Report on the oceanographic and Buoy Maintanance activities during Cruise LTES1-10 with R/V *Mariagrazia*: Adriatic Sea, 2010-05-27 - 2010-06-03. Projects LTES (Dr. M. Ravaioli).

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SUMMARY
We present the shipboard activities and results of Cruise LTES1-10(2010-05-27- 2010-06-03)) with R/V *Mariagrazia*. The cruise was scheduled to acquire seasonal oceanographic data on the Central and Northern Adriatic Sea, and perform routine and emergency maintanance on meteoceanographic buoys S1 and E1. The two buoys have been deployed and 105 CTD casts were performed from Ancona to Venezia.

Key words: Oceanography – Adriatic Sea – Meteoceanographic Buoys

1 INTRODUCTION AND SETTING

Cruise LTES1-10, coordinated by ISMAR-CNR of Bologna, has been dedicated to the maintanance of the observational sites already included (buoy S1) or next to be included (buoy E1) on the network LTER-Italia. LTER-Italy is coordinated by CNR and Dr. Ravaioli is member of the Coordinating Committe. It participates to the EU project Life + Enveurope, thank to the data provided by the S1 Buoy. The cruise was planned also to further acquire oceanographic data for the biogeochemical modeling designed within the EMMA project (Life 2004-2007) and aiming at the monitoring of extension and timings of hypoxic and anoxic phenomena on the Adriatic Basin, i.e. by repeating classical and well known transects (Venezia, Adige, Po-Rovinij, Casal Borsetti, Rimini, Senigallia, Ancona) and other ones.

This paper reports the shipboard activities during cruise LTES1-10, including description of the ship, equipment and their usage, along with details of the general settings, performances and some scientific and technical results.

1.1 GEOLOGICAL AND OCEANOGRAPHICAL SETTING

GEOLOGICAL SETTING

The Adriatic Sea (Fig.1) is an epicontinental sea showing two margin configurations, north and south of the Gargano Promontory (Ridente & Trincardi 2005) and references therein).

The northern Adriatic (NA) Sea is bounded by the Italian peninsula to the east and by the Balkans to the east (Fig. 1) and is the northernmost part of the Mediterranean Sea. It

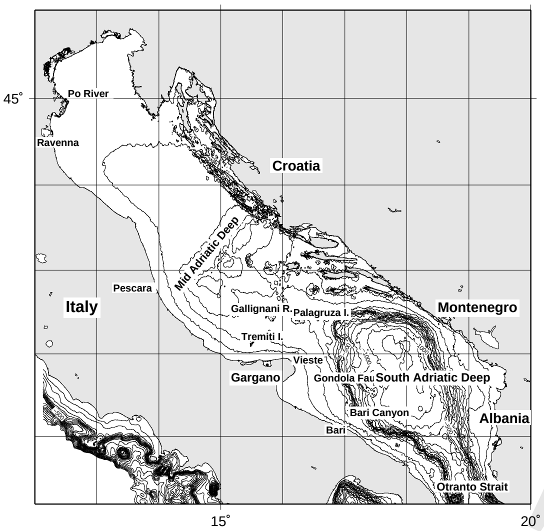

Figure 1. Adriatic Sea setting.

is characterized by very shallow environment, with an average depth of ∼35 m, and regularly and gently slopes toward the south until the 120 m isobath, taken as its southern open boundary, approximately north of 43:20 (Artegiani et al. 1997a; Russo & Artegiani 1996; Poulain et al. 2001). Other authors consider Ancona or Rimini to be the southern limit of the NA.

The Central area is characterized by the Mid Adriatic Deep (MAD), a remnant basin, 260 m deep, separated in 2 depocenters by the Central Adriatic deformation belt (Argnani & Frugoni 1997), and bordered by the Gallignani and Pelagosa (Palagruža) ridges to the south and by the structural high of the Tremiti Islands. The two depressions of the MAD are likely to be filled by the NadDW.

Oceanographical setting

Being an epicontinental basin, the hydrology and dynamics of the NA are primarily influenced by meteorological forcing, thermal variations and river runoff. Climatological studies (see Cushman-Roisin et al. (2001) and citations therein) indicate that prominent weather situations in the NA include unperturbed weather or airflow from the northwestern, northeastern and south-eastern quadrants (respectively Etesian, Bora and Sirocco winds). Bora and Sirocco are the most frequent winds in the area and often trigger severe wind-storms. Despite its limited volume, the NA receives approximately 20 % of the total Mediterranean river runoff (Russo & Artegiani 1996). This runoff comes mainly from the Po River, whose annual average flow rate is approximately 1500 m^3/y (Artegiani & Azzolini 1981; Raicich 1994). This leads to a net gain of fresh water. In autumn, intense cooling and evaporation processes, usually associated with Bora wind events over the NA, create conditions for dense water formation during the winter (Vibilič & Supič 2005).

Due to runoff and heating in the late spring and summer and to autumn-winter cooling, gradient currents are established leading to a cyclonic circulation system (Zore-Armanda 1956; Buljan & Zore-Armanda 1976; Franco et al. 1982; Orlić et al. 1992; Artegiani et al. 1997a,b; Russo & Artegiani 1996; Hopkins et al. 1999; Poulain & Cushman-Roisin 2001) consisting of an entering NW-ward current (the Eastern Adriatic Current, EAC), on the eastern coast, and an exiting SE-ward current (the Western Adriatic Current, WAC) on the western coast. EAC introduces warmer and saltier water into the subbasin, while WAC pushes fresher water towards the southern regions. The general circulation pattern in the NA is also largely affected by wind. Bora episodes can generate a transient double gyre circulation consisting of a cyclone north of Po delta and an anticyclone to the south, driving the upwind extension river plume filaments (Jeffries & Lee 2007); an anticyclonic circulation also develops along the southern Istrian coast (Poulain & Cushman-Roisin 1992, 2001), while Bora enforce flow in the WAC (Book et al. 2007; Ursella et al. 2006).

The NA Sea is one of the most biologically productive regions of the whole Mediterranean. The rate of oxygen consumption due to biogeochemical processes is the largest of the entire Adriatic basin, with a maximum occurring around the Po River delta area (Artegiani et al. 1997b). This region can thus be regarded as a favourable environment for the development of hypoxic conditions. The formation of a hypoxic bottom layer in wide areas of the basin (Degobbis et al. 1993, 2000) can cause major ecological problems such as the mass mortality of marine animals, defaunation of benthic populations and a decline in fisheries production.

Hypoxia is usually defined as occurring in regions where dissolved oxygen concentrations are less than 2 ml l^{-1} (equivalent to 2.8 mg l^{-1}). This concentration is the lower tolerance limit for many benthic species (Simunovic et al. 1999; Rabalais et al. 2000; Wu 2002).

2 MATERIALS AND METHODS

The research cruise was carried out with the 42 meter R/V *Mariagrazia* (Societa' Tonno Rosso) (fig. 2), owned by F.lli Ferdinando Gallo and Bros., operated by SO.PRO.MAR. and on lease to CNR. Ship is normally used for geological, geophysical and oceanographical work in the Mediterranean Sea.

R/V *Mariagrazia* is equipped with DGPS positioning system (satellite link by FUGRO, and

Figure 2. R/V *Mariagrazia*, starboard side.

