FIRST TOSCA DRIFTER EXPERIMENT IN THE GULF OF TRIESTE (APRIL 2012)

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INDICE:

1. Introduction

As part of the TOSCA project, the surface circulation and the dispersion of the Gulf of Trieste were intensely studied for more than a week by means of drifters, HF radars and models. The experiment was initially planned to be held at the end of March 2012. Unfortunately, due to the delay in the delivery of some drifters (Gerin et al., 2012), the experiment was delayed by one month.

This experiment also allowed us to test different drifter types to follow surface water (and oil slicks) and to study the drifter slip and the vertical shear of horizontal currents. The report gives essential information about the instrumentations used for the experiment, but focuses mainly on the drifters.

2. The planned experiment

The operability of the HF radar network and the model were checked a few days in advance with respect to the scheduled drifter deployments, so as to guarantee the generation of near-real-time products and to optimize/fine tune the choice of the deployment sites.

The drifters deployment strategy ensured a proper coverage of the entire Gulf of Trieste. Since drifters were expected to exit the Gulf from the north-western part (close to Grado), drifter deployments were denser close to Trieste to avoid the drifter to leave immediately the study area (Fig. 1).

The six deployments within the yellow area of Fig. 1 were carried out by the colleagues of the Marine Biology Station of Piran (Slovenia), while the deployments in the other two areas were conducted by OGS (green area) and by OGS with the collaboration of the Marine Reserve of Miramare (red area).

Dispersion studies were performed nearly at the center of the Gulf deploying drifters in two specific locations (orange circles in Fig. 1).

Several drifters were recovered during the experiment (because of stranding or because they came too close to the coast) and were redeployed at convenient locations (mainly at station 17, see Fig. 1).

A Waverider buoy was also deployed approximately in correspondence to station 17 and recorded wave parameters for the entire period of the experiment.

