MREA08 EXPERIMENT IN THE LIGURIAN SEA: CRUISE and MODELLING PLAN

Version 6.0

CONTENTS

SUMMARY

This document summarizes operational activities for the MREA08 Experiment, to take place in the Ligurian Sea in the period September 29 – October 24, 2008.
The main goals of MREA08 Experiment are:

- To collect oceanographic data to calibrate and validate the MREA concept for environmental applications in open sea and coastal areas.
- Calibrate/Validate a relocatable model system nested in the basin scale operational oceanographic model (called MREA model system)
- Demonstrate the utility of MREA model system for contaminant dispersal forecasting
- Study mesoscale processes in the Ligurian Sea and their importance on contaminant dispersal

The outline of this document is as follows. Section 1 lists the contributing Institutions and personnel, section 2 shows the classical CTD and XBT sampling strategy. Section 3 the drifter deployment strategy and finally Section 4 the glider operation.

1. PARTICIPANTS

Istituto Idrografico della Marina (IIM) : Maurizio De Marte, Piero Di Vasta
Centro Nazionale di Meteorologia e Climatologia Aeronautica (CNMCA) - Ufficio Spazio Aereo e Meteorologia (USAM): Massimo Ferri, Lucio Torrisi, Massimo Capaldo, Francesca Marcucci, Sergio Pasquini.
Università di Bologna (UNIBO) - Ravenna : Nadia Pinardi, Nicoletta Fabbroni
INGV-GNOO : Paolo Oddo, Massimiliano Drudi, Michela Dedominicis, Claudia Fratianni, Marina Tonani
OGS : Pierre-Marie Poulain, Riccardo Gerin
CNR-ISMAR : Annalisa Griffa
ENEA : Giuseppe Manzella, Franco Reseghetti
CNR-ISAC : Rosalia Santoleri

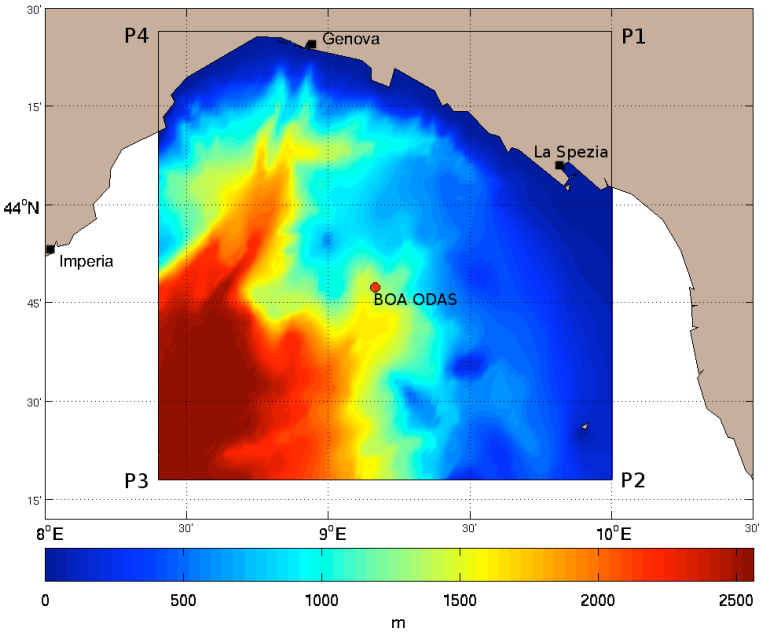
NURC : Michel Rixen, Alberto Alvarez
MIT : Pierre Lermusiaux, Patrick Haley, Wayne Leslie.

2. CTD AND XBT SAMPLING STRATEGY

The collection of oceanographic data will be carried out by Istituto Idrografico della Marina Militare Italiana with the vessel Magnaghi.
The experiment will be performed in two periods:

- Phase I: September 30 (Monday) – October 4 (Friday) (5 days)
- Phase II: October 13 (Monday) – October 24 (Friday) (12 days) with October 18-19 parking stop in La Spezia

Figure 1 shows the area in the Ligurian Sea where the sampling will be performed.



Area coordinates:

P1 : 10° 0' 0" E , 44° 26' 24" N
P2 : 10° 0' 0" E , 43° 18' N
P3 : 8° 24' 0" E , 43° 18' N
P4 : 8° 24' 0" E , 44° 26' 24" N

ODAS buoy coordinate:

ODAS : 9° 9' 54" E , 43° 47' 18" N

Figure 1 : Map of the sampling area.

2.1 SAMPLING STRATEGY: PHASE I

The goal of the first cruise (30 September – 4 October 2008) is to provide in near real-time oceanographic data over the study area to have an accurate description of the initial conditions for the models. The MFS and/or nested HOPS model will assimilate the collected data.

