physical and biological aspects. During the winter, processes of dense water formation often occur. Its productivity is very high and its ecosystem very rich and complex. The strong air-sea interaction processes greatly affect both atmospheric and marine circulation, determining a strong variability in the upper ocean thermal gradient.

The circulation and the most important processes of the Ligurian basin are mainly influenced by the local atmospheric-climatological conditions, which, in their turn, depend on planetary oscillations (e.g., tight relationship between the water fluxes in the Corsica channel and the NAO variability)[Astraldi and Gasperini (1992)], [Vignudelli et al.(1999)].

As for the biological and marine living aspects, the richness and variety of populations found in the basin induced the coastal governments to sign an international treaty for the delimitation of an area (the so-called 'Cetacean Sanctuary'), mostly centered on the Ligurian Sea, dedicated to the preservation and study of the existing species. It must be stressed that the Ligurian Sea can be clearly distinguished from all the other basins in the Mediterranean as to the number and variety of great pelagic fishes and mammals. Cetaceans, Dolphins, Swordfish, Tuna that are present in the offshore waters, form the upper level of an ecosystem distributed over a water column of more than 2000 m and strongly diversified as far as the planktonic components. Along the zooplankton trophic chains, this richness manifests itself with an abundance of the same species of krill that is present in the North-Atlantic (*Meganyctyphanes Norvegica*), representing a key-species in the trophic chains of large pelagic, directly (fin whales, young tuna, etc.) or indirectly (sperm whales, swordfish, etc.). Very recent studies have shown that the Ligurian Sea is the region where the Mediterranean fin whales are born, thus indicating very favourable conditions for their living, which do not exist in any other part of the Mediterranean.

CRUISE PLANNING AND STRATEGY

The working strategy was based on meteorological and hydrological measurements and was carried out by a preliminary survey of the interested area in order to localise the dynamical structures (if any) and the frontal area. The investigation on the dynamic structures would have been performed in a much greater detail over a smaller area, centered around the ODAS buoy.

The survey was planned to carry out the following tasks

- air-sea fluxes continuous measurements, including launches of expendable Radio Probes
- CTD casts with Water sampling, bio-optical and sea-truth investigations,
- ODAS buoy servicing,
- ADCP profiling
- multibeam bathymetric mapping

The areas planned for surveying were :

A the Capraia Transect

B the ODAS Buoy site

C the C.Corso-Marseille Transect

Area A and C, being considered the boundary for the Ligurian Basin, would have to be investigated in detail by hydrological casts and XBT launches, whereas area B would have been surveyed for ODAS buoy data and CM mooring QC and data validation, and for defining fine structures and front systems.

The ODAS Buoy and mooring servicing were planned for the second part of the cruise.

The whole daylight time in favourable weather conditions was devoted to Cetacean sighting.

Several measurements of the optical properties were scheduled on some CTD stations on different water bodies (Thyrrhenian, transition and Ligurian).

Any transit or available time was devoted to Multibeam (and SBP) acquisition. In particular, the ISMAR of Bologna team planned to collect data primarily on an area NNW of the Capraia Island, were ancient deep sea corals were dredged from mounds and small reliefs and other research studies have been carried out by ISMAR-Bologna [Remia et al.(2003), Remia and Taviani(2005)]). The possibility to take the opportunity of transits and any other available ship time for multibeam surveying, nevertheless, pointed toward the build-up of high resolution, publicy available, bathymetric databases.

3 CRUISE SUMMARY

SHIP: R/V URANIA
START: 2005-04-12 PORT: CIVITAVECCHIA
END: 2005-04-22 PORT: LIVORNO
SEA/OCEAN: Mediterranean Sea/Thyrrhenian Sea, Ligurian Sea
LIMITS: NORTH 44:00.0 SOUTH: 41:45.0 WEST: 08:00.0 EAST: 12:00.0
OBJECTIVE: OCEANOGRAPHICAL INVESTIGATIONS IN THE N.THYRRHENIAN AND LIGURIAN SEA
COORDINATING BODIES: ISMAR-CNR LA SPEZIA (ITALY)
PARTICIPATING BODIES: CNR,ENEA,UNIVERSITY SIENA AND GENOVA
CHIEF OF EXPEDITION: Mireno Borghini(ISMAR-CNR)
CONTACT: mireno.borghini@ismar.cnr
DISCIPLINES: OCEANOGRAPHY, WATER SAMPLING, MORPHOBATHYMETRY,
WORK DONE: 54 CTD CASTS/ROSETTE SAMPLES,
2 MOORING RECOVERY/DEPLOYMENT BUOY SERVICING
7 BIO-OPTICAL STATIONS, WATER RADIANCE,
550 KM^2 SURVEY MULTIBEAM, 100 KM SBP,
ADCP, METEO, SURFACE TEMPERATURE/SALINITY

LOCALIZATION:

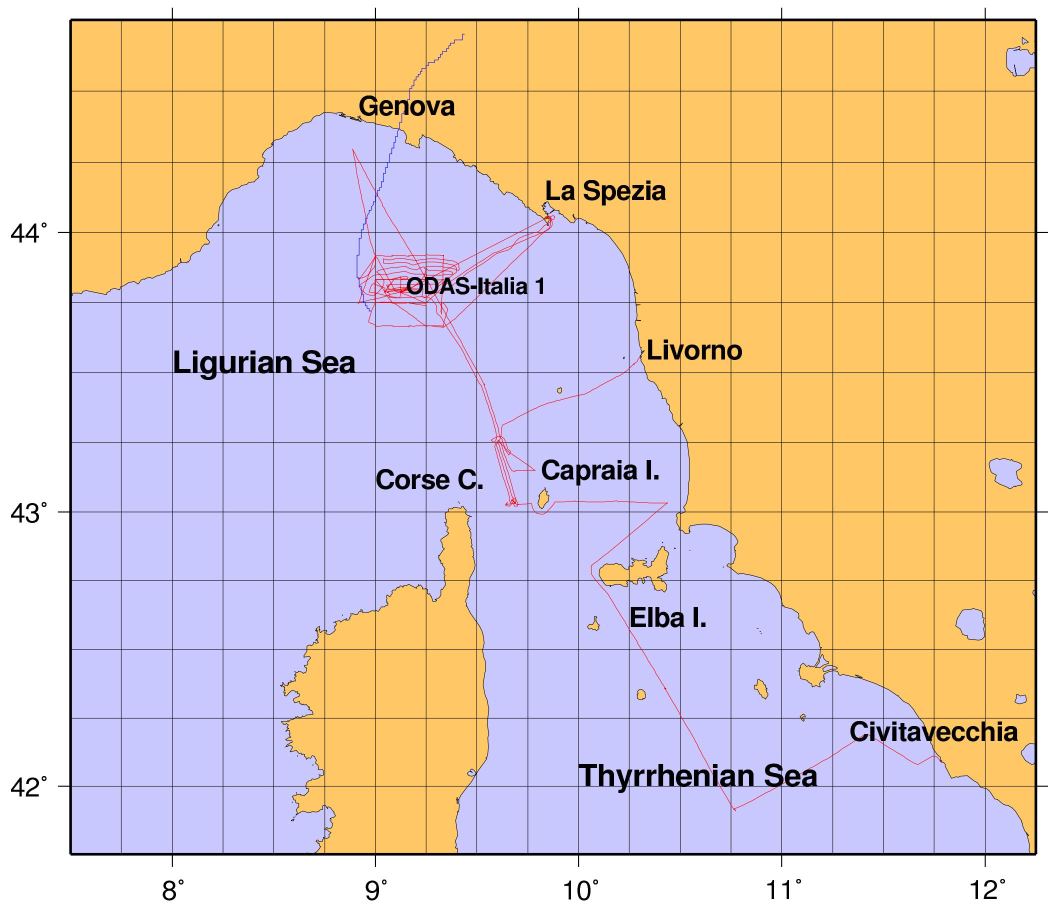

Figure 3: Ship tracks during Cruise MFSTEP2. The blue line is the trajectory of one of the Vaisala radiosonde launches.