Kongsberg's SEAPATH), single-beam and multi-beam bathymetry and integrated geophysical and oceanographical data acquisition systems, including ADCP, CHIRP SBP and other Sonar Equipment, other than water and sediment sampling. Additional equipment can be accommodated on the keel or towed, e.g. Side Scan Sonars.

2.1 NAVIGATION, CHIRP SBP, SWATH BATHYMETRY

The vessel was set-up for data acquisition and navigation with PDS-2000 software by RESON, interfacing by a multiserial and Ethernet link several instruments, among them the SEAPATH (Kongsberg) and DGPS (Fugro), the Kongsberg EA-600 echosunder, the MRU and the AANDERAA meteorological station. A Kongsberg processor running the SIS software, collected the multibeam data, including a SEAPATH MRU, compass, and DGPS. The MBES was the 300kHz, 400 1x2° beams, 150° aperture, dual head EM-3002-D (200 m range) model by Kongsberg. The sonar head is positioned on the ship's keel using a V-shaped steel frame. A Sound Velocity probe at the keel 1m above the Sonar Head is interfaced directly to the MBES processor, thus providing the necessary real-time data for the beam-forming. CTD casts were normally used for input of the sound velocity profile to the system. An Anderaa Meteorological Station was also made available, at a rate of one measurement every 10-15 s.

Table 1 shows the instrumental offsets (SEAPATH) during cruise LTES1-10.

CTD

CTD data were obtained by a Sea Bird SBE 911 probe. Table 7 in the appendix shows the position of the stations. Hydrological measurements included CTD vertical profiles (pressure, temperature, conductivity, dissolved oxygen), acquired by the SeaBird SEASAVE software. Among the many parameters, T, S, Pressure were used to provide to the MBES the necessary water column speed of sound profile. Data were extracted from the 0.25 or 0.5 m averaged profiles, and input on the MBES console. A procedure was set up in order to ease the handling of the procedure, in particular for the extension of data to the depth of 12000m, as required by the SIS Kongsberg's software.

POSITION	ACROSS	ALONG	HEIGHT
REFERENCE	0.00	0.00	0.00
SEAPATH	-4.039	0.163	-18.211
MRU	-0.341	-1.342	-1.596
MBEAM TX	0.0936	10.2964	5.0623
MBEAM RX	-0.0031	11.0144	5.0600
SEALEVEL	0	0	-0.0875
MAGNETOM.	2.0	-145.0	0.0
CHIRP	1.5	7.0	2.0
STERN	4.0	-10.0	0.0
CORER	-8.0	8.0	0.0

Table 1. SEAPATH offsets during cruise LTES1-10 R/V *Mariagrazia*. Z positive downwards.

BOTTOM SAMPLING

Bottom sampling was performed by Van-Veen grab. Table 2 shows the position of samples, that were subsampled and preserved on fridge and freezer.

MAPPING AND MISCELLANEOUS

The datum was set to WGS84 and the UTM, zone 33N projection, was chosen for navigation, display, and data acquisition. The time zone was set to the UTC for the instrumental data acquisition.

The positioning maps and bathymetric images were produced with GMT Wessel & Smith (1998).

The multibeam data were pre processed on board by the MB-SYSTEM (Caress & Chayes 2009) and GMT software and ISMAR's routines and scripts, using the SIS production DTMS or raw .all file.

Photographs and video were taken by digital cameras and video-camera.

lon lat depth	sample	date	where
1234.312 4408.580 10.5	G01	2010-06-02	E1

Table 2. Samples on cruise LTES1-10. BC=box-corer, G=grab. Latitude and Longitude expressed as ddmm.xx

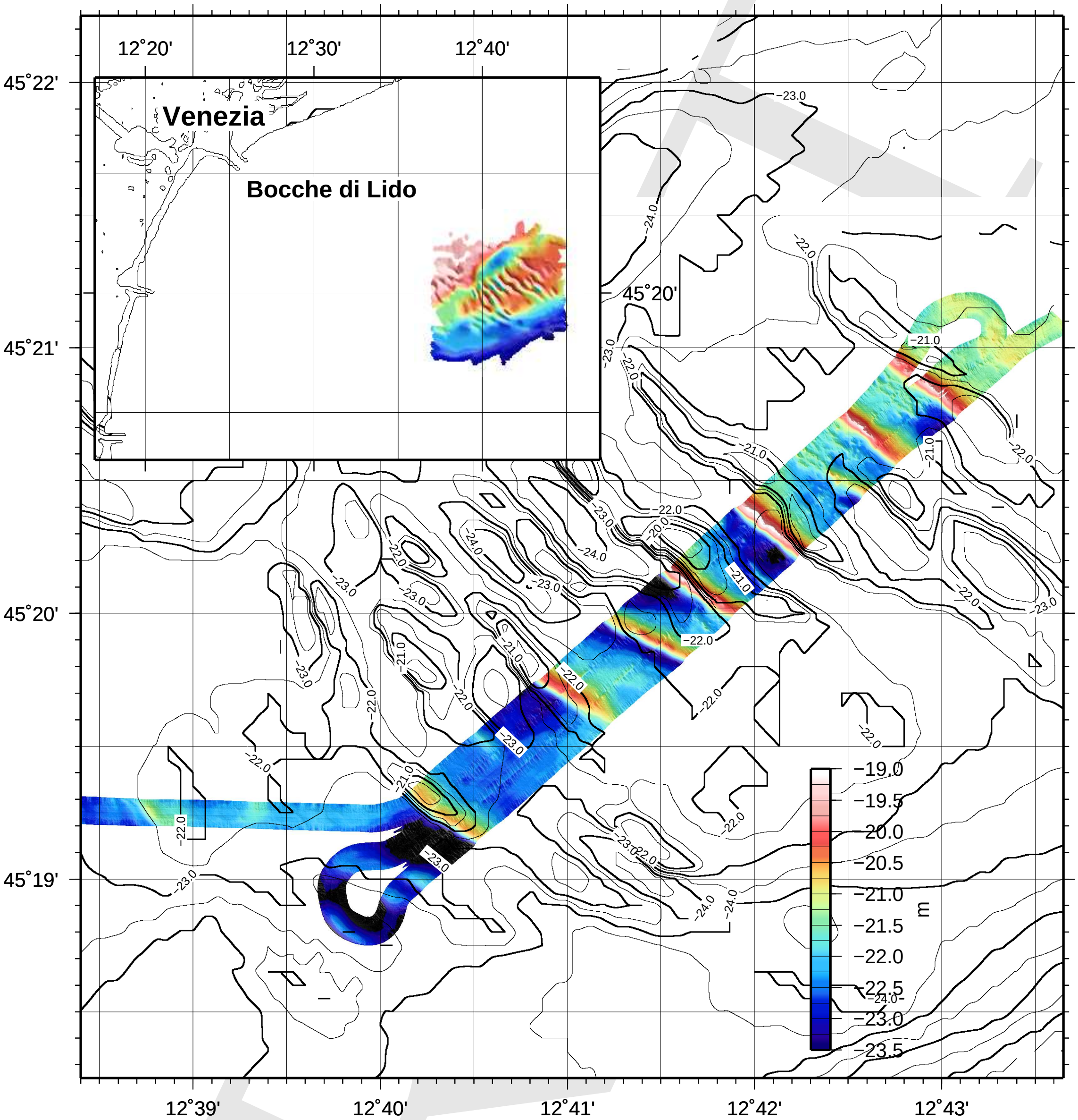

Figure 3. Cruise LTES1-10: shaded relief bathymetry obtained by 4 multibeam runlines SE of Bocche di Lido (Venice), *sand waves* area. Superimposed contour lines are from 1990 and 1991 R/V *Bannock* cruises (single beam data)

3 INITIAL RESULTS

3.1 Buoys deployments

The S1 buoy was redeployed SE of the Po di Goro Mouth. Figure 20 shows the position of the mooring (train wheel 200 Kg, 45 m chain). The E1 buoy was recovered on board and, after refurbishment of body and sensors, and change of batteries and telephone terminal (GPRS-UMTS) was deployed (Fig. 21), using the same anchor and ∼ 20 m chain.