The information used to develop the sampling plan are:

- The ship will depart from La Spezia (44° 6' 0" N, 9° 49' 0" E)
- Arrival in La Spezia harbor
- Total estimated time: 5 days
- Estimated time to make one CTD till 400 meters : 30 minutes
- Ship velocity during the sampling: 4 knots

We consider:

- The transects will go from East to West following to the cyclonic circulation the Ligurian Sea.
- The distance between transects will be increased from East to West and from coastal area to open sea.
- Alternate CTD stations with XBT launches.
- Perform CTD profiles till 400 meter depth in order to capture the Levantine Intermediate Water signal.

Figure 2 shows the total track of the vessel, from the starting port (La Spezia) to the end port (La Spezia).
Time elapsed :

- From La Spezia to the first CTD station : 1.5 hours
- Time to perform the sampling plan (23 CTD) : 77 hours
- From last CTD station to La Spezia port: ~ 9 hours

Total time elapsed: 87.5 hours ~ 3 days 15 hours

The sampling plan realized (Figure 3 - Figure 4) includes:

- 5 transects
- 23 CTD stations
- 22 XBT

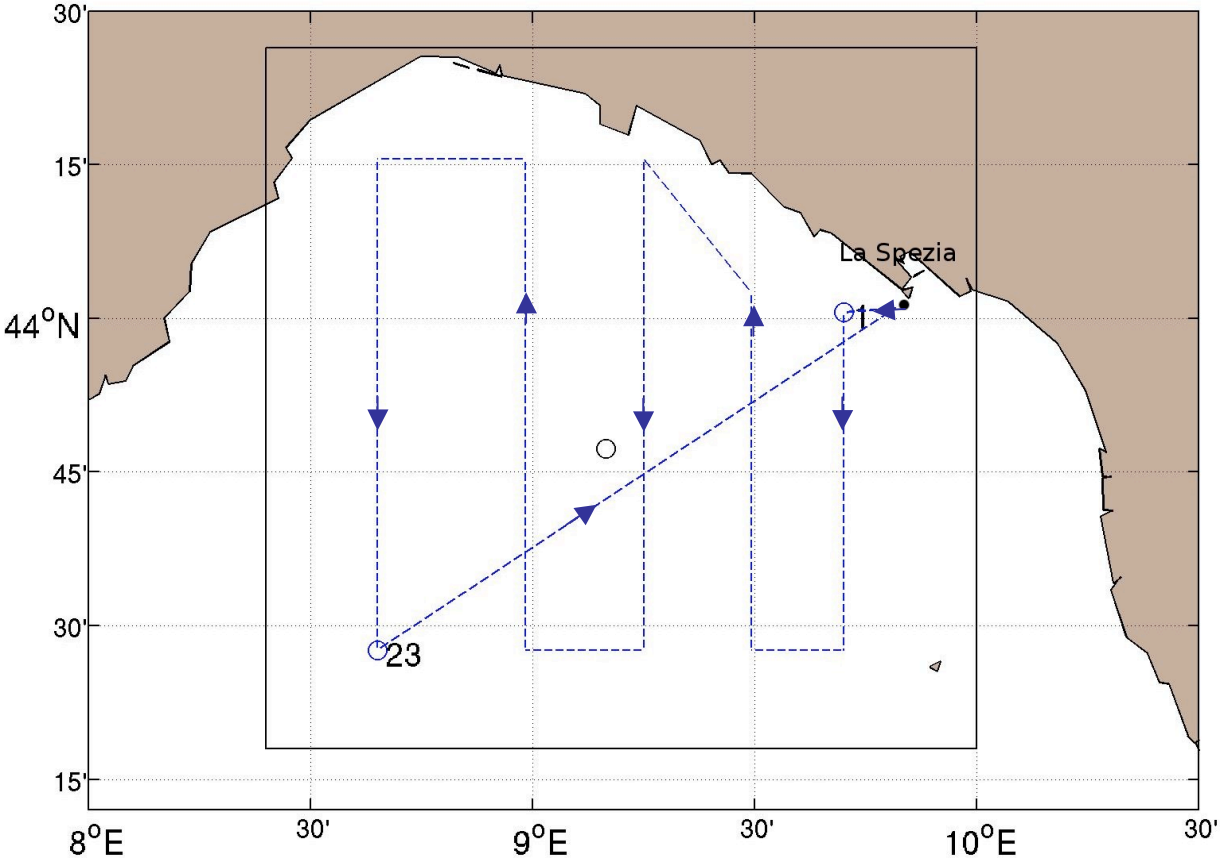


Figure 2 : Planned ship track

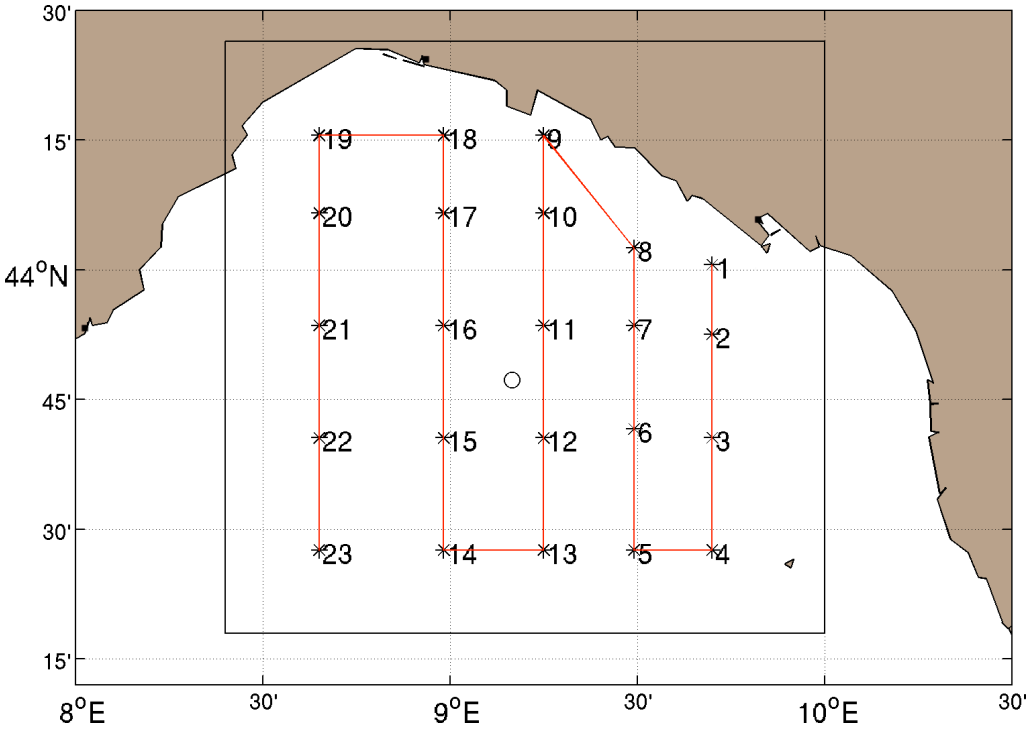


Figure 3 : Map with the locations of the CTD stations.

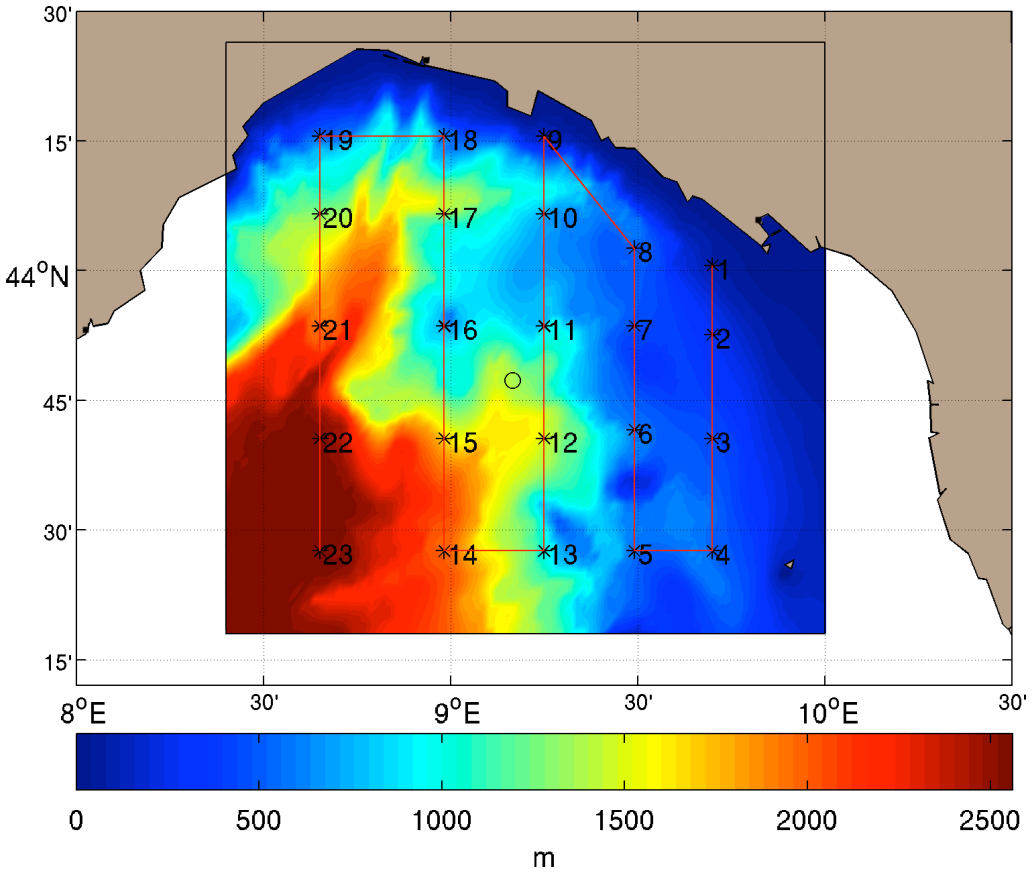


Figure 4 : CTD positions with the bathymetry of the area.