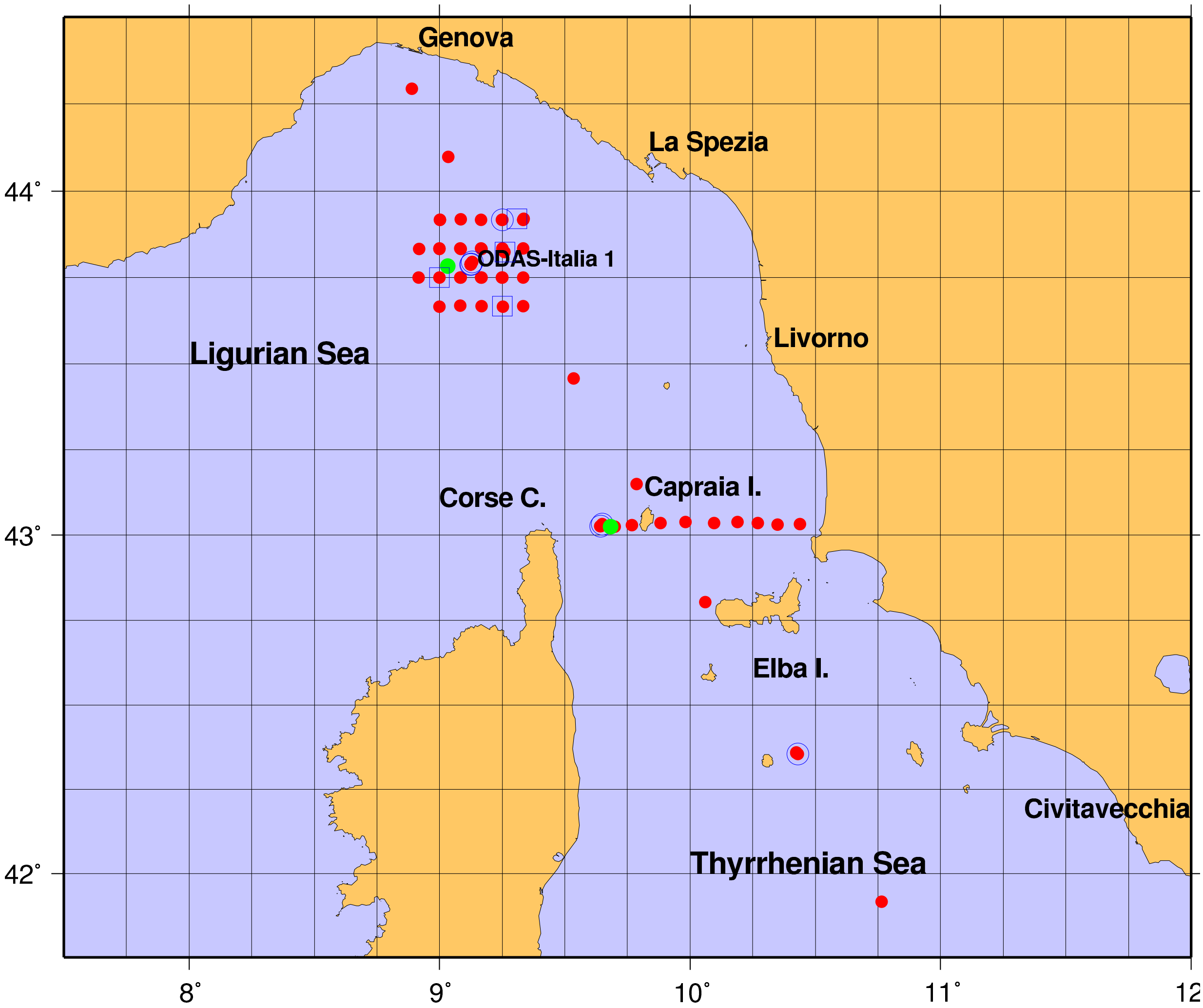

Figure 4: Sample locations during Cruise MFSTEP2. Red circles are CTD/Caroussel Stations, green circles are the Instrumental moorings, blue circles are the bio-optical stations. The blue squares are the Vaisala Radiosonde launches.

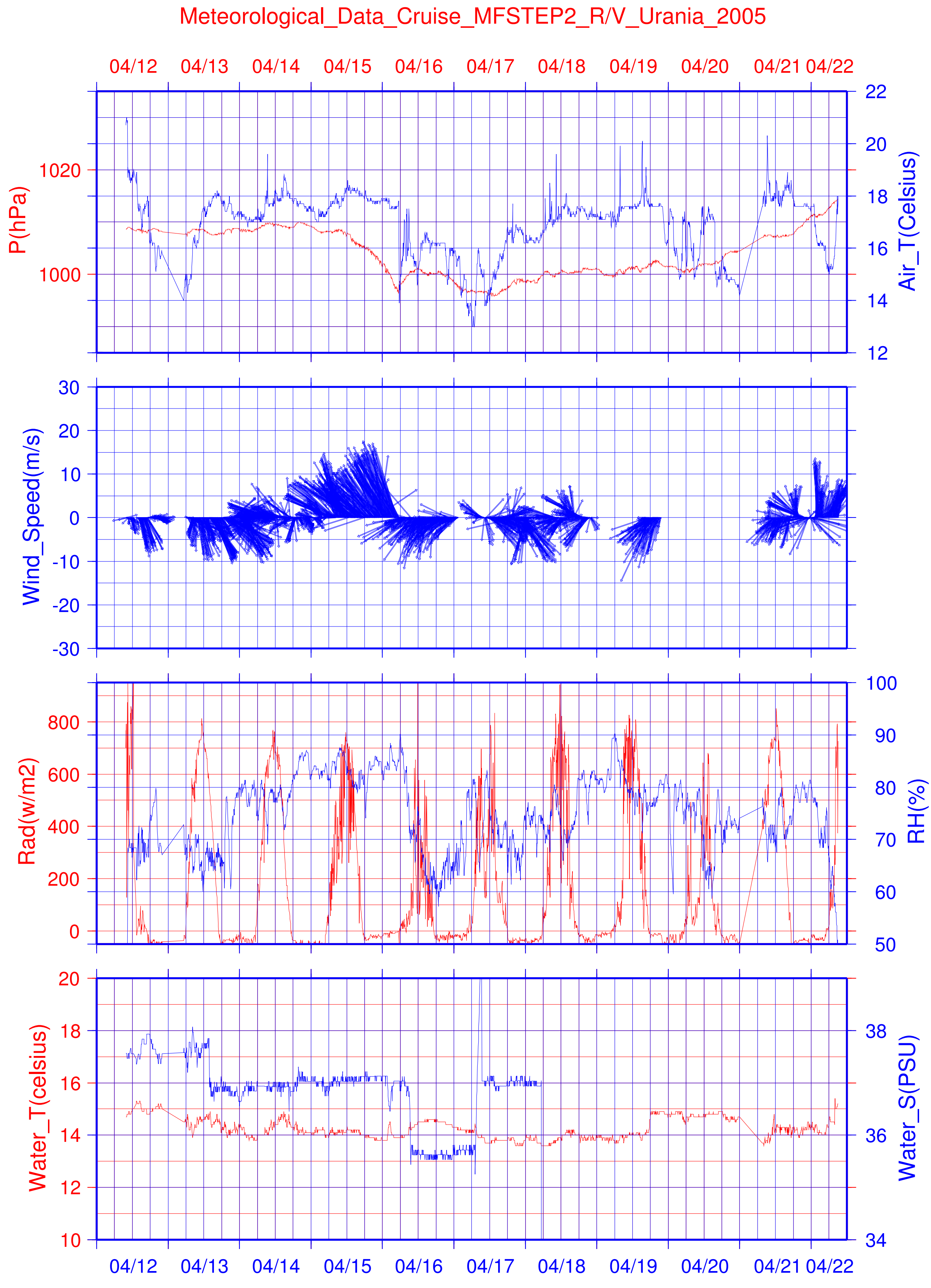

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Figure 5: Meteorological data during Cruise MFSTEP2

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Table 2: Scientific and technical parties

4 MATERIALS AND METHODS

The cruise was carried out by the 61 meter R/V URANIA (Fig.6), owned and operated by SO.PRO.MAR. and on long-term leased to CNR.

The boat is normally used for geological, geophysical and oceanographical work in the Mediterranean Sea and surrounding waters, including but not limited to, the Atlantic Ocean, the Red Sea, and the Black Sea.

R/V Urania is equipped with DGPS positioning system, single-beam and multibeam bathymetric equipment and integrated geophysical and oceanographical data acquisition systems, including ADCP, CHIRP SBP and other Sonar Equipment.

Figure 6: R/V Urania.

4.1 SHIP-BORNE AIR-SEA FLUXES INSTRUMENTATION

Two sets of instruments were positioned on the bow and on top of ship's masts. The sea surface temperature was measured by infrared thermometers (PRT-5, Minirad-RS20, Everest 112 ALCS, Tasco THI-500). The radiative properties of the atmosphere (LDR) was investigated by two Eppley Precision Infrared Pyranometers mounted on one of the ship's masts on the upper deck at about 15m above sea level. Full information on the rationale and on instrumental deployment can be found on [Schiano et al.(1993), Schiano (1996), Schiano et al.(2000)]. Figures 7, 8, 9 and 10 show the sensors. The 1Hz PC based data acquisition was complemented by meteorological observations by an automated station and by hourly manual recordings. Vaisala Radiosondes were also launched (see Tab.3) to study pressure, temperature and wind components up to 20 Km into the lower stratosphere. The GPS data in the telemetry messages were used for accurate probe location.

Figure 7: Cruise MFSTEP2, April 2005. Infrared thermometer.

Figure 8: Cruise MFSTEP2, April 2005. Infrared thermometer.

Figure 9: Cruise MFSTEP2, April 2005. Spectral Pyranometers on the ship's mast.

Figure 10: Cruise MFSTEP2, April 2005. Launch of Vaisala radio probe.

DATE	TIME	LON	LAT	LAUNCH
2005-04-14	23:53:00	9.2596667	43.8233333	001
2005-04-15	12:01:00	9.3090000	43.9200000	002
2005-04-15	18:16:00	9.2503333	43.6675000	003
2005-04-16	00:13:00	8.9991667	43.7501667	004

Table 3: Vaisala Radiosonde launches localization.

SEA RADIANCE AND 'SEA-TRUTH" MEASUREMENTS

The Clorophyll remote sensing by satellite requires an accurate modelling of the athmospheric effects. For an uncloudy scene the aerosol diffusion is considered to be the principal effect. When dealing with enclosed seas like the Mediterranean, anthropogenic or non oceanic aerosol effects, including dust transportation from Sahara must be taken into account. The sea surface radiance and the optical thickness were obtained by a SIMBADA radiometer (Laboratoire d'Optique Atmospherique, CNRS, Lille, France) measuring 11 spectral bands centered at 350, 380, 412, 443, 490, 510, 565, 620, 670, 750 e 870 nm. The aereosol content may be detected by analyzing the spectral variations of the optical thickness. Measurements were taken during the daylight hours and with unclouded sun. The 12:00 measurements will be used for the SeaWiFS Satellite 'sea-truth'.

4.2 THE ODAS BUOY - M3A

The original M3A configuration was designed to use high quality and world-wide referenced sensors. For the E1-M3A system in the Cretan Sea, already developed during the past project MFSPP [Nittis et al.(2003)], sensors from Seabird Inc. were mainly selected for measuring chemical-physical parameters of the sea water.

Figure 11: Servicing of ODAS-Italia1.