3.2 CTD data

In the Appendix Table 7 shows the CTD data collected during cruise LTES1-10, and figure 22 plots a summary of the data.

At the E1 site the first CTD cast showed low oxygen values below the thermocline at ∼ -6 m. Therefore, additional measurements were performed in the area around the station, aiming at defining the areal extension, that resulted to be confined in fron of Rimini.

Figure 4. Buoy S1 on bridge, R/V *Mariagrazia*, LTES1-10.

Figure 5. Buoy S1 on bridge, R/V *Mariagrazia*, LTES1-10.

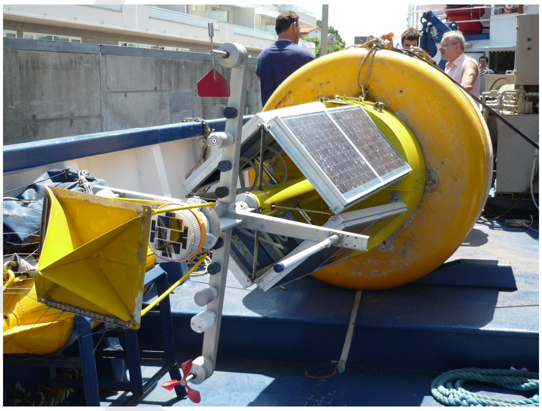

Figure 6. Buoy S1 on bridge, R/V *Mariagrazia*, LTES1-10.

3.3 Multibeam

Multibeam data have been acquired on the S1 and E1 sites (see Fig. 20 and 21). During the transit to the northern oceanographic transects (Venice and Adige) the area with relict sand waves SE of the Bocche di Lido was mapped (Fig.3).

4 CONCLUSIONS

During the 11 days of cruise LTES1-10, including transits and port calls, we obtained:

- 105 CTD casts and along Adriatic transects;

Figure 7. Buoy S1, dead weight, R/V *Mariagrazia*, LTES1-10.

Figure 8. Buoy S1, deployment, R/V *Mariagrazia*, LTES1-10.

- S1 and E1 buoys maintanance and deployment;
- multibeam mapping

Analysis of the data collected during the expedition is under process, and will continue during the forthcoming several months.

No problems were encountered regarding neither the people nor the environment during the cruise.

ACKNOWLEDGMENTS

We are indebted to the Master, the officers and crew members of R/V *Mariagrazia* for their professionalism, work and efforts in assuring the success of the cruise. We thank also Francesco Riminucci and Fabrizio Del Bianco for their help and availability.

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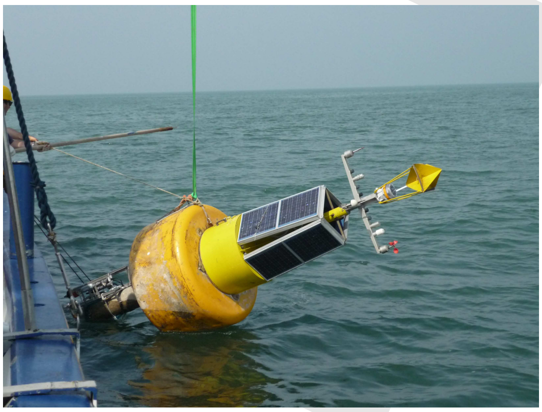

Figure 9. Buoy S1, deployment, R/V *Mariagrazia*, LTES1-10.

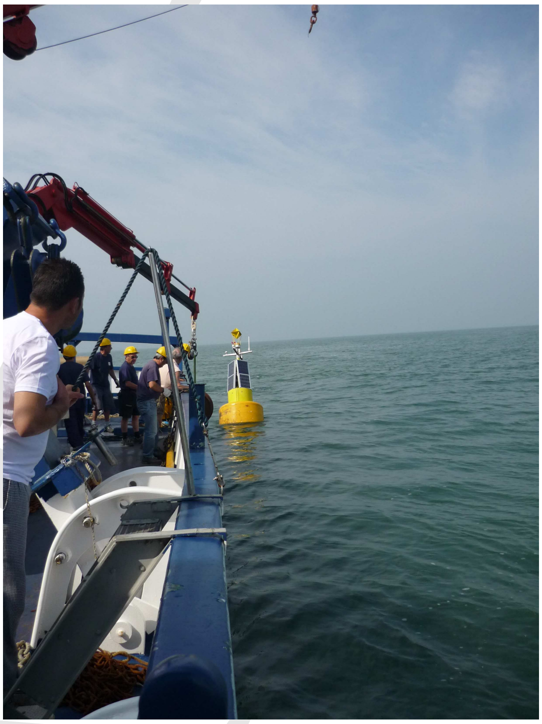

Figure 10. Buoy S1, deployment,, R/V *Mariagrazia*, LTES1-10.

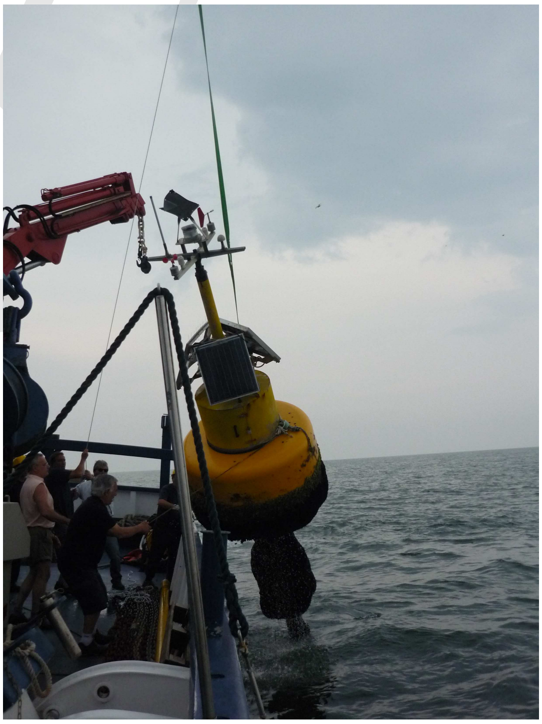

Figure 11. Buoy E1, recovery, R/V *Mariagrazia*, LTES1-10.

Figure 12. Buoy E1, recovery, R/V *Mariagrazia*, LTES1-10.

Figure 13. Buoy E1, recovery of anchor, R/V *Mariagrazia*, LTES1-10.

Figure 14. Buoy E1, recovered, on bridge. Note the cover of mussels and other biological material, R/V *Mariagrazia*, LTES1-10.