2.1.1 CTD OPERATION

The horizontal distance between transect increases from East to West according to this scheme:

Distance between 1°-2° transects: 12.5 miles
Distance between 2°-3° transects: 14.5 miles
Distance between 3°-4° transects: 16 miles
Distance between 4°-5° transects: 20 miles

The following tables show the features of the transects, in particular we define: the length of the transect, the expected total time, the latitude, longitude and depth of the CTD stations.

1° transect:
Length : 33 miles
Estimated time : 10.25 hours

N° stations	Longitude (East)	Latitude (North)	Prof. (m)
1	9.7	44.0096	88
2	9.7	43.8764	281
3	9.7	43.6765	452
4	9.7	43.46	523

2° transects:
Length : 35 miles
Estimated time: 10.75 h

N° stations	Longitude (East)	Latitude (North)	Prof. (m)
5	9.4918	43.46	568
6	9.4918	43.6932	584
7	9.4918	43.893	453
8	9.4918	44.0429	507

3° transect:
Length : 48 mile
Estimated time: 14.5 h

N° stations	Longitude (East)	Latitude (North)	Prof. (m)
9	9.2503	44.2595	131
10	9.2503	44.1096	739
11	9.2503	43.893	844
12	9.2503	43.6765	1467
13	9.2503	43.46	1004

4° transect:
Length : 48 mile

Estimated time: 14.5 h

N° Stations	Longitude (East)	Latitude (North)	Prof. (m)
14	8.9838	43.46	1988
15	8.9838	43.6765	1680
16	8.9838	43.893	711
17	8.9838	44.1096	1309
18	8.9838	44.2595	588

5° transect:
Length: 48 mile
Estimated time: 14.5 h

N° Stations	Longitude (East)	Latitude (North)	Prof. (m)
19	8.6507	44.2595	534
20	8.6507	44.1096	1298
21	8.6507	43.893	1952
22	8.6507	43.6765	2530
23	8.6507	43.46	2526

2.1.2 XBT OPERATION

During the first cruise the launch of XBT between the CTD positions is scheduled. The deployment XBT suggested is illustrated in Figure 5.

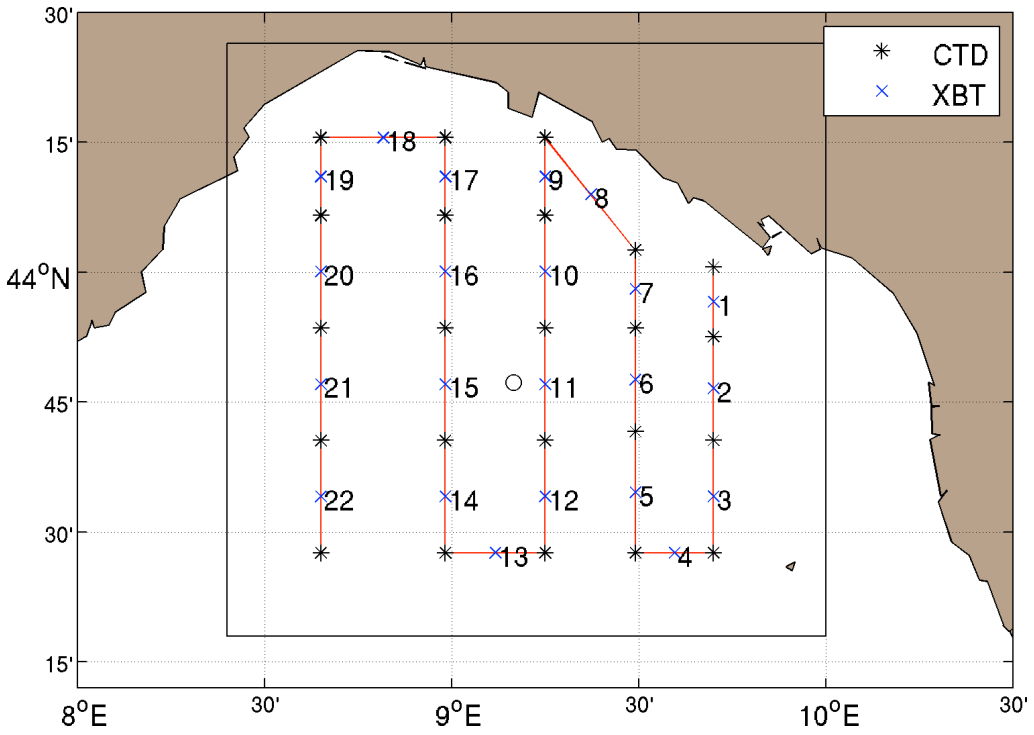


Figure 5 : Map of the XBT positions (cross symbol X) and the CTD stations (star symbol *).

The following table (Table1) shows the details of the XBT launching. The deployment should be identical in Phase I and II.