The W1-M3A system (Fig.11) can be briefly described by the following characteristics:

- employment of a large spar buoy (formerly named ODAS Italia 1) specifically developed for air-sea interaction studies and meteorological measurements;
- location offshore and on a deep site;
- capability of measuring a complete set of meteorological parameters;
- capability of measuring physical parameters of the sea down to about 50 m, marine currents down to about 200 m by means of electromechanical and acoustic current meters;
- capability of measuring physical and chemical properties of the sea water by means of a multiparametric device close or on the damping disk of the buoy, i.e. at a favourable depth for measuring, for instance, the maximum of fluorescence;
- transmission of acquired data in near-real time to the station ashore by means of a dedicated phone link;
- on-line application of data quality control procedures on the acquired data and their forwarding to the data management centre.

By summarising, W1-M3A is able to collect CT (Condictivity/Temperature) measures at six depths from the surface down to about 50 m, CT + turbidity + fluorescence + dissolved oxygen + chlorophyll at about -40 m, sea waves statistics, water current at two depths above the damping disk with mechanical sensors and current below the buoy with an ADCP. For what concern the meteorological parameters, W1- M3A measures atmospheric pressure (with a mechanical and a piezoelectric sensors), wind speed and direction, air temperature and relative humidity (with a sensor in a standard shield and another one in a ventilated shield), precipitation, global solar radiation. Other measured parameters are: buoy geographical position, inclination (roll and pitch angles) and heading, DC current by the eight solar panels, and on- board battery charge.

Table 4 presents the mooring coordinates by analyzing a several months time series of the on-board GPS data:

UTM 32	Geographical	Water depth
513135 4848497	009 09 47.88"E 043 47 21.84"N	1377

Table 4: UTM 32 and geographical (WGS-84) coordinates of the anchor of the buoy computed by using 6668 positions acquired by the on-board GPS in 10 months.

Since the buoy has a slack mooring, it freely moves within a circle with a diameter of about 3.2 Km (precisely, 3.259 Km along East and 3.240 Km along North).

The buoy occupies positions resulting from the composition of two main forces (the sea wave and the wind) with the constraint of the mooring line. A more refined analysis can reveal that northern positions occur with light winds whereas southern positions are associated with strong northern winds: however, since the prevailing and almost constant current stream flows towards North, in case of northerly winds the resultant positions are in the south-western sector rather than in the southern sector itself.

Further information of Instrumental payloads and buoy activity can be found in the ODAS buoy WWW homepage.

4.3 WATER COLUMN INVESTIGATIONS AND SAMPLING

SeaBird SBE CTD, oxygen and SeaTech Fluorimeter probes were assembled on the bottom of a 24 Niskin Bottle Caroussel Sampler operated by the ISMAR team..

On some of the stations the water column was sampled at different depths. A minimum of 2.5L of water per sampling level was immediately filtered by GF/F filters and deep-frozen stored.

Immediate Quality Control and calibration of S and Oxygen data were done by a Model 8400B Autosal Guildline Salinometer and by Shott Gerate Titronic T100 and Titronic Controller 1200.

Nutrient, Clorophyll and other analysis on the filtrates are undergoing in the laboratory.

Table 5 shows the localization of the stations.

OPTICAL AND BIO-OPTICAL PROPERTIES

The optical properties of the upper water column, were investigated on some stations by UV and PAR irradiance profiles using a PUV541 (Biospherical Istruments, S.Diego, Ca) and a EPP2000 (Stellarnet) spectroradiometers. Further analysis by spectrophotometer will be perfomed on water samples filtrated on 0.2 micron and preserved at 4°. Details on the sampling and analytical procedures can be found in [Bracchini et al.(2004,a), Bracchini et al.(2004,b), Dattilo et al.(2004)].

DATE	TIME	LON	LAT	STATION	TYPE
2005-04-13	11:24:33	10.764000	41.916167	A6	ROS
2005-04-13	19:13:27	10.429588	42.354715	A5	RAD
2005-04-13	19:24:23	10.424450	42.359460	A5	ROS
2005-04-13	19:59:33	10.424033	42.358193	A5	ROS
2005-04-13	21:41:10	10.061220	42.802812	A4	ROS
2005-04-13	23:55:28	10.438087	43.031793	100	ROS
2005-04-14	00:31:35	10.348273	43.031252	101	ROS
2005-04-14	01:09:50	10.270977	43.035145	102	ROS
2005-04-14	01:47:59	10.188725	43.038300	103	ROS

2005-04-14	02:28:56	10.094937	43.034925	104	ROS
2005-04-14	03:19:14	9.980693	43.038303	105	ROS
2005-04-14	04:23:23	9.882937	43.034903	106	ROS
2005-04-14	05:22:07	9.768133	43.029242	107	ROS
2005-04-14	06:02:35	9.699663	43.025215	108	ROS
2005-04-14	13:05:47	9.642173	43.025515	109	RAD
2005-04-14	13:45:11	9.649123	43.032882	109	RAD
2005-04-14	13:59:47	9.641512	43.025570	109	ROS
2005-04-14	17:22:01	9.785565	43.149292	A3	ROS
2005-04-14	20:20:30	9.535643	43.457975	A2	ROS
2005-04-14	23:54:00	9.259562	43.823467	A1	ROS
2005-04-15	02:42:44	9.035222	44.098128	A1B	ROS
2005-04-15	05:09:32	8.888315	44.294160	A1C	ROS
2005-04-15	08:11:11	9.000395	43.916757	S16	ROS
2005-04-15	09:41:28	9.083492	43.917745	S17	ROS
2005-04-15	10:21:52	9.166305	43.917110	S18	ROS
2005-04-15	11:12:23	9.249275	43.917310	S19	ROS
2005-04-15	11:27:50	9.250127	43.917417	S19	RAD
2005-04-15	12:17:37	9.332708	43.917392	S20	RAD
2005-04-15	12:27:54	9.335125	43.919757	S20	ROS
2005-04-15	12:39:35	9.333283	43.917470	S20	ROS
2005-04-15	15:24:40	9.332705	43.750572	S10	ROS
2005-04-15	16:43:59	9.332747	43.667068	S5	ROS
2005-04-15	18:22:34	9.251772	43.666422	S4	ROS
2005-04-15	19:16:21	9.167597	43.666618	S3	ROS
2005-04-15	20:01:40	9.083297	43.668023	S2	ROS
2005-04-15	21:47:18	9.000022	43.665127	S1	ROS
2005-04-16	00:13:58	8.999233	43.750280	S6	ROS
2005-04-17	10:43:09	9.249413	43.749758	S9	ROS
2005-04-17	12:15:34	9.165707	43.749808	S8	ROS
2005-04-17	13:03:00	9.082188	43.749707	S7	ROS
2005-04-17	14:06:57	9.000045	43.832737	S11	ROS
2005-04-17	15:21	9.085	43.832737	S12	ROS
2005-04-17	17:14	9.167	43.832737	S13	ROS
2005-04-17	18:10	9.250	43.832737	S14	ROS
2005-04-17	19:34:03	9.333490	43.833563	S15	ROS
2005-04-18	00:38:02	8.917932	43.833027	S21	ROS
2005-04-18	02:13	9.001	43.917	S16B	ROS
2005-04-18	05:15:22	8.916678	43.749995	S23	ROS
2005-04-18	06:19	9.124093	43.789162	L1	ROS
2005-04-18	10:29:21	9.125147	43.789495	L1	RAD
2005-04-18	10:57:23	9.129178	43.795063	L2	RAD
2005-04-18	11:10:44	9.124093	43.789162	L2	ROS
2005-04-18	15:35:57	9.124567	43.788040	L3	RAD
2005-04-18	15:46:04	9.124477	43.788377	L3	ROS
2005-04-18	18:11:51	9.124352	43.788097	L4	ROS
2005-04-18	19:10:28	9.249798	43.749497	S9B	ROS
2005-04-18	20:01:14	9.166547	43.749960	S8B	ROS
2005-04-18	20:45:38	9.083500	43.750305	S7B	ROS
2005-04-18	22:19:31	8.999058	43.833680	S11B	ROS
2005-04-18	23:08:41	9.082563	43.833677	S12B	ROS
2005-04-18	23:54	9.166	43.833677	S13B	ROS
2005-04-19	00:38	9.250	43.833677	S14B	ROS

Table 5: Cruise MFSTEP: Station localization.

4.4 ADCP AND MOORING CURRENT METER DATA

The RDI Mod. Workhorse 300Khz and Ocean Surveyor 75Khz ADCP were used. The data were collected by the VMDAS software Version.

The ADCP system on the RV Urania is formed by two ADCPs, an Ocean Surveyor 75KHz , able to investigate the current field up to about 600 m and a WorkHorse 300KHz resolving the surface layers up to 95 m, both manufactured by RDI. During our experiments OS was configured in Narrow Bandwidth mode, a processing method which uses low-pass filters to measure the returned Doppler energy spectrum, differently the WH operated in Broad Bandwidth mode. Navigation data (positions) are provided by a differential GPS system, and the ship's heading is provided by an analog gyro signal coming from the conventional compass of the ship. The ship's heading is needed to transform the flow relative to the transducer into earth coordinates. To remove spurius contamination from gyro signal, such as the Schuler oscillations, an independent measurement of heading was performed using a 3-D Ashtech-GPS system ADU2. ADCP data were collected from the OS75 profiler every 3 s in 45 vertical bins of depth 16 m. The WH300 profiler collected data every 1 s in 40 vertical bins with a vertical resolution of 4 m. Both the transducers were located behind an acoustic window in a wall of the ship's keel, at 3.5 m below the surface. The data acquisition was controlled by the RDI VMDAS software package. The bottom track was activated only when the ship was sailing in shallow water. Data were processed using the Common Oceanographic Data Access System (CODAS V3.1) developed and maintained by a group from the University of Hawaii [Firing (1995)]. The settings are shown in Tab.6.

	Ocean Surveyor 75KHz	WorkHorse 300KHz
number of depth cells	45	40
transducer depth	3.5 m	3.5 m
depth cell size	16 m	4 m
blank after transmit	8 m	3 m
time per ensemble	3 s	1 s

Table 6: ADCP settings.