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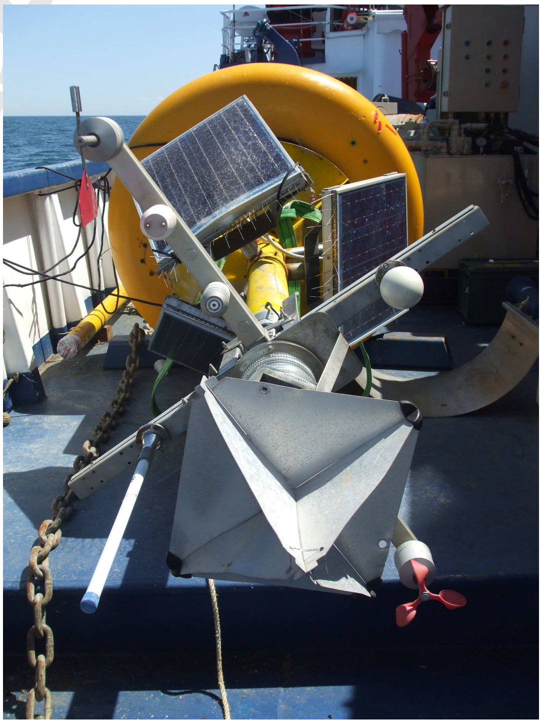

Figure 15. Buoy E1, refurbished, on bridge, R/V *Mariagrazia*, LTES1-10.

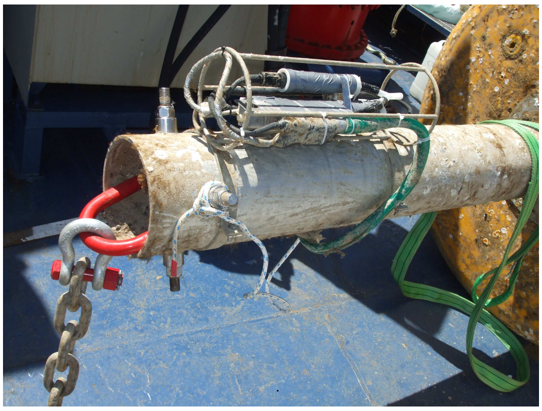

Figure 16. Buoy E1, refurbished, on bridge, Level 1, R/V *Mariagrazia*, LTES1-10.

Figure 18. Buoy E1, deployment, R/V *Mariagrazia*, LTES1-10.

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Figure 17. Buoy E1, deployment, R/V *Mariagrazia*, LTES1-10.

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5 APPENDIX

DIARY OF OPERATIONS

SHIP	R/V *Urania*
START	2010-05-27 PORT: Marina di Ravenna
END	2010-06-03 PORT: Termoli
SEA/OCEAN	Adriatic Sea
LIMITS	NORTH: 45:30 SOUTH: 42:00 WEST: 12:00 EAST: 16:45
OBJECTIVE	BUOY MAINTANANCE OCEANOGRAPHY
COORDINATING BODIES	ISMAR-CNR Bologna
CHIEF OF EXPEDITION	Giovanni Bortoluzzi
CONTACT	G.Bortoluzzi at ismar.cnr.it
DISCIPLINES	OCEANOGRAPHY, MORPHOBATHYMETRY, BOTTOM SAMPLING.
WORK DONE	105 CTD CASTS, 1 GRAB, TWO BUOY DEPLOYMENTS.

Table 3. Cruise Summary.

PARTICIPANTS	ORGANIZATION	EXPERTISE	tel & email & www
Giovanni Bortoluzzi	ISMAR,Bologna	Chief-of-Expedition	G.Bortoluzzi@ismar.cnr.it
Paola Focaccia	ISMAR, Bologna		P.Focaccia@bo.ismar.cnr.it
Francesco Falcieri	UNIVPM, Ancona		f.falcieri@univpm.it
Alessandro Giordano	Comm-Tech		ag@comm-tec.com
Alessio Cesari	SO.PRO.MAR.		ale.cesari88@gmail.com

Table 4. Scientific and technical parties

DATE	OPERATIONS
2010-05-25	Transit Messina to Marina di Ravenna
2010-05-27	mob Marina di Ravenna; departure 17:30 local, multibeam S1 site, CTD transect S1
2010-05-28	08:06 UTC deployment buoy S1, CTD transect S1 onshore; transit to E1 site; 13:45 buoy E1 recovered; CTD transect E1
2010-05-29	CTD transects, Casal Borsetti Venice. Po-Rovinji
2010-05-30	In port, Marina di Ravenna, BUOY E1 repair.
2010-05-31	In port, Marina di Ravenna, bad weather, BUOY E1 repair.
2010-06-01	Depart 11:15 UTC. Deploy buoy E1 14:36 UTC. Multibeam and CTD around E1 site. Cesenatico Transect.
2010-06-02	Ravenna transect. CTD around E1 site. Senigallia transect.
2010-06-03	Ancona transect. Berthed in Ancona, 07:00 UTC.
2010-06-04	Transit to Cagliari

Table 5. Diary of Operations.