Table1 : XBT panned launch positions

N°	Longitude (East)	Latitude (North)	Prof. (m)
1	9.7	43.9430	201
2	9.7	43.7764	361
3	9.7	43.5682	506
4	9.5959	43.46	542
5	9.4918	43.5765	288
6	9.4918	43.7931	423
7	9.4918	43.9679	494
8	9.3731	44.1504	677
9	9.2503	44.1845	800
10	9.2503	44.0013	694
11	9.2503	43.7847	1177
12	9.2503	43.5682	1017
13	9.1170	43.46	1594
14	8.9838	43.5682	2063
15	8.9838	43.7847	1004
16	8.9838	44.0013	980
17	8.9838	44.1845	998
18	8.8172	44.2595	1064
19	8.6507	44.1845	997
20	8.6507	44.0013	1663
21	8.6507	43.7847	2377
22	8.6507	43.5682	2531

2.2 SAMPLING STRATEGY: PHASE II

The second and third oceanographic cruises (PHASE II) are scheduled from October 13 to October 24 and they are finalized to collect oceanographic data to validate the operational ocean model (MFS) and the relocatable model at higher resolution (HOPS model).
The sampling will be subdivided in two parts: PHASE IIa and PHASE IIb.

The PHASE IIa will run from October 13 to October 17 (Monday through Friday) and PHASE IIb from October 20 to October 24. Between PHASE IIa and PHASE IIb (from 18 to 19 October) the Magnaghi ship will stay in La Spezia port.

PHASE IIa should:

- collect the first verification CTD and XBT data set
- deploy the second set of drifters

PHASE IIa will deploy the same CTD and XBT sampling of PHASE I.

PHASE IIb will repeat the same CTD and XBT sampling of PHASE IIa.

3. DRIFTER DEPLOYMENT

During MREA08 the release of 10 drifters CODE/GPS/ARGOS will be performed:

- 6 drifters from INGV (Argos ID numbers: 85741, 85742 ,85743 ,85744, 85745, 85746)
- 2 drifters from CNR (Argos ID numbers: 85747, 85748)
- 2 drifters from OGS (Argos ID numbers: 85193, 85194)

The drifters will be divided in two cluster of five drifters:

- the first cluster includes 1 unit from OGS (85193), one from CNR (85747) and 3 from INGV (85741 – 85742 - 85743), it will be deployed during PHASE I ;
- the second cluster includes 1 unit from OGS (85194), one from CNR (85748) and 3 from INGV (85744 – 85745 – 85746), it will be released during PHASE IIa.

3.1 RELEASE 1

The first cluster of 5 drifters will be deployed during the first hydrographic survey (September 30 –October 3) close of the ODAS buoy (9° 9□ 54□ E , 43° 47□ 18□ N).

The drifter deployment will have a shape similar to release done during MREA07, one drifter in the vicinity of the ODAS buoy and the other four units about 500 meters away from this central location in the North, East, South and West directions. The map of the release is shown in Figure 6**.**

Table 2 shows the proposed details of the drifters deployment.
The drifters will be release during the first survey when the Magnaghi will be in the vicinity of CTD 10-11 stations. The area of the release has been chosen close to the ODAS buoy because the velocity field shows high variability and it could be guarantee the drifter spread. The Figure 7 illustrates the mean field velocity for October 2007 obtained from MFS operational model in the vicinity of the ODAS buoy.

Table 2 : Planned drifter positions and timing for the release 1.

Drifter ID	Date of the release	Longitude (East)	Latitude (North)
85193	Near October 2	9.166	43.7883
85747	Near October 2	9.1705	43.7883
85741	Near October 2	9.166	43.7838
85742	Near October 2	9.1615	43.7883
85743	Near October 2	9.166	43.7928

3.2 RELEASE 2

The second cluster will be released from Italian Navy during the second hydrographic survey PHASE IIa (October 13 – 17) close to ODAS buoy. The deployment will be identical to the release 1 and the drifters will be released when the Magnaghi ship will be in the vicinity of CTD 10 -11 (near October 15).

Table 3 : Planned drifter positions for the release II.

Drifter ID	Date of the release	Longitude (East)	Latitude (North)
85194	Near October 15	9.166	43.7883

85748	Near October 15	9.1705	43.7883
85744	Near October 15	9.166	43.7838
85745	Near October 15	9.1615	43.7883
85746	Near October 15	9.166	43.7928