An oceanographic mooring located E of the Capraia I. was successfully recovered on 2005-04-14. The mooring design is presented in Tab.7 and in Fig.12.

An oceanographic mooring located W of the buoy ODAS ITALIA1 was successfully recovered on 2005-04-18. The mooring design is presented in Tab.8. Figures 13 and 14 show operations on deck.

Date	Time	Lon	Lat
2005-04-14	12:34:30	43:01:45.20	09:41:15.25
Depth	Instrument	Sampling rate	Comment
71	VACM		RCM9
121	VACM		RCM9
319	VACM		RCM7
413	VACM		RCM7

Table 7: Mooring W Capraia I..

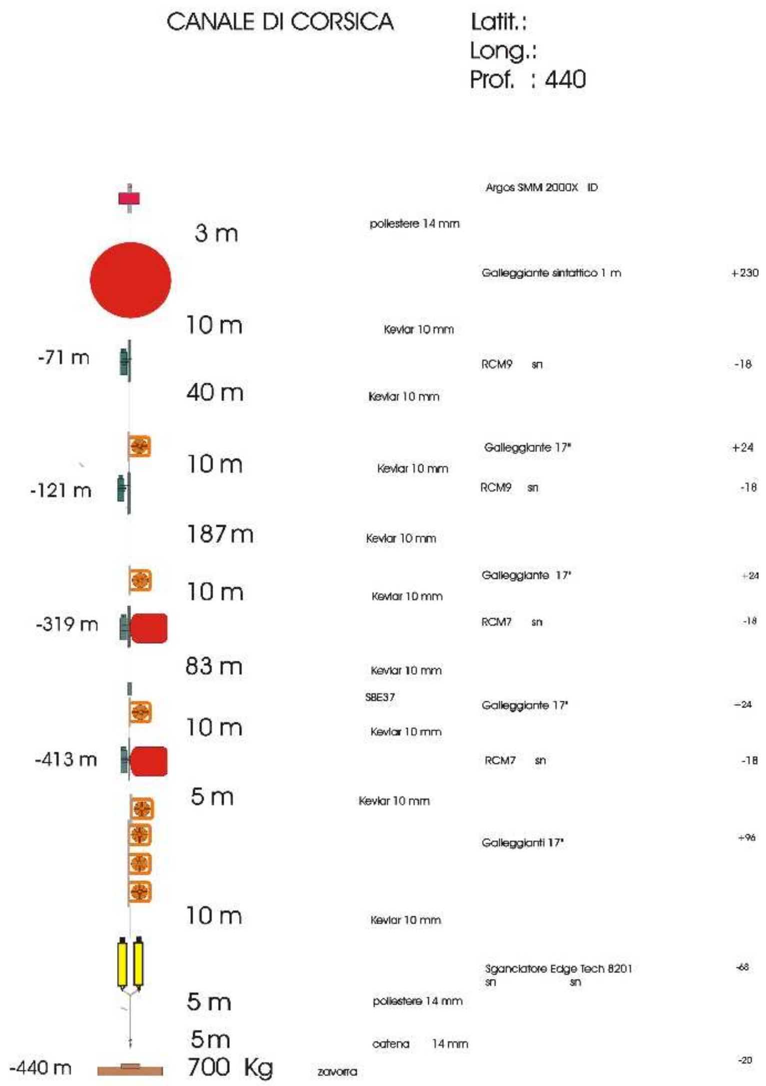

Figure 12: Mooring design.

Date	Time	Lon	Lat
2005-04-18	14:01:49	009:02:49.47	43:47:15.59
Depth	Instrument	Sampling rate	Comment
90	T/Cond	15’	SBE 37
100	ADCP	60’	Workhorse Sentinel 300 Khz upward looking
120	T/Cond	15’	SBE 37
250	T/Cond	15’	SBE 37

Table 8: Mooring W ODAS Buoy.

Figure 13: Servicing of mooring W of ODAS-Italia1.

Figure 14: Servicing of mooring W of ODAS-Italia1.

After maintenance and data download, the mooring was deployed with the same configuration. The mooring was working since 2004-09-22 other than from 2003-09-13 to 2004-05-26.

Data collected integrate those from buoy ODAS and are used for the study of air-sea interaction and dynamics of the upper thermocline.

4.5 NAVIGATION, SWATH BATHYMETRY AND CHIRP SBP

Two workstations were used for (a) ship's guidance, navigation, and multibeam data acquisition by the RESONS's PDS2000 V2.3.4.35 and (2) meteo, conductivity/temperature at the keel, DESO 25 echosounders data acquisition by the Communication Technology NAVPRO V5.6.

The latter workstation collected also the navigation data every 5 minute and at different sampling rates.

The Multibeam data acquisition system interfaced the RESON 8160 Operator's console, a TSS MAHRS gyrocompass and MRU, and the DGPS receiver. Multi serial I/O was accomplished by a MOXA interface.

The NAVPRO system used a Microtecnica Gyrocompass, and the SeaStar GPS receiver with a DGPS Satellite link by FUGRO. The variuos instruments were interfaced by a Digiboard Multi Serial I/O.

The instrumental offsets are presented in Fig. 15 and in tables 9 and 10.

An RDI ADCP @300Khz and 75 Khz was run almost constantly during work. The positioning and attitude data were provided by a 4 antenna Ashtec GPS and by a MAHRS TSS gyrocompass and attitude sensor.

The SBP sonar data were acquired by Benthos software Chirp2 V3.09, having Latitude and Longitude data sent by the NAVPRO software as instrumental position.

The speed of Sound for DEPTH 1 and 2 was set to 1508m/sec, with a transducer immersion of 3.8m.

The NAVPRO computer interfaced also an AANDERAA meteorological station and a Conductivity/Temperature sensor on the keel at a depth of 3.5m. Data was collected at the same rate as above.

The SBP-CHIRP workstation received the 'VESSEL(0,0)' positions by the NAVPRO serial output. The positions were therefore recorded on the SEGY trace headers.

WHERE	ALONG(Y)	ACROSS(X)	RANGE	BEARING
POS 1	4.80	1.40	5.0	16.26
VESSEL (POS 2)	0	0	0	0
ECHO SOUNDER 33	5.50	1.85	5.80	18.59
CHIRP	-5.50	-0.95	5.58	189.80
CORER	-14.20	7.0	15.83	153.76
STERN	-46.6	-1.40	46.62	189.80
ADCP	0.10	-0.15	-0.40	

Table 9: Instrumental Offsets on Ship Urania for the NAVPRO Navigation System. Point (VESSEL,(0,0)) is located on the axis of the mast just behind the Command Bridge. The main GPS antenna (primary positioning system is located on point POS1.

WHERE	X	Y	Z
ZERO	0.0	0.0	0.0
DGPS	1.64	14.30	14.18
8160 MB	0.0	14.36	-4.96
MAHRS	0.0	3.50	-0.60
SEALEVL			-0.20

Table 10: Instrumental Offsets on Ship Urania for the PDS2000 Navigation System. Positive directions are X:starboard, Y:ahead, Z:up. Point of ZERO offset (0,0) is located aproximately near the ship's center of motion.. The main GPS antenna (primary positioning system is located on point DGPS.

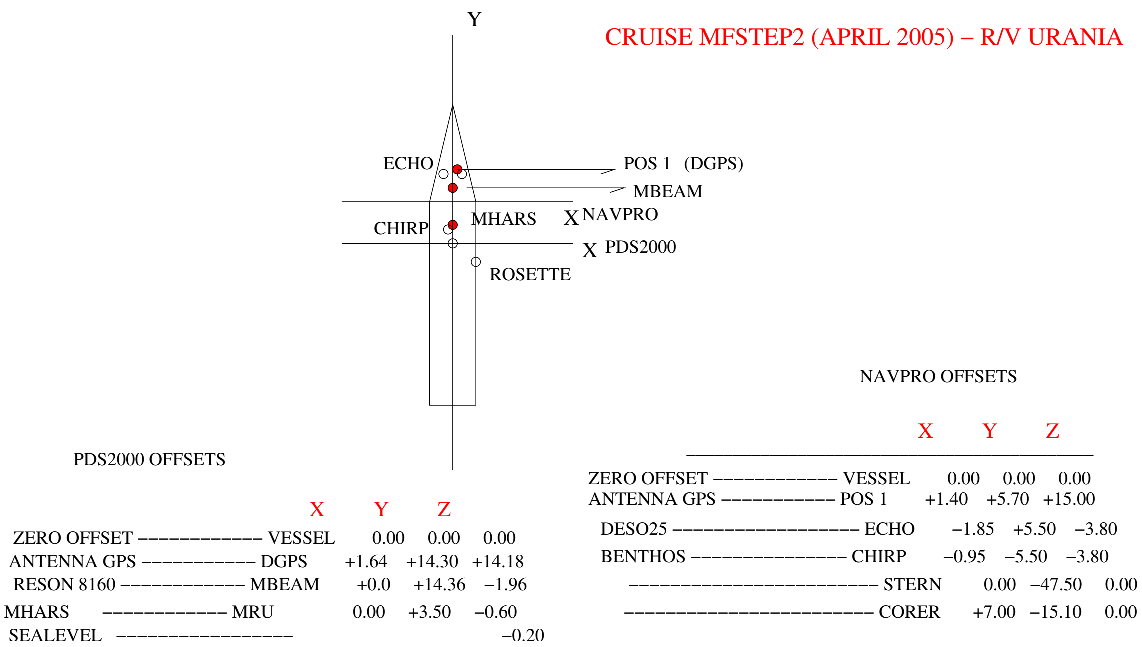

Figure 15: Cruise MFSTEP2, April 2005. Instrumental Offsets on R/V Urania

MULTIBEAM BATHYMETRY

The MBES was the 50 Khz, 126 0.5°beams, 150°aperture RESON 8160, capable (theoretically) to acquire data at 5000 m range.The sonar data were collected and recorded in realtime on HD by direct interfacing of the sonar processor P1 to the PDS-2000 software. A TSS MAHRS Motion reference Unit and gyrocompass and DGPS receiver provided the necessary real-time information for data acquisition.