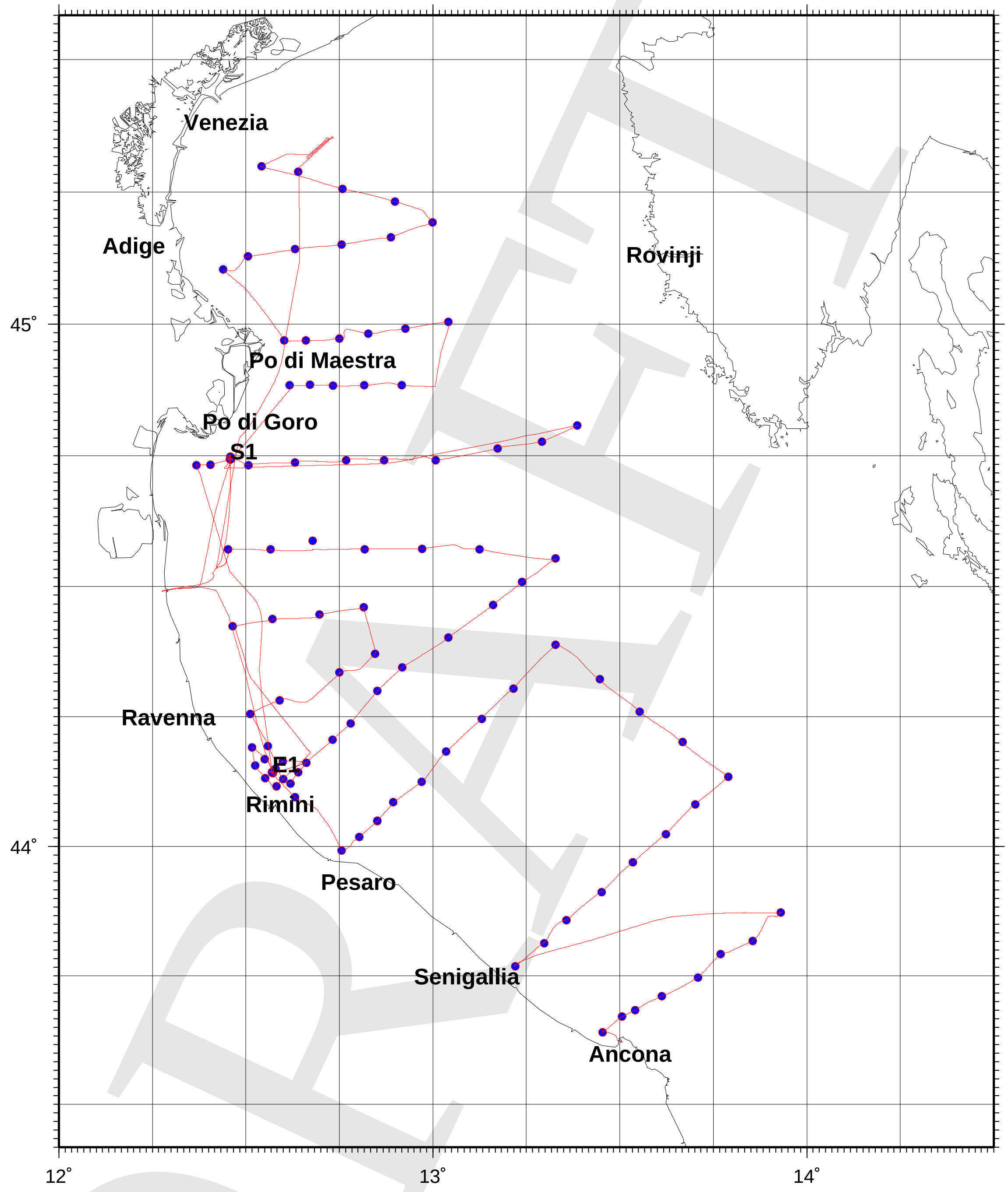

Figure 19. Whole ship track during Cruise LTES1-10. Blue circles are CTD stations. Blue lines show navigation.

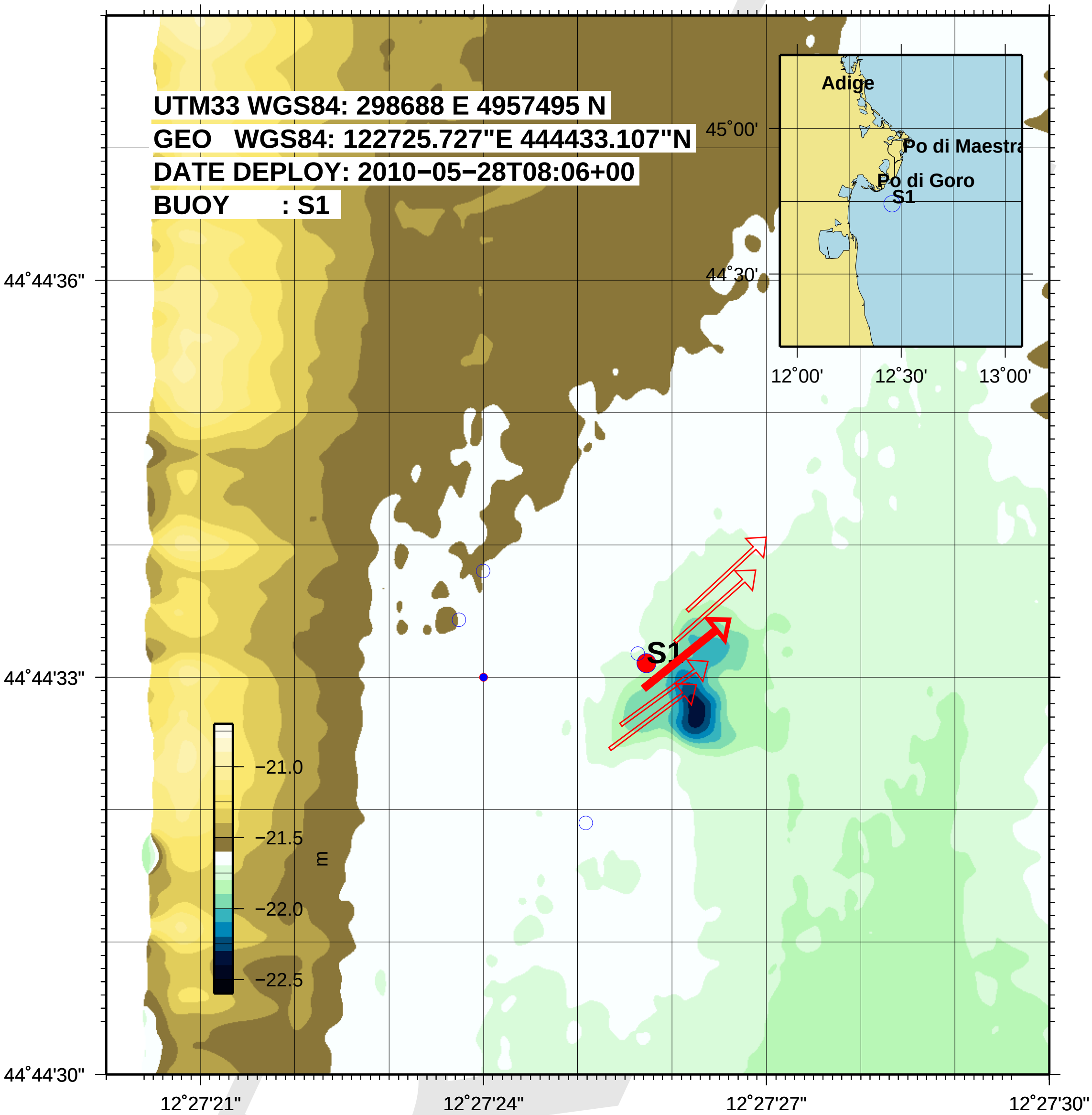

Figure 20. Whole ship track during Cruise LTES1-10. The arrows show ship layout (30m). The thick arrow is the ship's position during deployment of dead weight. Blue circles are CTD stations. Blue lines show navigation.