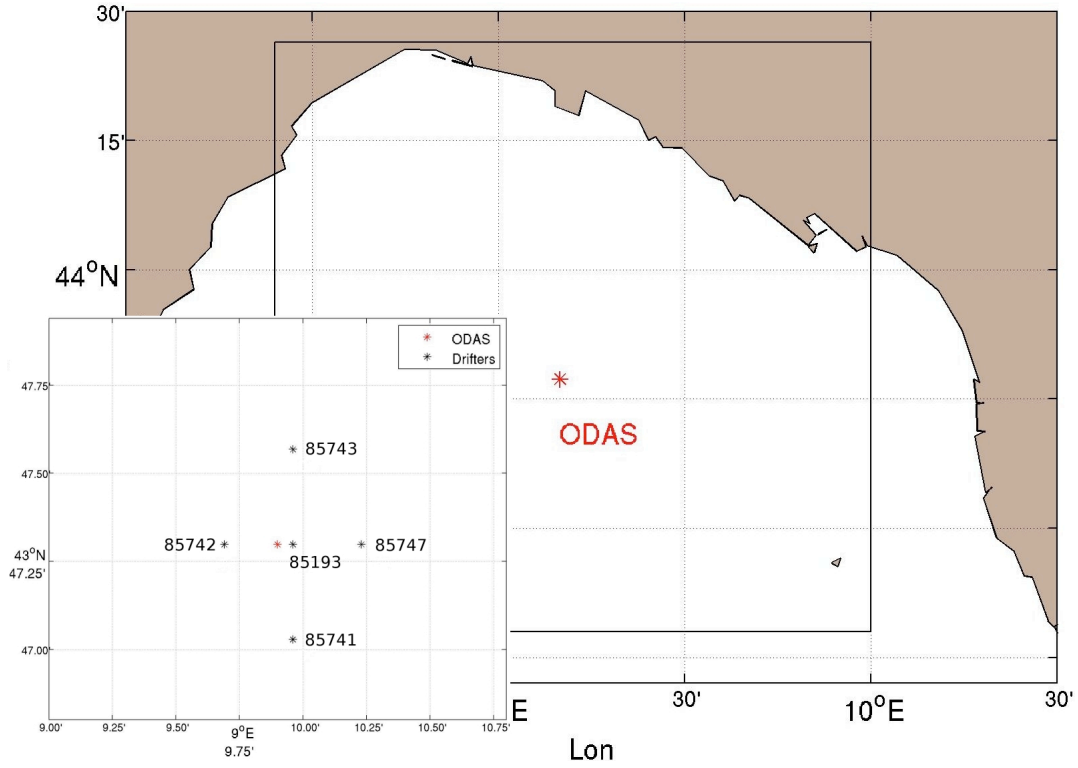


Figure 6 : Deployment of the first cluster around ODAS buoy. The five drifters are indicated with ID Argos number, the red star represents the ODAS buoy position.

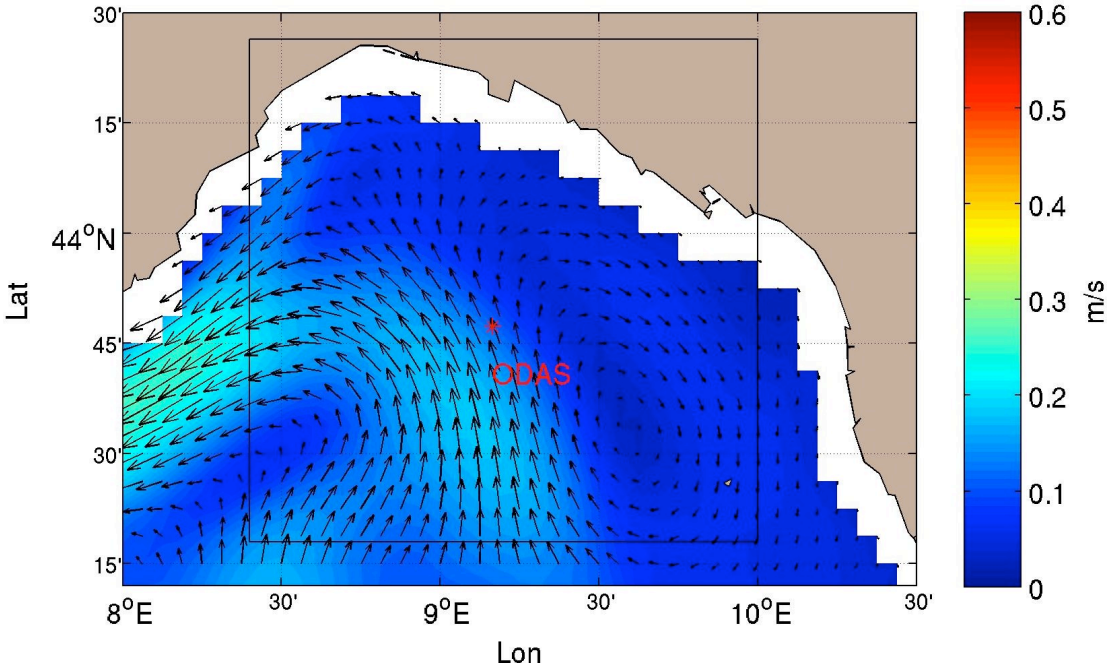


Figure 7 : Mean field velocity for October 2007 obtained from MFS model.

4. GLIDER DEPLOYMENT

During MREA08 the glider provided by OGS will be deployed in three different periods following this scheme:

- Survey 1 : (September 30 - October 4) the glider will be released in the vicinity of CTD station 2 and it will be recovered close to CTD station 21.
- Survey 2: (October 4 - October 13) the glider will be released in the vicinity of CTD 2 station and it will be recovered close CTD station 2.
- Survey 3 : (October 13 - October 24) the glider will be released close CTD 2 and it will be recovered close CTD 2.