The PDS-2000 was set to build a DTM at 10m spatial resolution during the acquisition of the surveyed area.

SOUND VELOCITY ANALYSIS

The Sound Velocity data were obtained by utilizing the data of the SBE probe during the downcasts on some of the scheduled CTD stations. A SVP sensor provided a continuous, direct estimate of the sound velocity at the sonar head, being interfaced to the 8160 SeaBat 81-P processor.

The position of the CTD stations are reported in Table 11.

Longitude	Latitude	Station	UTC time	System Time	Depth
010:45.84	41:54.99		11:31:29	2005-Apr-13 13:29:27	
010:25.44	42:21.56	A5	17:27:16	2005-Apr-13 19:25:16	443
010:03.67	42:48.16	a4	21:40:26	2005-Apr-13 23:38:27	91
010:26.28	43:01.91	100	23:57:09	2005-Apr-14 01:55:10	76
010:16.24	43:02.11	102	01:12:44	2005-Apr-14 03:10:46	120.8

Table 11: MFSTEP2 CTD/SVP Locations.

The more interesting data are presented in Fig. 16. The SV profiles were used for real-time acquisition and post-processing, being input to the PDS-2000 software just after collection and conversion to ASCII (depth,svp, space delimited) by the SeaBird VMDAS software.

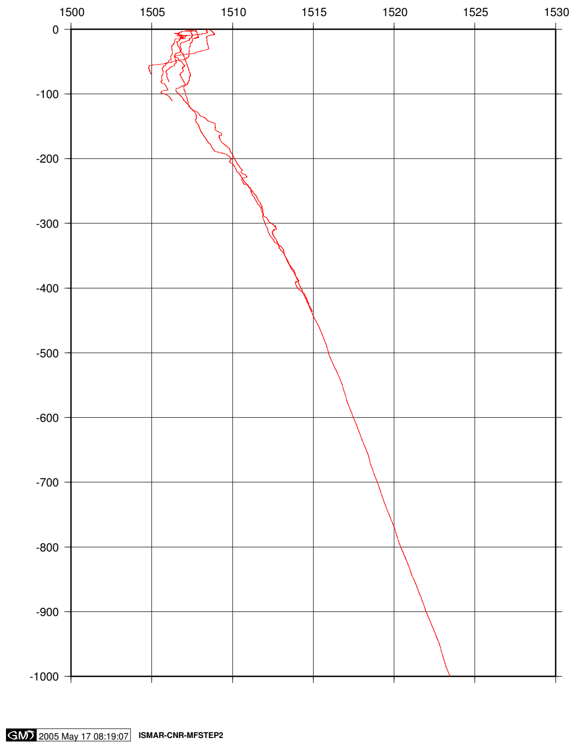

Figure 16: Plot of Speed of sound of the CTD data used for Multibeam.

CALIBRATION

The RESON 8160 Multibeam was calibrated during cruise STRATA05 in Southern Adriatic a week before MFSTEP2.

8160	RS05
roll offset	-0.8 ° *PU+
pitch offset	+0.12 ° *BU+
heading offset	+0.5 °
time delay	0.0 s

Table 12: RESON 8160 Multibeam calibration results.

CHIRP SBP

SBP data was acquired by the 16 transducers, hull mounted BENTHOS (DATASONICS) Mod.CAP-6600 CHIRP-II profiler, with operating frequencies ranging 2-7 Khz. The pulse length was maintained at 20 ms while the trigger rates varied from 0.25 to 0.5 seconds according to water depth. Digital data were recorded in the SEG-Y format on Hard Disk. The navigation data were made available to the system by NAVPRO as VESSEL (0,0) at a rate of aproximately 0.5hz (GMT+2). The position data were recovered from routines developped at ISMAR (`read_segy`) that read the SEGY header to check data integrity and retrieve positioning and recording data. These latter were then used for the navigation map production.

4.6 MARINE MAMMALS OBSERVATIONS

Observers were located on the ship's bridge to cover the horizon. In this case the three observers covered angular sectors of 120°(180°or even 360°in case of emergencies). Every 20 minutes the navigation and meteorological data were logged. During a sighting, the logged information were increased, including also photographs and the standard observations on individuals or shoals. During bad seas (>3 Beaufort) the observations become more difficult [Gowans et al.(2000)], and are considered unreliable.

Despite of non favourable meteorological conditions, we had several sigths of the two most common species that populate the Ligurian (*Stenella coeruleoalba* and *Balaenoptera physalus*). This latter was mainly found nearby the ODAS buoy.

4.7 MISCELLANEOUS

The datum was set to WGS84 and the UTM projection (zone 32) was chosen for navigation and display and data acquisition. The time zone was set to the UTC for the whole data acquisition, except for the SBP data that were recorded in UTC+2.

The positioning maps and bathymetric images were done with GMT [Wessel and Smith (1995)].

A WWW server on a Linux Machine was used to share ongoing information and results, including a 30 minutes timed procedure for positioning update and display.

5 INITIAL RESULTS

In this section we will present the data we acquired with some very preliminary processing, with the aim of showing their quality and of addressing their potential and importance in the whole processing sequence.

5.1 OCEANOGRAPHY

CTD OBSERVATIONS

Fig.17 presents the salinity/depth data on the Capraia I. transect.

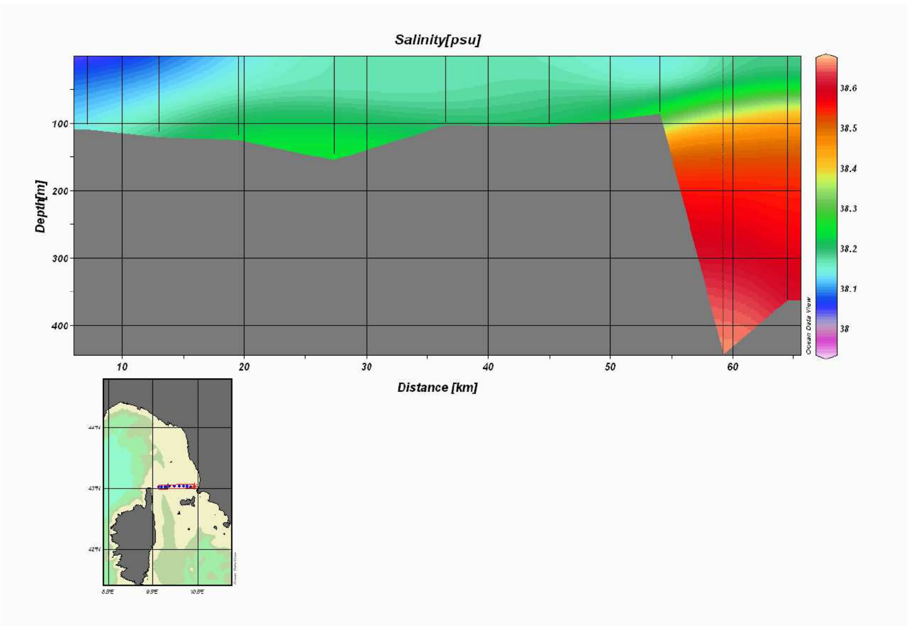

Figure 17: Salinity data (Capraia I.).

CURRENT METERS OBSERVATIONS

Fig.18 shows current data at 27m depth.

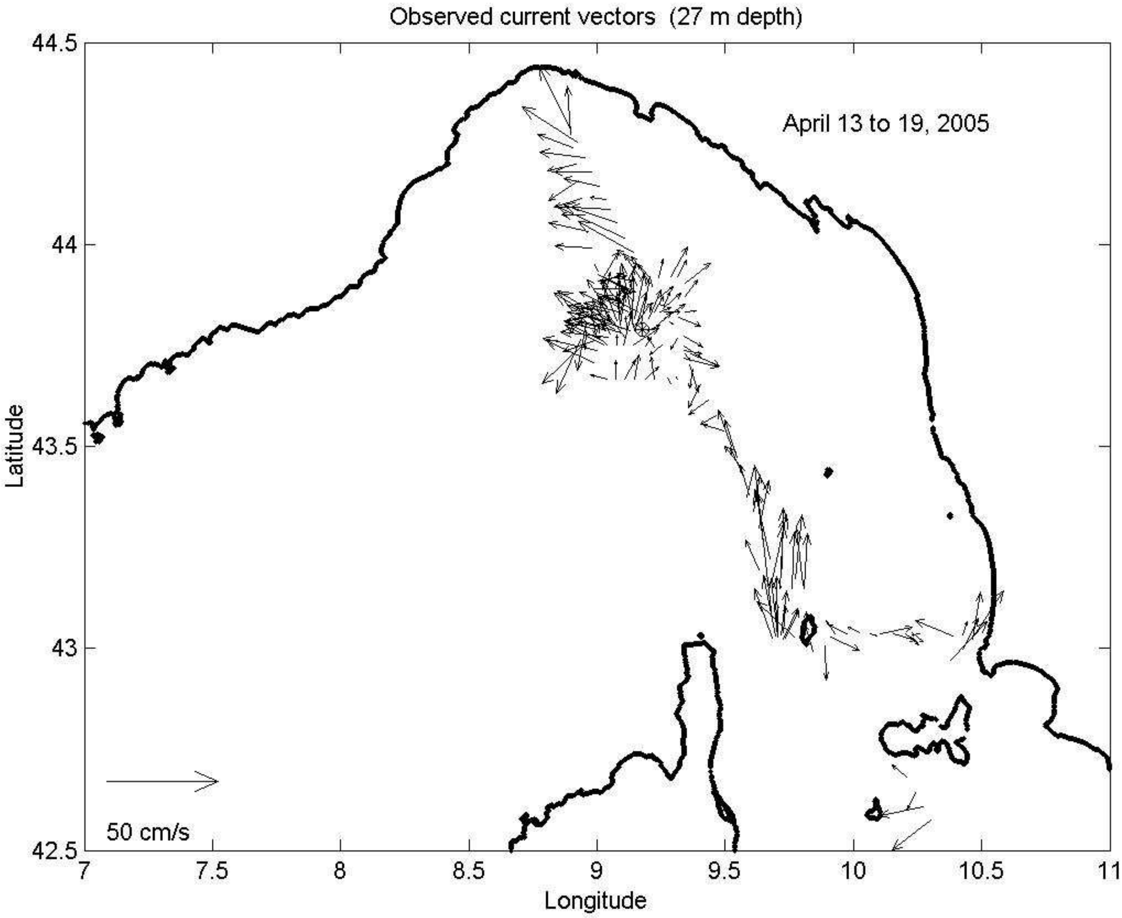

Figure 18: ADCP data, 27m depth.