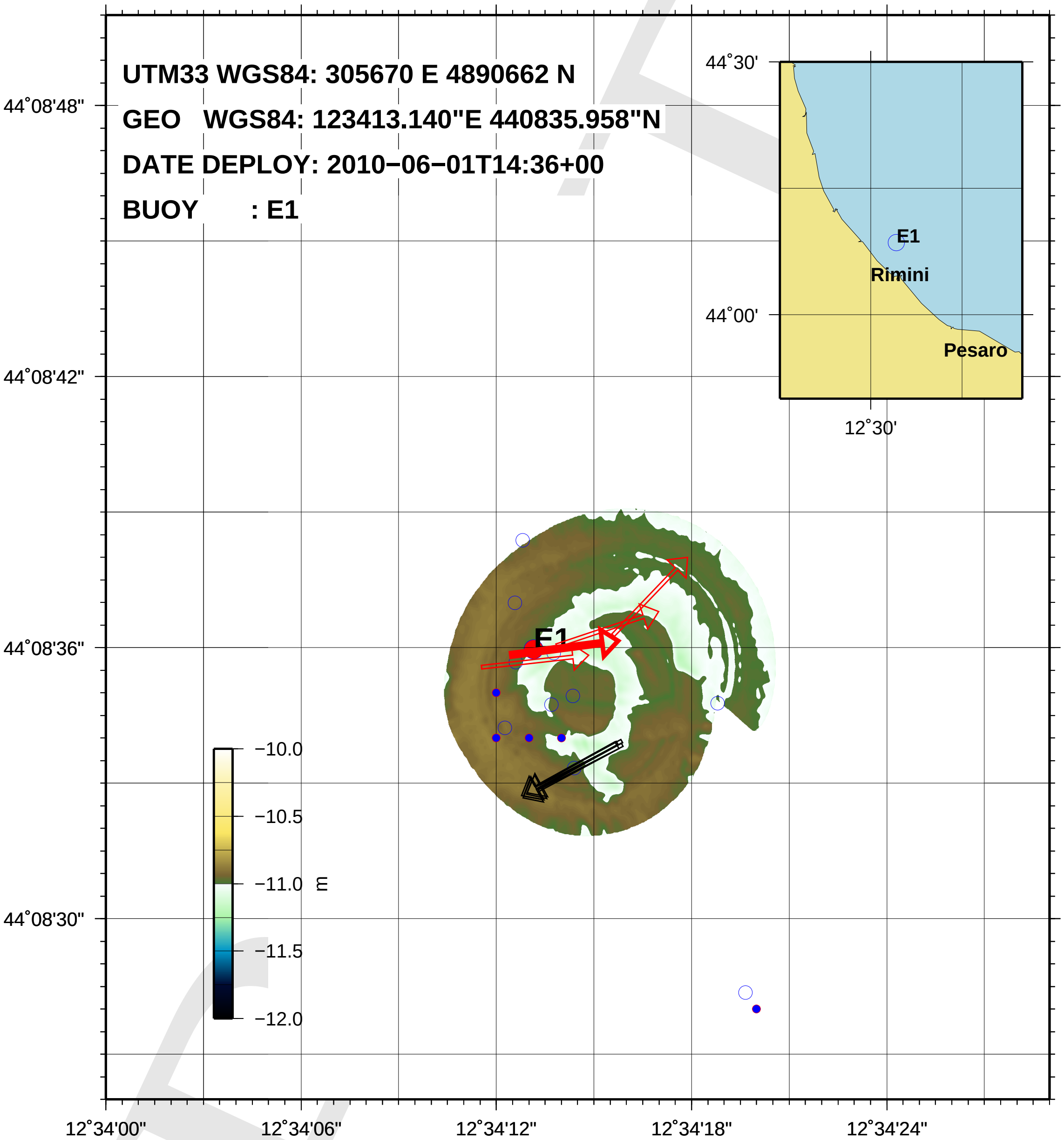

Figure 21. Whole ship track during Cruise LTES1-10at E1 site. The arrows show ship layout (30m). The thick arrow is the ship's position during deployment of anchor. Blue circles are CTD stations. The circle and rhomb are the buoy (2010-06-01T1600+00) and anchor position, respectively.

[H]

ACRONYM	DESCRIPTION	URL-email
CNR	Consiglio Nazionale Delle Ricerche	www.cnr.it
ISMAR	Istituto di Scienze Marine	www.ismar.cnr.it
ISMAR-BO	ISMAR, Bologna	www.bo.ismar.cnr.it
UNIVPM	Universita' Politecnica delle Marche	www.univpm.it
LTER	Long Term Ecological Research	www.lteritalia.it
EMMA	Environmental Management trough Monitoring and Modeling of Anoxia	emma.bo.ismar.cnt.it
MFS	Mediterranean ocean Forecasting System	www.bo.ingv.it/mfs
MOON	Mediterranean Operational Oceanography	
SIAM	Sistema Informativo Ambiente Mediterraneo	moon.santateresa.enea.it
SIS	Sea-floor Information System	www.kongsberg.com
SBE	Sea Bird Electronics	www.seabird.com
GMT	Generic Mapping Tool	gmt.soest.hawaii.edu/gmt
NRT	Near Real Time	
MBES	Multibeam Echosounder System	
SBP	Sub Bottom Profiling	
SVP	Sound Velocity Profile	
CTD	Conductivity/Temperature/Depth	
MAW	Modified Atlantic Water	
LSW	Levantine Surface Water	
LIW	Levantine Intermediate Water	
CIW	Cretan Intermediate Water	
CDW	Cretan Deep Water (Involved recently in EMDW. Sometimes referred as CSOW).	
LDW	Levantine Deep Water (Formed in NW Levantine Basin).	
EMDW	Eastern Mediterranean Deep Water (Kept for historical reasons).	
EOW	Eastern Mediterranean Overflow Water (Sometimes called AIW or tEMDW at the Sicily channel).	
EAC	East Adriatic Current	
WAC	Western Adriatic Current	
GPS-DGPS-RTK	Global Positioning System	samadhi.jpl.nasa.gov
DTM	Digital Terrain Model	en.wikipedia.org

Table 6. Acronyms of Organizations, Manufacturers and Products

CTD and water sampling

Some notes on the CTD casts performed during the cruise LTES1-10 on the R/V *Mariagrazia*.

Overall notes:

- most of the cast do not have the top 3/5 meters
- the ship didn't have a NMEA system so the timing and position of each cast had to be manually given to the acquisition program
- the bottom depth was not acquired during the casts and on the probe was not mounted an altimeter. Anyway all the cast were performed to get as close to the sea floor as possible (usually about 1 m)
- each cast can be identified in tow ways:
- a station name (based on previous cruises) that identity the historical position
- a file name (a progressive number) that define the cruise station number.

CTD station notes (here the casts are identified by file name):

- 001: longitude and latitude in the header file are switched
- 013: the cast was done 2 nm east of the planned point (station name 068).
- 017: the down cast was done with an high descent rate
- 021: the cast was repeated on the same position after a very short time due to not acquisition of the first cast
- 038: the cast was repeated on the same position after a very short time due to not acquisition of the first cast
- 046: in the header file the cast is located 45N instead of 44N
- 047: the weight attached to the probe touched the sea floor. After the cast the probe was cleaned with distilled water. This seems to have caused any problems to the sensors.
- 056: the cast was done with a very slow speed
- 057: the cast was not saved in an .hex file
- 102: the weight attached to the probe touched the sea floor. After the cast the probe was cleaned with distilled water. This seems to have caused any problems to the sensors.

Table 7. CTD Stations on cruise LTES1-10 with R/V *Mariagrazia*. Latitude and longitude expressed as ddmm.xx.