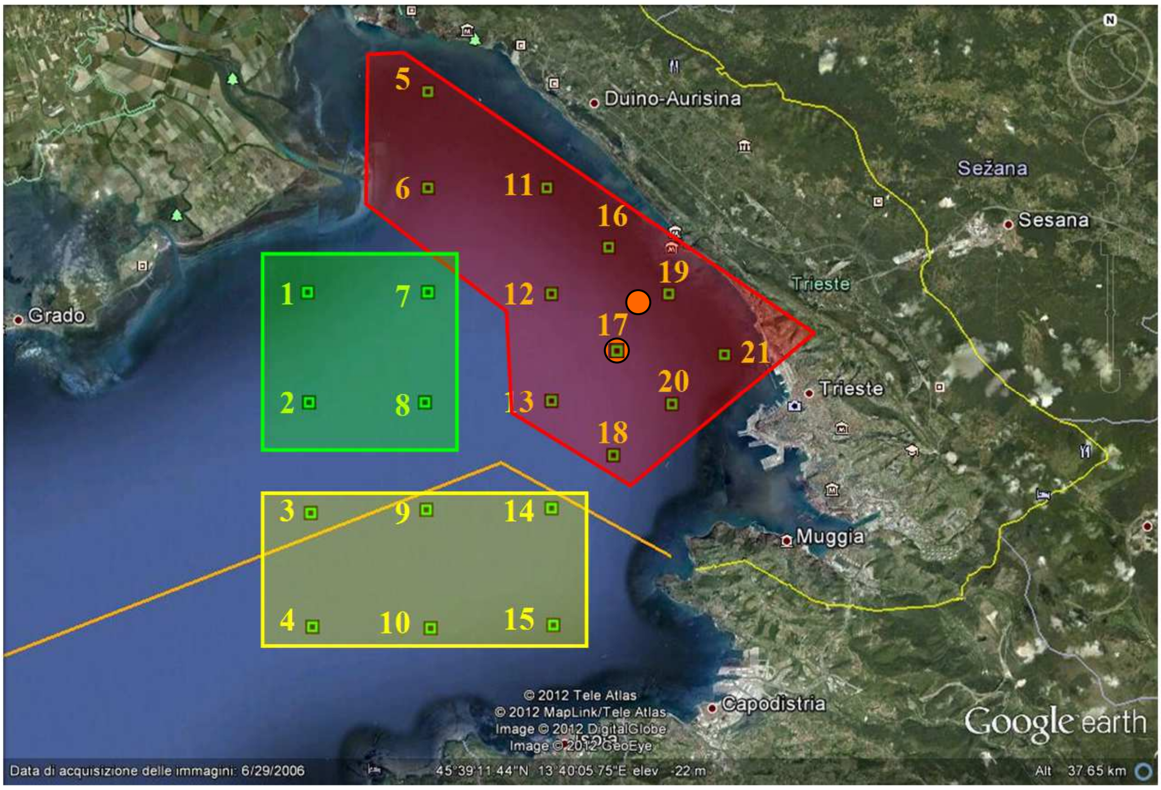

Fig. 1. Drifter deployment schema in the Gulf of Trieste. The green squares represent the drifter deployment positions and the two orange circle indicate the deployment locations of the dispersion experiments.

3. The different type of drifters used

Several types of drifters were used in the experiment (Table 1). In particular, we deployed 6 Iridium CODE drifters from Technocean and DBI (Fig. 2), 7 CODE drifters from Technocean modified by OGS with GSM transmission (Fig. 3) and 15 GSM CODE drifters produced by Elcon (Italy) (Gerin et al., 2012, Fig. 4). Other CODE like drifters were used: 2 Metocean drifters (Fig. 5) and 3 CODE drifter realized by the University of the Aegean (UAEGEAN) (Fig. 6). Additionally, 4 I-sphere drifters (Metocean) (Fig. 7), 2 Oilspill prototype drifters produced by TEI Piraeus in the framework of TOSCA project (Fig. 8) and 2 prototype surface drifters from the Institute of Marine Sciences (ICM, CSIC, Spain) (Fig. 9) were also released at sea. Due to technical problems while setting the instruments, we were not able to operate the 2 Albatros drifters from IMEDEA (Fig. 10).

In addition to the above-described instruments, 2 CODE type prototype drifters equipped with ADCP were also deployed in order to estimate the drifter slip and the vertical shear of horizontal currents. One of the prototype was realized by OGS (Fig. 11) and has one current meter for the measurements of the current just below the water surface and one downward-looking 1 MHz ADPC measuring the water current below the instrument, from about 2.5 m down to the bottom in cells of 50 cm. Further information on this instrument can be found in Gerin and Poulain (2012). The other prototype drifter (Fig. 12) was achieved by UAEGEAN and is equipped with one upward looking 2 MHz ADCP that measures the water currents from a depth of 2 m up to the surface in cells of about 10 cm. The two instruments can be considered complementary.

Type	Quantity	Institute	Telemetry	Deployed	Recovered	Lost
CODE/Elcon	15	OGS	GSM	15	6	9
CODE/DBI	3	OGS	Iridium	3	2	1
CODE/ADCP	1	OGS	GSM	1	1	0
CODE/Metocean	2	OGS	Iridium	2	2	0
CODE/OGS	4	OGS	GSM	4	2	2
CODE/Technocean	2	OGS/UNINAP	Iridium	1	1	0
CODE/OGS	3	UNINAP	GSM	3	3	0
I-SPHERE/Metocean	4	UNINAP	Iridium	4	4	0
CODE/UAEGEAN	3	UAEAGEAN	GSM	3	0	3
CODE/ADCP	1	UAEAGEAN	GSM	1	1	0
OILSPILL	2	TEI PIRAEUS	GSM	2	0	2
PROTOTYPE	2	ICM	Globalstar	2	2	0
ALBATROS	2	IMEDEA	GSM	0	0	0
TOTAL	**44**			**41**	**24**	**17**

Table 1: Quantities and types of drifters used during the experiment.