Survey nr 1

Deployment	9.7000 - 43.8764 (CTD 2)	30 September,12:00
waypoint 1	9.4295 - 43.7379	1 October,12:00
waypoint 2	9.1556 - 43.9245	2 October,12:00
waypoint 3	8.8796 - 43.7394	3 October,12:00
Recovery	8.6507 - 43.8930 (close CTD 21)	4 October,08:00

Survey nr 2

Deployment	9.7000 - 43.8764 (CTD 2)	4 October,16:00
waypoint 1	9.4295 - 43.7379	5 October,12:00
waypoint 2	9.1556 - 43.9245	6 October,12:00
waypoint 3	8.8796 - 43.7394	7 October,12:00
waypoint 4	8.6507 - 43.8930 (CTD 21)	8 October,12:00
waypoint 3	8.8796 - 43.7394	9 October,12:00
waypoint 2	9.1556 - 43.9245	10 October,12:00
waypoint 1	9.4295 - 43.7379	11 October,12:00
Recovery	9.7000 - 43.8764 (close CTD 2)	12 October,16:00

Survey nr 3

Deployment	9.7000 - 43.8764 (CTD 2)	13 October,16:00
waypoint 1	9.4295 - 43.7379	14 October,16:00
waypoint 2	9.1556 - 43.9245	15 October,16:00
waypoint 3	8.8796 - 43.7394	16 October,16:00
waypoint 4	8.6507 - 43.8930 (CTD 21)	17 October,16:00
waypoint 5	8.2842 - 43.8579	18 October,16:00
waypoint 4	8.6507 - 43.8930 (CTD 21)	19 October,16:00
waypoint 3	8.8796 - 43.7394	20 October,16:00
waypoint 2	9.1556 - 43.9245	21 October,16:00
waypoint 1	9.4295 - 43.7379	22 October,16:00
Recovery	9.7000 - 43.8764 (CTD 2)	23 October,16:00

5. FTP ARCHITECTURE

This section describes the FTP site dedicated at the MREA08 experiment, it will be available from September, 15 to end of November. Figure 8 shows the FTP scheme.
The parent directory is MREA08_GNOO and it contains this following six directories :

- INGV : contains MFS_Sys2b ocean model products;
- CNMCA_USAM : contains atmospheric forcing dataset;
- UNIBO : with HOPS model outputs and lagrangian simulation;
- OGS : glider and drifters data;
- CNR : sea surface temperature operational field;
- ENEA_IIM : CTD and XBT data collected during the oceanographic cruise.

The description of each products is in the following sections.

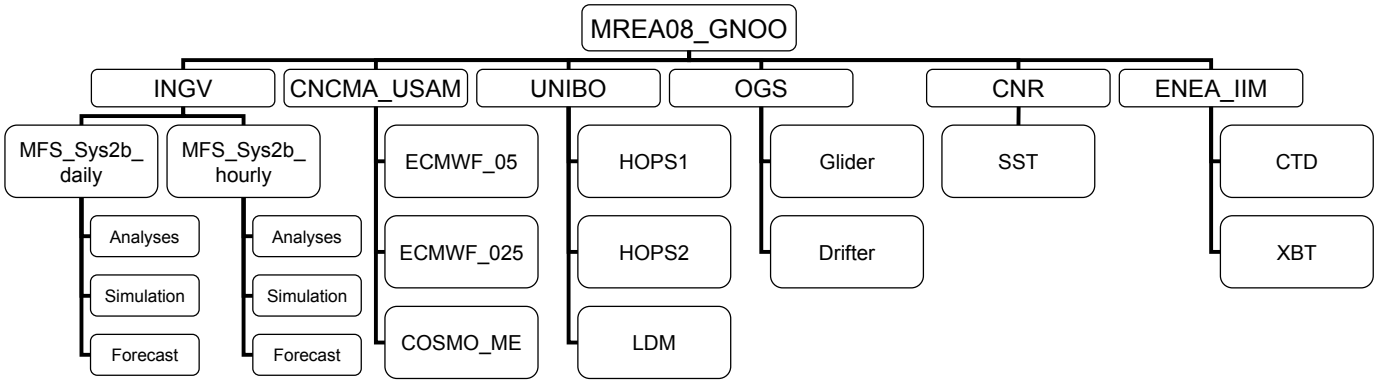


Figure 8 : FTP Architecture for MREA08 Experiment.

5.1 INGV : Ocean models

The MFS_Sys2b operational oceanographic model outputs will be available in real time for the period September 15, 2008 to November 30, 2008. The ocean outputs, released for the only region of the Ligurian Sea (Lon: 6.5° - 12.3125° , Lat: 41.75 – 44.5°), are :

- MFS_Sys2b_daily model output (analyses, simulation and 10 days forecasts) at daily time resolution for the selected area. The state variables archived are: net downward heat flux, shortwave radiation, sea surface height (ssh), net upward water flux, salinity (S), temperature (T), horizontal velocity components (U,V) and wind stress.
- MFS_Sys2b_hourly model output (analyses, simulation and 10 days forecasts) at hourly time resolution. The state variables archived are: net downward heat flux, shortwave radiation, ssh, S, T, (U,V) and wind stress.