LON	LAT	STATION	DATE	FILE
4443.850	1227.333	S1	2010-05-27T17:33:33	001.hex
1227.500	4444.900	toS1-1	2010-05-27T19:06:25	002.hex
1230.383	4443.917	066	2010-05-27T19:44:27	003.hex
1237.867	4444.183	065	2010-05-27T20:28:18	004.hex
1246.083	4444.450	064	2010-05-27T21:16:21	005.hex
1252.167	4444.467	063	2010-05-27T21:50:20	006.hex
1300.433	4444.467	062	2010-05-27T22:35:12	007.hex
1310.400	4445.783	061	2010-05-27T23:21:36	008.hex
1317.500	4446.567	050	2010-05-27T23:59:21	009.hex
1323.200	4448.450	049	2010-05-28T00:31:38	010.hex
1227.400	4444.550	ToS1-2	2010-05-28T08:38:58	011.hex
1224.317	4443.933	067	2010-05-28T09:22:59	012.hex
1222.050	4443.917	068	2010-05-28T09:42:01	013.hex
1234.333	4408.467	CTD14-E1	2010-05-28T14:24:33	014.hex
1239.700	4409.683	097	2010-05-28T15:23:45	015.hex
1243.933	4412.333	098	2010-05-28T16:24:03	016.hex
1246.800	4414.217	099	2010-05-28T16:45:58	017.hex
1251.083	4417.967	100	2010-05-28T17:21:54	018.hex
1255.050	4420.667	101	2010-05-28T18:07:04	019.hex
1302.500	4424.133	102	2010-05-28T18:46:58	020.hex
1309.650	4427.867	102	2010-05-28T19:30:21	021.hex
1314.300	4430.517	104	2010-05-28T20:02:48	022.hex
1319.683	4433.217	105	2010-05-28T20:39:19	023.hex
1307.483	4434.283	073	2010-05-28T21:36:18	024.hex
1258.283	4434.300	074	2010-05-28T22:25:29	025.hex
1249.033	4434.283	075	2010-05-28T23:21:43	026.hex
1240.717	4435.250	076	2010-05-29T00:05:33	027.hex
1233.933	4434.283	077	2010-05-29T00:39:54	028.hex
1227.167	4434.250	078	2010-05-29T01:20:18	029.hex
1238.400	4517.283	024	2010-05-29T10:33:56	030.hex
1232.500	4517.900	023	2010-05-29T12:57:39	031.hex
1245.517	4515.350	025	2010-05-29T14:03:58	032.hex
1253.900	4513.917	026	2010-05-29T14:47:50	033.hex
1259.917	4511.567	027-b	2010-05-29T15:24:22	034.hex
1253.250	4509.867	028	2010-05-29T16:04:35	035.hex
1245.350	4509.050	029	2010-05-29T16:48:26	036BIS.hex
1237.867	4508.533	030	2010-05-29T17:27:19	037.hex
1230.350	4507.733	031	2010-05-29T18:18:20	038.hex
1226.350	4506.217	032B	2010-05-29T18:48:31	039.hex
1236.150	4458.117	034	2010-05-29T19:58:21	040.hex
1239.633	4458.117	035	2010-05-29T20:21:54	041.hex
1245.000	4458.350	036	2010-05-29T20:55:56	042.hex
1249.650	4458.900	037	2010-05-29T21:36:56	043.hex
1255.583	4459.500	038B	2010-05-29T22:11:20	044.hex
1302.483	4500.250	039	2010-05-29T22:51:00	045.hex
1300.350	4553.017	054	2010-05-29T23:42:17	046.hex
1255.017	4453.017	055	2010-05-30T00:14:27	047.hex
1248.967	4453.017	056	2010-05-30T00:49:05	048.hex
1244.000	4453.000	057	2010-05-30T01:16:28	049.hex
1240.250	4453.067	057BIS	2010-05-30T01:39:27	050.hex
1237.000	4453.033	058	2010-05-30T02:00:51	051.hex
1227.550	4444.550	S1	2010-05-30T03:15:15	052.hex
1234.217	4408.567	E1-B	2010-06-01T14:56:55	053.hex

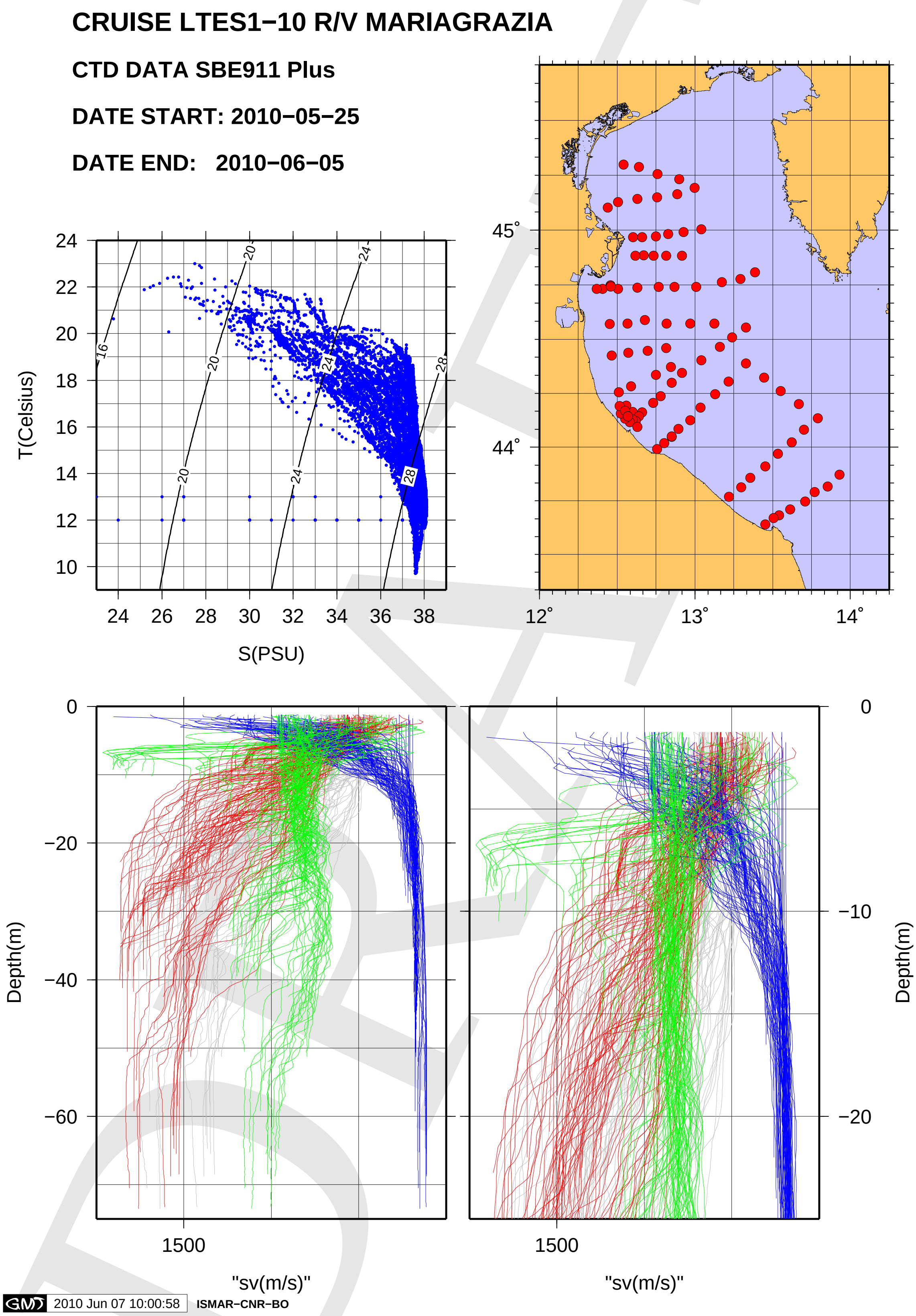

Figure 22. CTD data(T,S,SV), cruise LTES1-10.