Fig. 2. CODE drifter from DBI

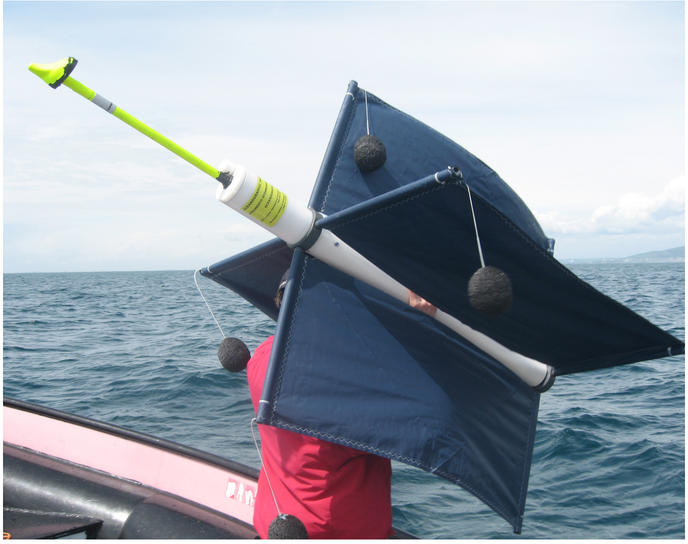

Fig. 3. CODE drifter modified by OGS

Fig. 4. CODE drifter manufactured by ELCON

Fig. 5. CODE drifters from Metocean

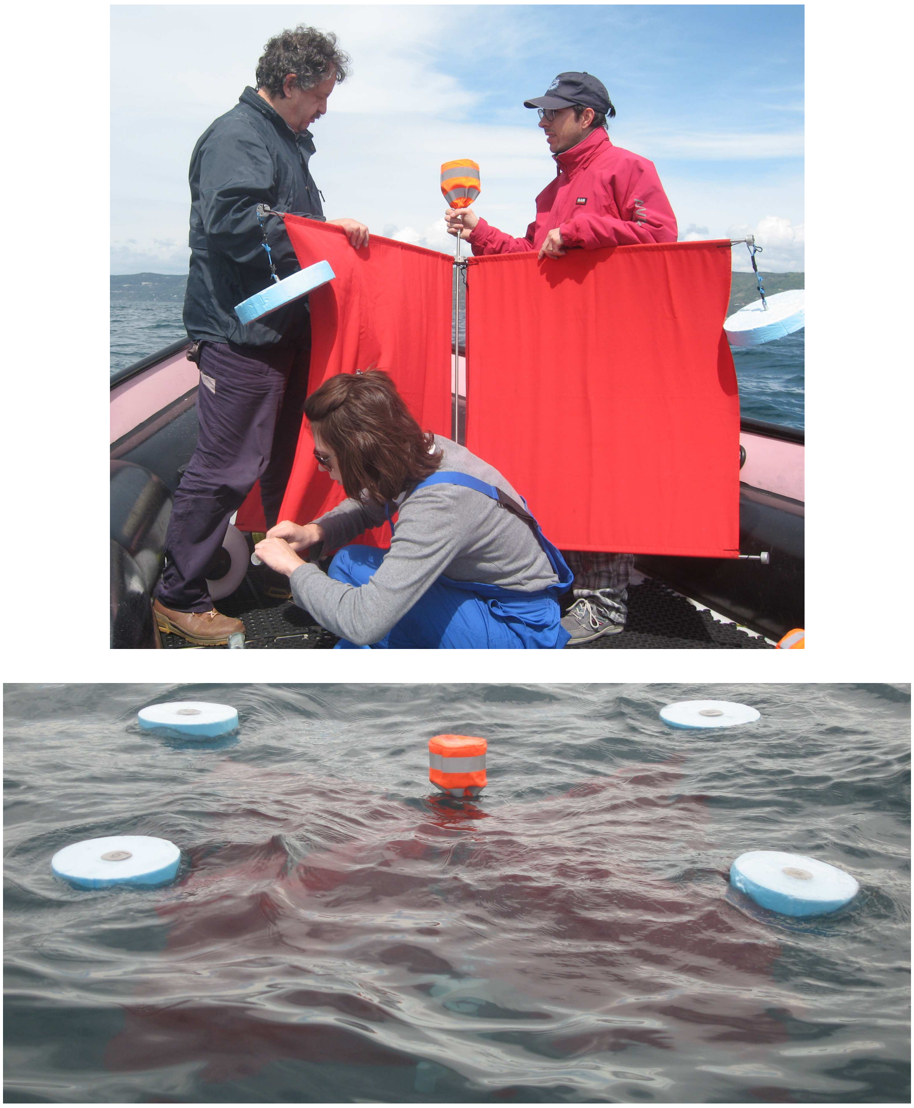

Fig. 6. CODE drifters from UAEGEAN

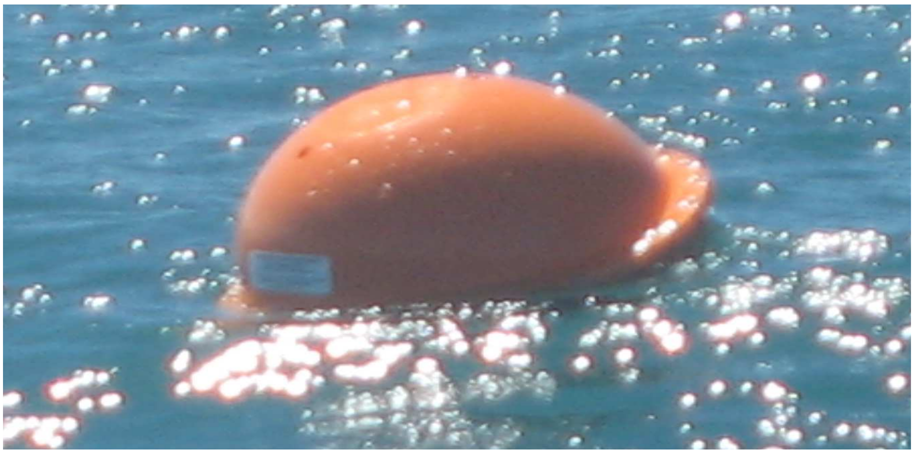

Fig. 7. I-sphere drifters from Metocean

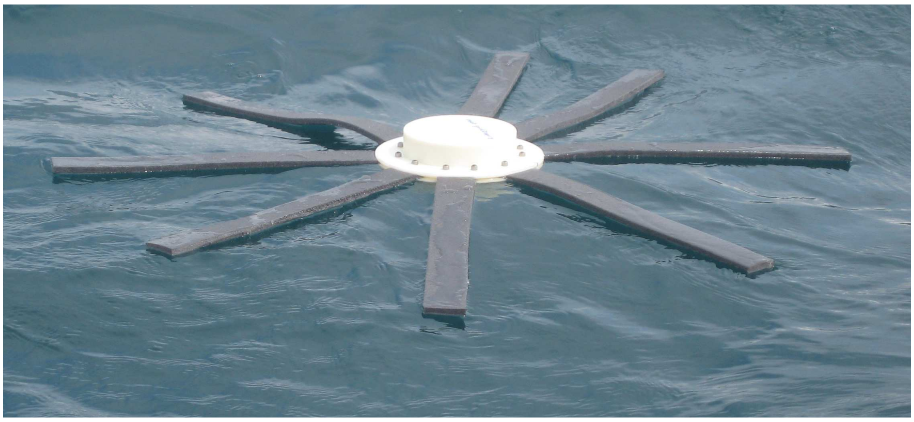

Fig. 8. Oil spill drifters from TEI Pireus

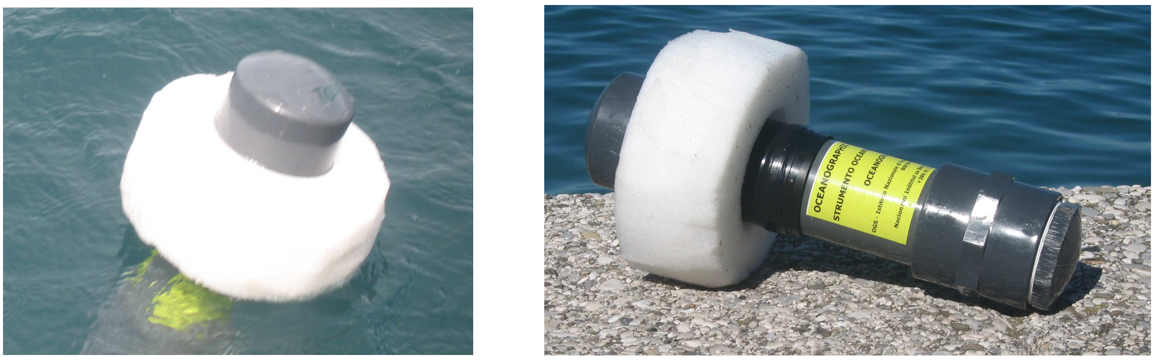

Fig. 9. Prototype drifters from ICM

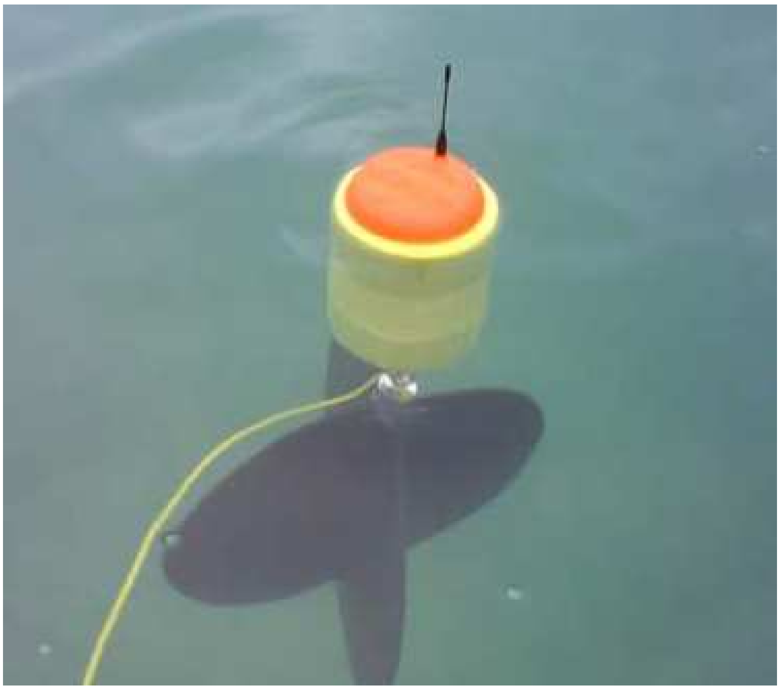

Fig. 10. Albatros drifter from IMEDEA

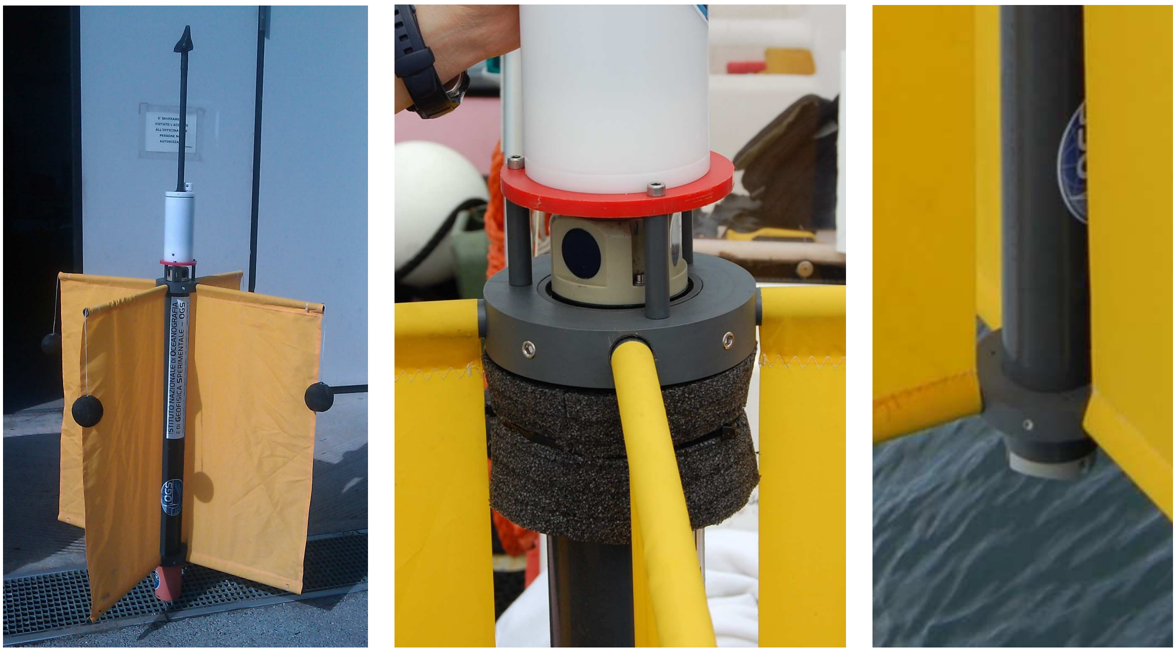

Fig. 11. CODE drifters from Technocean modified by OGS with currentmeter (center) and downward-looking ADCP (right)