OPTICAL PROPERTIES

We discuss the results obtained on Station A6 on 2005-04-13. UV and visible irradiance at surface are shown in Fig.19, while Fig.20 presents the irradiance profiles in water. Since the PAR profile evidenced a stratification in the water column, an unique exponential function was not found. To overcome this, we studied the attenuation coefficient every 10m down to 60m depth. Between 60 and 80 m depth we were able to define a single decreasing exponential function to represent the radiative transfer along the water column.

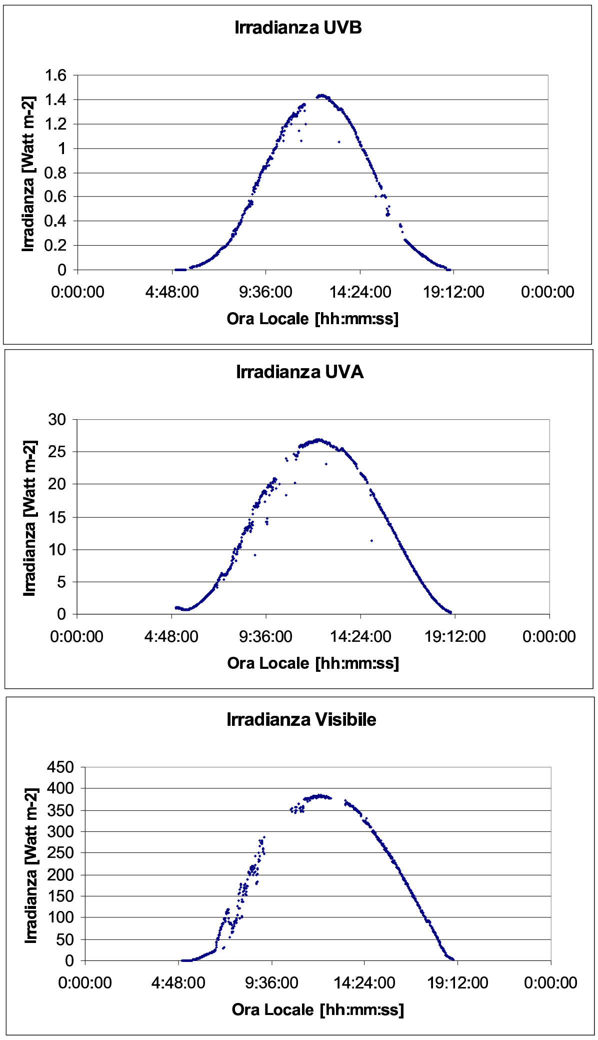

Figure 19: Station A6. UV-B(up), UV-B (mid) and visible (lower) irradiance data at surface.

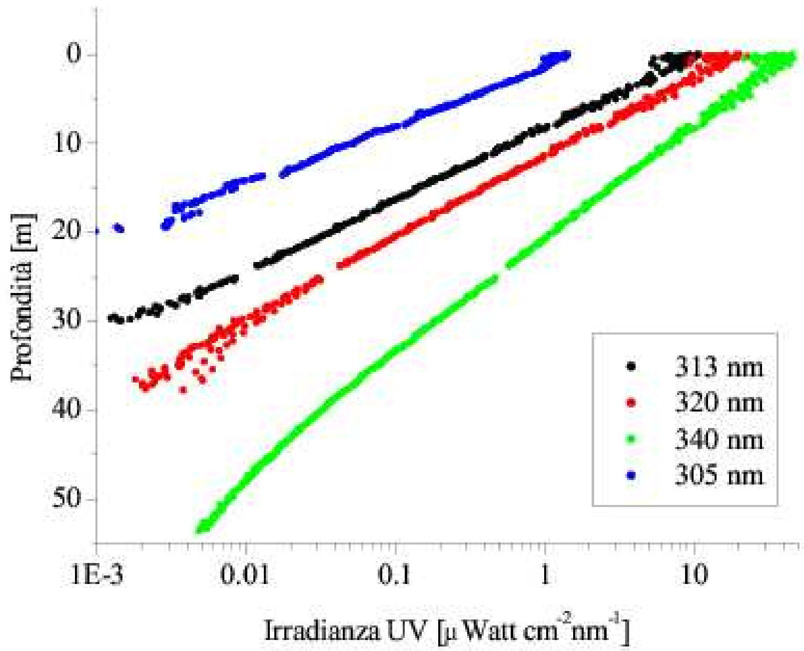

Figure 20: Station A6. Irradiance in water measured by PUV 541.

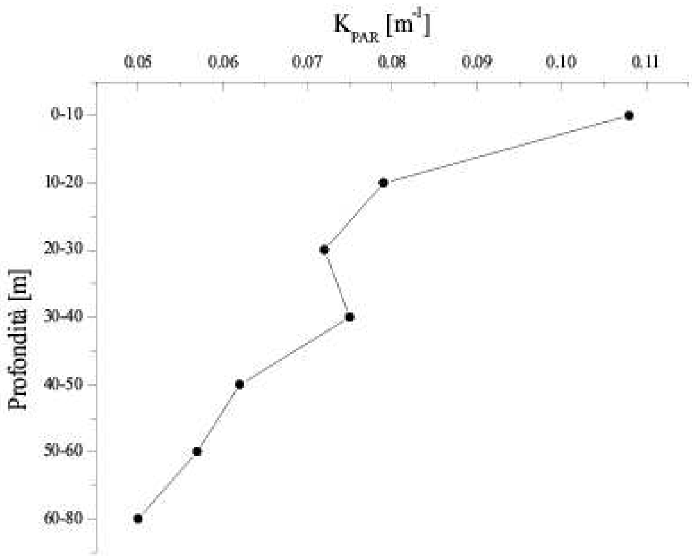

Figure 21: Station A6. PAR attenuation coefficient.

Fig.22 presents the spectral irradiance in the water column.

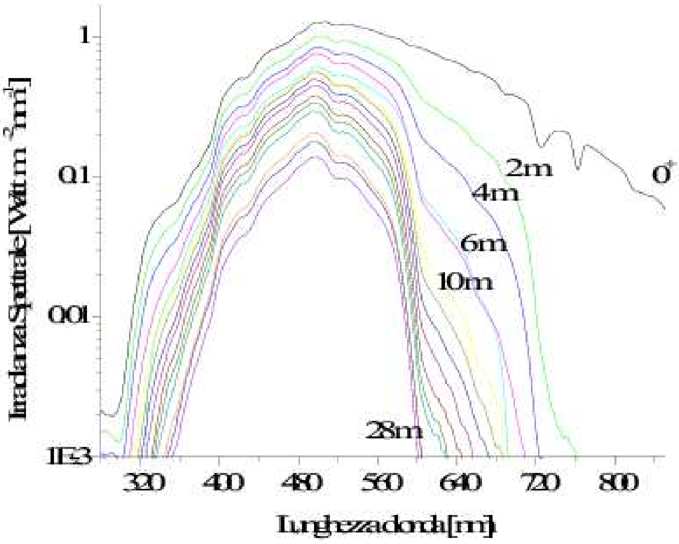

Figure 22: Station A6. Spectral irradiance measure by EPP2000.

5.2 ODAS BUOY SERVICING

The buoy ODAS-Italia 1 was serviced on date 2005-04-20 to 2005-04-21. The buoy sensors and data transmission are performing nominally. Fig. 23 show the operations.

Figure 23: Servicing of ODAS-Italia1.

5.3 MULTIBEAM MORPHOBATHYMETRY

The data were collected primarily on two areas: (1) NNW of the Capraia Island, were ancient deep sea corals were dredged from mounds and small reliefs and other research studies have been carried out by ISMAR-Bologna [Remia et al.(2003), Remia and Taviani(2005)]) and (2) nearby the ODAS-Italia 1 buoy. The survey was generally performed at the speed of 10 Kn, except during high seas, utilizing as much as possible transit time from one station to the other, as well as periods during mooring and buoy maintenance.

For quick production we were able to use the 'real-time' DTM (resolution 10m), after a filtering step using a ISMAR procedure, able to detect and clean outliers and high-frequency noise. A better, yet preliminary processing was made at ISMAR Bologna. We present here some results.

Figures 24 and 25 show the area of the mooring W and of the 'mounds' NNW of Capraia Island. The Side Scan Sonar data that were collected NNW of Capraia by the above cited previous ISMAR cruises, will be reprocessed for a better georeferencing using the above DTM.

Figures 26 and 27 present the bathymetry of the area around the ODAS buoy. Figure 28 shows the area of the mooring W of the ODAS buoy.

6 CONCLUSIONS

During a 10 days cruise in the Northern Thyrrhenian and Ligurian Sea we obtained:

1 continuous measurements of the air/sea fluxes, including sea-truth data collection

2 CTD casts, for front system analysis and control of ODAS buoy data, and water samplings

3 servicing of the ODAS Buoy and of two Current Meter moorings

4 measurement of the optical characteristics of the upper water column

5 multibeam swath bathymetry data,

6 marine mammals observations.