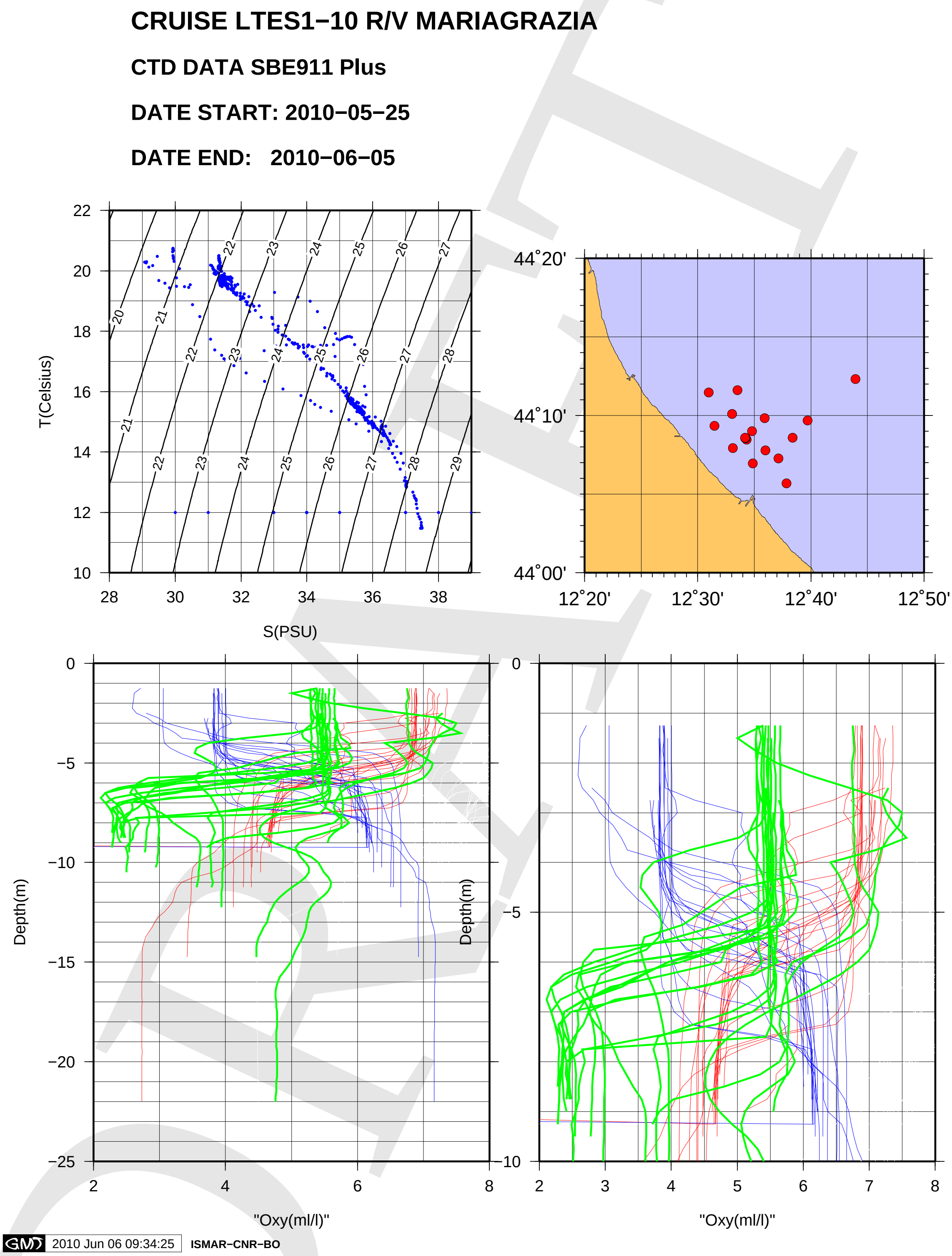

Figure 23. CTD data(T,S,SV), cruise LTES1-10.

Table 7—Continued

.233	4408.567	E1-C	2010-06-01T16:05:26	054.hex
1234.783	4409.000	E1-D	2010-06-01T16:34:22	055.hex
1235.933	4409.850	E1E	2010-06-01T16:56:02	056.hex
1238.383	4408.583	058	2010-06-01T18:04:08	058.hex
1237.150	4407.283	059	2010-06-01T18:25:36	059.hex
1235.983	4407.783	060	2010-06-01T18:38:20	060.hex
1233.500	4411.617	E1-G	2010-06-01T19:15:44	061.hex
1230.700	4415.317	092	2010-06-01T19:50:06	062.hex
1235.383	4416.900	091	2010-06-01T20:23:22	063.hex
1245.017	4420.117	089	2010-06-01T21:25:22	064.hex
1250.733	4422.267	088	2010-06-01T22:07:47	065.hex
1248.917	4427.600	084	2010-06-01T22:51:56	066.hex
1241.800	4426.783	083	2010-06-01T23:48:49	067.hex
1234.267	4426.267	082	2010-06-02T00:36:00	068.hex
1227.900	4425.450	081	2010-06-02T01:12:46	069.hex
1234.883	4406.967	094	2010-06-02T04:57:36	070.hex
1233.117	4407.933	094	2010-06-02T05:37:16	071.hex
1231.467	4409.350	E1K	2010-06-02T05:57:59	072.hex
1230.967	4411.483	E1J	2010-06-02T06:20:57	073.hex
1233.033	4410.117	E1H	2010-06-02T06:46:27	074.hex
1234.200	4408.567	E1	2010-06-02T07:06:24	075.hex
1234.200	4408.583	E1-076	2010-06-02T07:53:42	076.hex
1237.850	4405.700	077	2010-06-02T08:34:10	077.hex
1245.367	4359.517	145	2010-06-02T09:39:57	078.hex
1248.217	4401.100	144	2010-06-02T10:09:18	079.hex
1251.100	4402.950	143A	2010-06-02T10:36:33	080A.hex
1251.083	4402.967	143	2010-06-02T10:34:00	080.hex
1253.600	4405.117	142	2010-06-02T11:18:03	081.hex
1258.217	4407.517	141	2010-06-02T11:54:08	082.hex
1302.117	4411.000	140	2010-06-02T12:29:00	083.hex
1307.833	4414.750	139	2010-06-02T13:09:25	084.hex
1312.933	4418.233	138	2010-06-02T13:51:54	085.hex
1319.717	4423.317	137	2010-06-02T14:42:33	086.hex
1326.783	4419.333	136	2010-06-02T15:33:03	087.hex
1333.150	4415.583	135	2010-06-02T16:17:21	088.hex
1340.067	4412.067	134	2010-06-02T17:04:28	089.hex
1347.417	4408.067	133	2010-06-02T18:01:48	090.hex
1342.083	4404.867	154	2010-06-02T18:41:59	091.hex
1337.367	4401.400	155	2010-06-02T19:22:45	092.hex
1332.100	4358.167	156	2010-06-02T20:02:53	093.hex
1327.100	4354.700	157	2010-06-02T20:49:20	094.hex
1321.400	4351.467	158	2010-06-02T21:34:16	095.hex
1317.867	4348.800	159	2010-06-02T22:07:15	096.hex
1313.200	4346.117	160	2010-06-02T22:49:31	097.hex
1355.800	4352.333	168b	2010-06-03T02:26:51	098.hex
1351.317	4349.050	167	2010-06-03T03:09:22	099.hex
1346.150	4347.500	166	2010-06-03T03:43:52	100.hex
1342.550	4344.783	165	2010-06-03T04:17:37	101.hex
1336.717	4342.617	164	2010-06-03T04:57:25	102.hex
1332.467	4341.017	163	2010-06-03T05:30:12	103.hex
1330.317	4340.233	162	2010-06-03T05:49:19	104.hex
1327.233	4338.400	161	2010-06-03T06:20:36	105.hex

Figure 24. Recovery buoy E1, rusted chain, ∼ 3 m below buoy, R/V *Mariagrazia*, LTES1-10.

Figure 26. Recovery buoy E1, rusted chain, ∼ 3 m below buoy, R/V *Mariagrazia*, LTES1-10.

PHOTO

Figure 27. Recovery buoy E1, rusted chain, ∼ 3 m below buoy, R/V *Mariagrazia*, LTES1-10.

Figure 25. Recovery buoy E1, rusted chain, ∼ 3 m below buoy, R/V *Mariagrazia*, LTES1-10.