5.2 CNMCA_USAM : Atmospheric forcing

Three data sets will be available at the MREA08 ftp site:

- ECMWF_05 : ECMWF forecast and analyses with 0.5x0.5 degrees horizontal resolution;
- ECMWF_025 : ECMWF forecast and analyses with 0.25x0.25 degrees horizontal resolution;
- COSMO_ME : forecast at 7 km horizontal resolution.

5.2.1 ECMWF

The USAM releases each day (D) analysis and forecast atmospheric forcing for different parameters. The ECMWF_05 and ECMWF_025 are organized with the same structure, the only difference is in the prefix of the files name: IQ for ECMWF_05 and IR for ECMWF_025. In details 64 files are released in grib format (GRIdded Binary).

- 4 analyses : 00, 06, 12 UTC of the day D and 18 UTC of the day D-1. The stored fields are: Mean Sea Level pressure (MSL), Total Cloud Cover (TCC), 10m u wind component (10U), 10m v wind component (10V), 2m Temperature (2T), 2m Dewpoint Temperature (2D), Land Sea Mask (LSM). The name of the file contained in the ftp site is: IQD**MMDDHH**00**MMDDHH**001 where **MMDD** indicate month and day, **HH** represents the hour (00, 06, 12 or 18).
- 8 forecast 00 of the day D with 3 hrs temporal frequency until 24 hrs. The stored fields are: Surface Solar Radiation (SSR), Surface Thermal Radiation (STR), Large Scale Precipitation (LSP), Convective Precipitation (CP) and Total Cloud Cover (TCC). The name of the file contained in the ftp site is: IQD**MMDD(HH1)**00**MMDD(HH2)**001 where **MMDD** indicate month and day, **HH1** represents the forecast 00 and **HH2** is the temporal frequency (03,06,09,12,15,18,21,00).
- 52 forecast 12 of the day D with 3 hrs temporal frequency until 72 hrs and 6 hours temporal frequency from 78 hrs to 240 hrs. The stored fields are: Mean Sea Level pressure (MSL), Total Cloud Cover (TCC), 10m u wind component (10U), 10m v wind component (10V), 2m Temperature (2T), 2m Dewpoint Temperature (2D), Surface Solar Radiation (SSR), Surface Thermal Radiation (STR), Large Scale Precipitation (LSP), Convective Precipitation (CP). The name of the file contained in the ftp site is: IQD**MMDD(HH1)**00**MM(DD+n)(HH2)**001 where **MMDD** indicate month and day, **HH1** indicates the forecast 12 and **HH2** indicates the temporal frequency (03,06,09,12,15,18,21,00 until 72 hrs and 00,06,12,18 from 78 hrs to 240 hrs), the **n** assumes the value from 1 to 10.

5.2.2 COSMO_ME

The USAM releases each day COSMO_ME atmospheric forcing forecast with horizontal resolution of 7 km and 3 hrs temporal frequency until 72 hrs, the initial time of the model run is 00 UTC.
The stored fields are: Sig. Height of Wind Waves (WVHGT), Net Short Wave (NSWRT), U wind (UGRT), V wind (VGRT), Temperature (TMP), Dew Point Temperature (DPT), Pressure Reduce to MSL (PRMSL), Total Cloud Cover (TCDC).
The ftp COSMO_ME directory will contain also the interpolation package on the geographic grid.

5.3 UNIBO

During MREA08 experiment, from September 29 the relocatable HOPS ocean model outputs will be available in the ftp site in near real time. In details the products are:

- HOPS1 : nested HOPS model output at 3 km horizontal resolution, hourly snapshots temporal frequency for the selected area: Lon: 6.9° - 11.8° , Lat: 42.14° - 44.49° ; the model releases every day

three-days forecast.

- HOPS2 : nested HOPS model output at 1 km horizontal resolution, hourly snapshots temporal frequency for the selected area: Lon: 8.34°- 10.02° , Lat: 43.26° - 44.49° , the model releases every day three-day forecast.

The state variables archived are: T, S, (U,V) and ssh.
The HOPS1 and HOPS2 will be nested in MFS_Sys2b in near real time during the observational cruise. Numerical drifters will be released every forecast from the designated area of release during MREA08 experiment and the result will be upload in Langrangian Dispersal Model directory (LDM).

5.4 OGS

The OGS directory will be contain the glider and drifters data, the data upload will be not in real time.

5.5 CNR

SST daily satellite operational fields will be available in the dedicated directory (CNR) of the MREA08 INGV ftp site.

5.6 ENEA_IIM

The XBT and CTD data collected during oceanographic cruise MREA08 will be uploaded in the ftp directories ENEA_IIM.