The principal mission objectives have been accomplished. The collected data and sample appear to be of good quality and will undergo the standard laboratory analysis and processing.

The integration of different research teams and data acquisition techniques was smooth and very profitable.

The weather conditions were good except two days of severe storm.

No problem to people or to environment have to be reported.

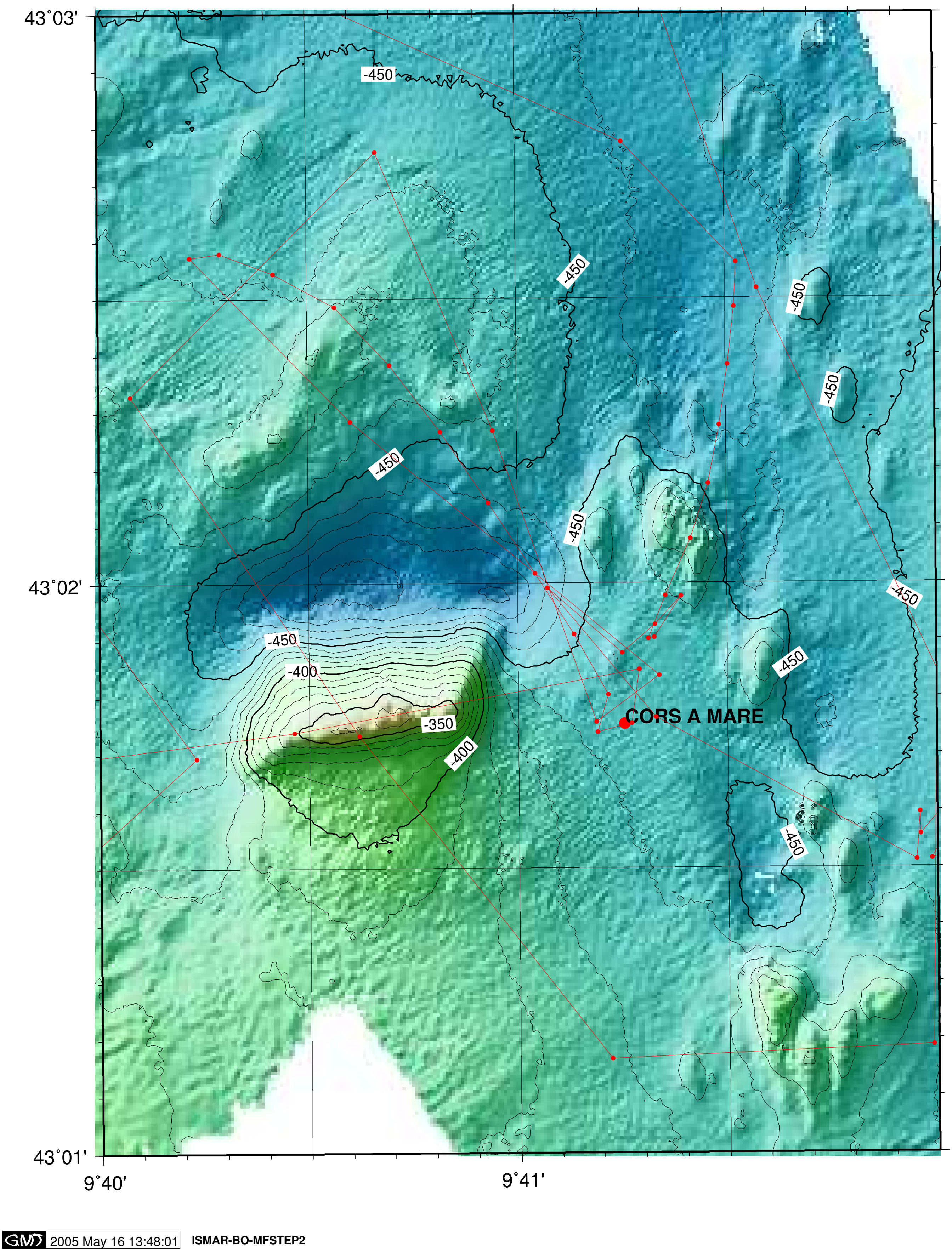

Figure 24: The area of mooring CORS1. DTM 10m resolution.

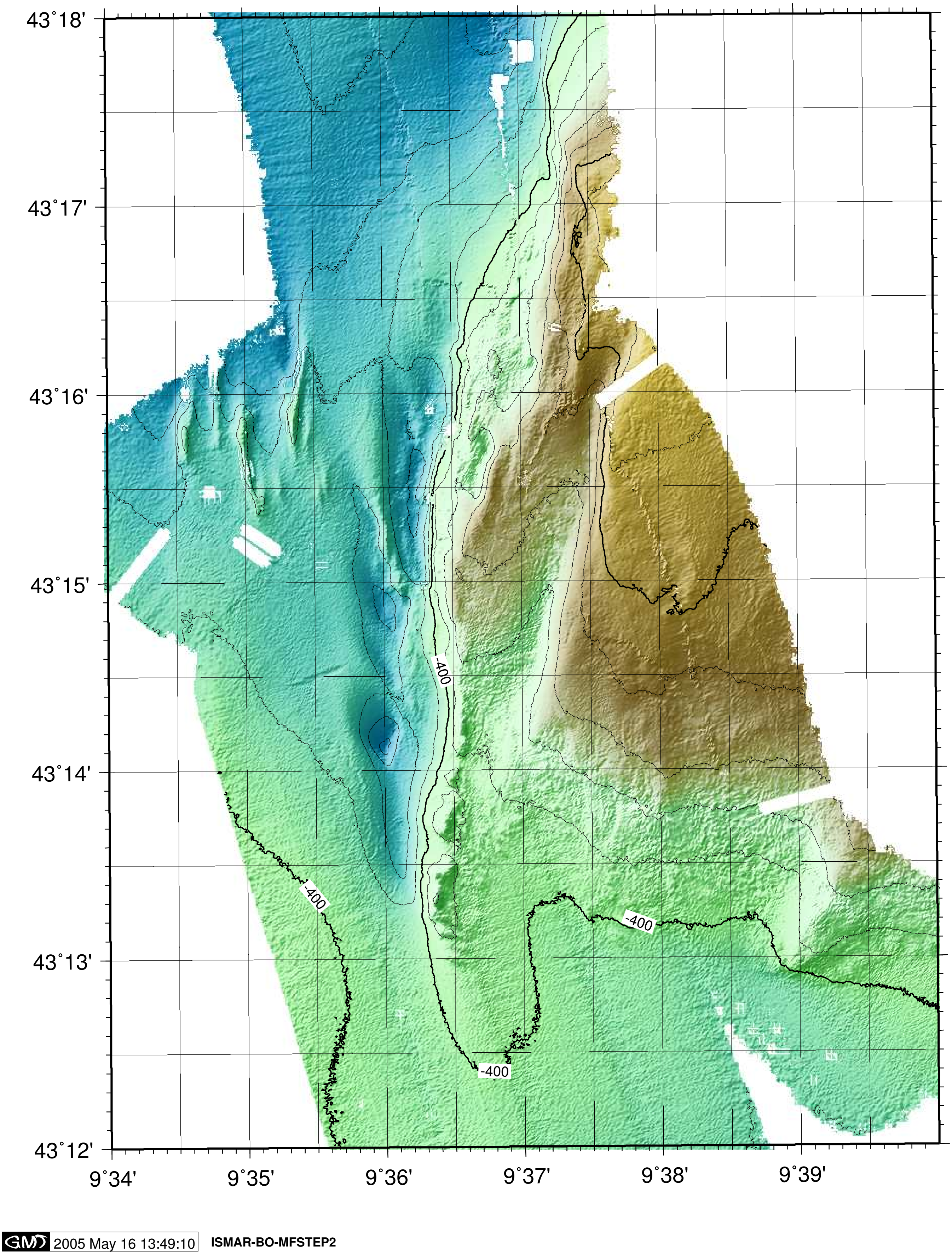

Figure 25: The area of 'mounds'.DTM 10m resolution.

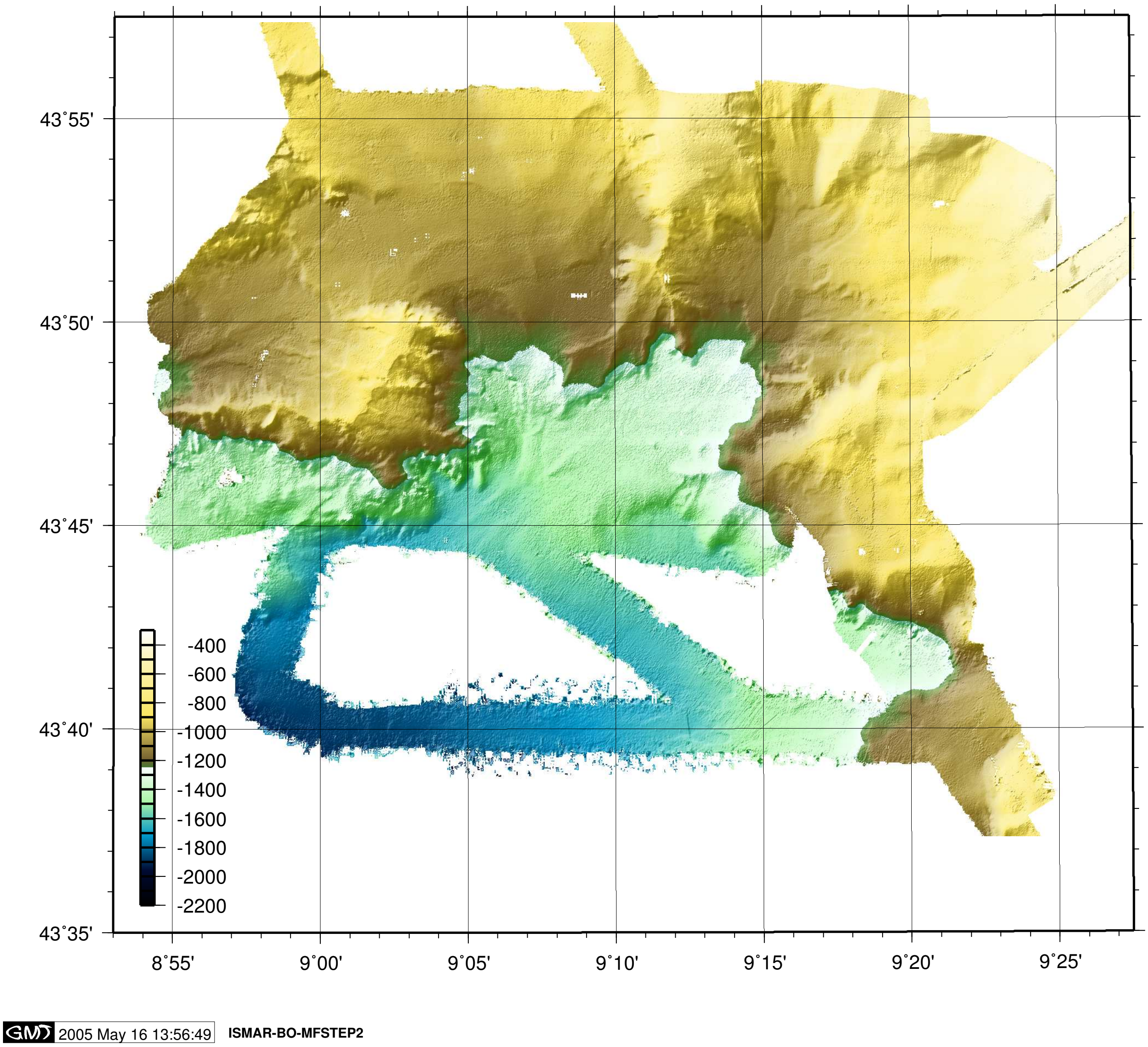

Figure 26: The area of ODAS buoy.DTM 25m resolution

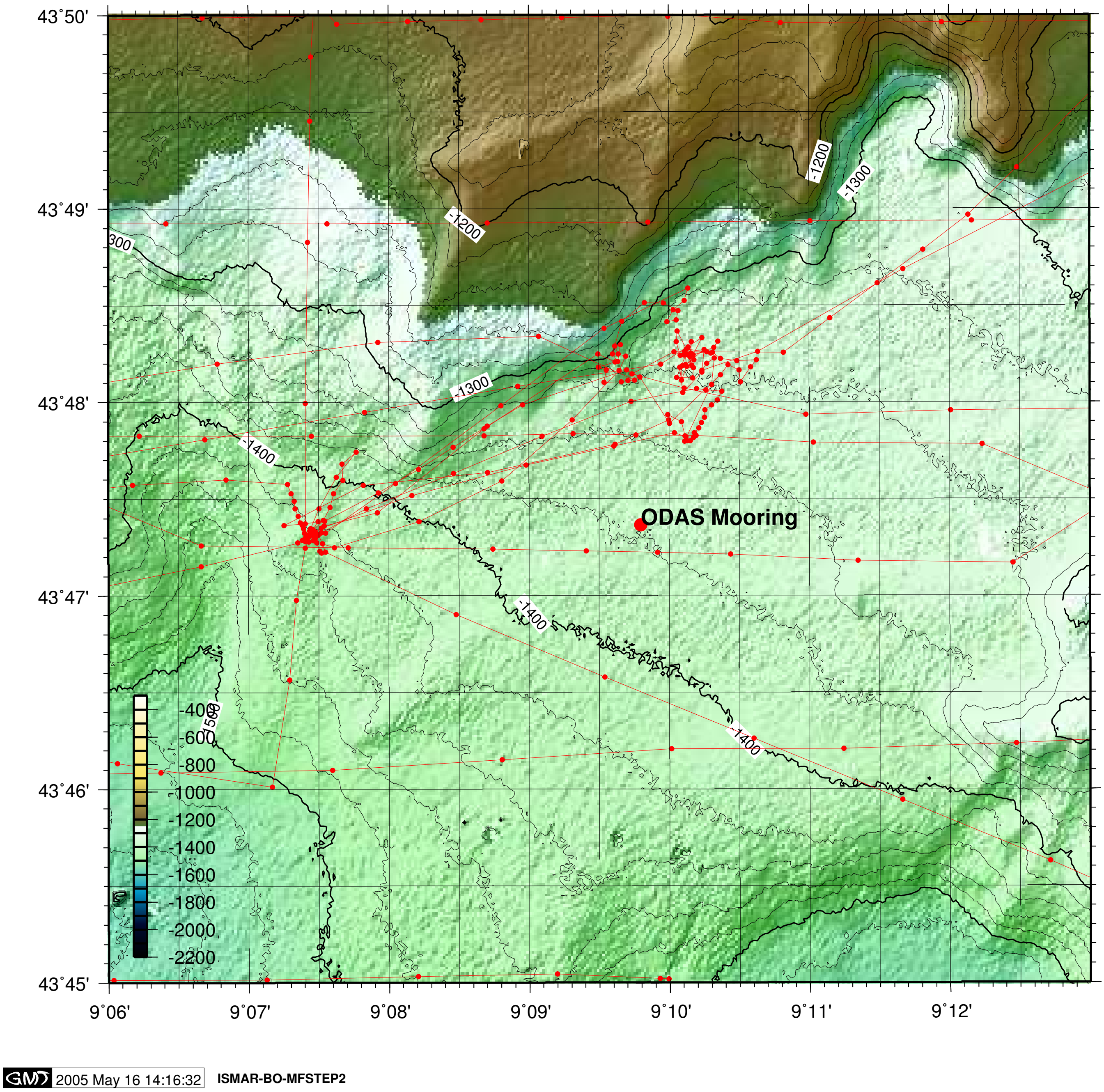

Figure 27: The area of the ODAS buoy.DTM 25m resolution.

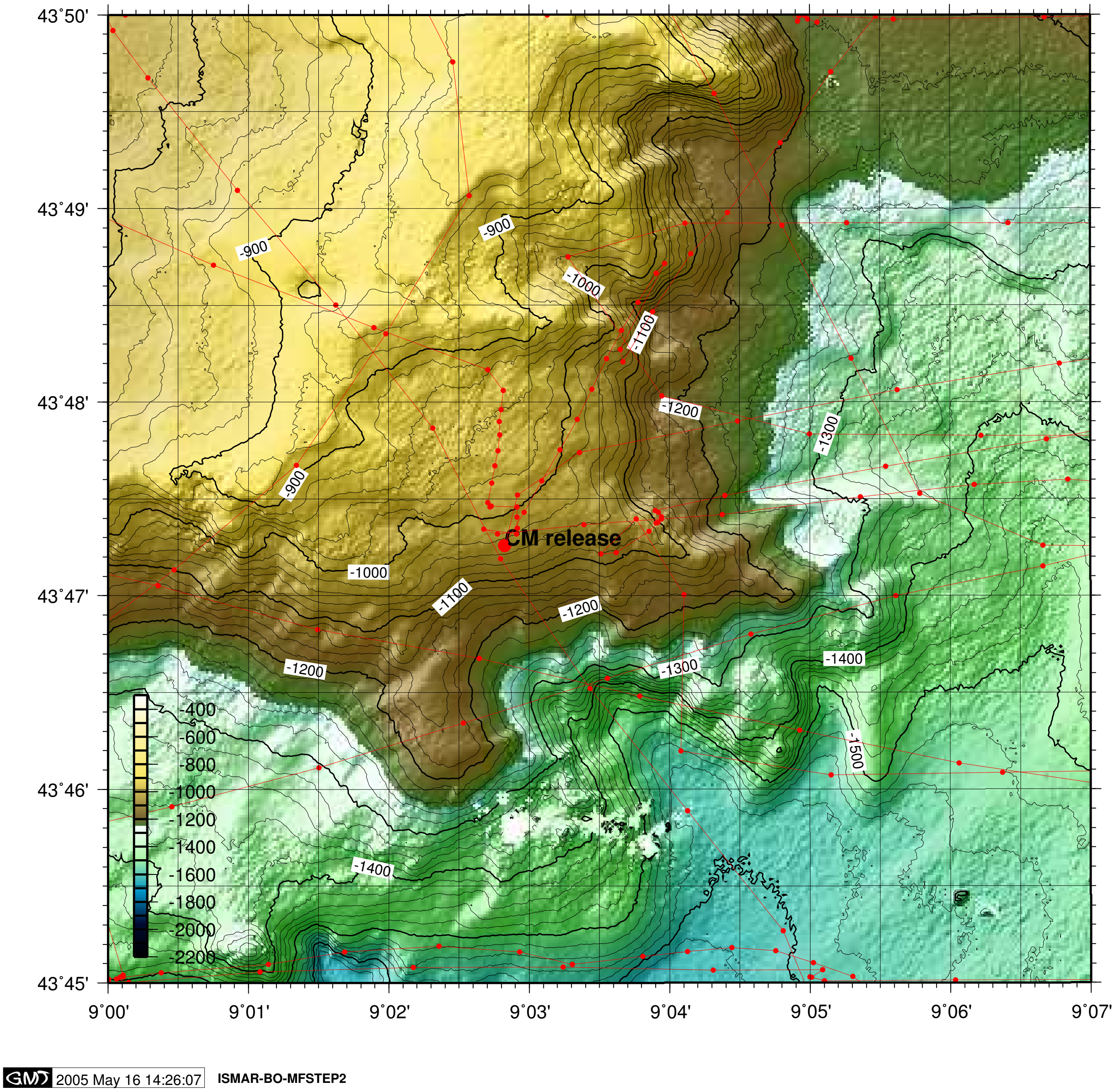

Figure 28: Mooring W of the ODAS buoy.DTM 25m resolution.

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