Fig. 12. CODE drifter with upward-looking ADCP from UAEGEAN

4. The experiment

4.1. Monday 23/04/2012

Six drifters were deployed early in the morning by the colleagues of the Marine Biology Station of Piran at the 6 positions inside the yellow area of Fig. 1 (Table 2). Then OGS deployed all the other instruments in the red and green areas of Fig. 1.

The ELCON drifters were supposed to be deployed during the morning manly in order to cover the red area of Fig. 1, but - as better described in Gerin et al. (2012) - they appeared to buoyant in water. Their deployment was postponed to the afternoon, after the fix of the buoyancy problem. Therefore during the morning OGS carried out the deployments of the dispersion experiment with several drifters released in very close clusters and of the drifter in the area close to Grado (green area of Fig. 1, after adding weights to the ELCON drifters).

In the afternoon OGS released all the remaining ELCON drifters with 2 shackles (about 0.6 kg) attached to the lower arms of the drifter so as to make the drifters floating perfectly in water. Only near the Isonzo river, the buoyancy of the drifters was found inadequate due to the extreme density variability of the surface waters caused by an exceptional plume event.

The deployment locations occurred on the first day and the trajectories of these drifters during the days after the releases can be seen in Figs. from 13 to 21.

drifter type	drifter id	drifter file name	depl lat	depl lon	depl time (GMT)
CODE-Elcon	00000FE0	a393356966778	45.614	13.536	23/04/2012 07:35
CODE-Elcon	00000FE3	a393356905137	45.614	13.594	23/04/2012 07:55
CODE-Elcon	00000FE4	a393356891951	45.614	13.653	23/04/2012 08:15
CODE-Elcon	00000FE5	a393356795465	45.575	13.653	23/04/2012 09:35
CODE-Elcon	00000FE1	a393356986714	45.576	13.595	23/04/2012 10:02
CODE-Elcon	00000FE2	a393356997265	45.575	13.536	23/04/2012 10:20
CODE-Elcon	00000FE6	a393356891535	45.755	13.597	23/04/2012 10:27
CODE DBI		a300234010470090	45.722	13.596	23/04/2012 10:48
CODE-OGS	SN00015	a393284386371	45.667	13.688	23/04/2012 10:59
CODE-OGS	SN00013	a9393356695106	45.667	13.686	23/04/2012 11:00
CODE-OGS	SN00004	a393356699978	45.667	13.686	23/04/2012 11:02
CODE-OGS	SN00012	a393356496545	45.668	13.680	23/04/2012 11:06
CODE DBI		a300234010755110	45.686	13.596	23/04/2012 11:10
CODE-OGS	SN00008	a393356388212	45.668	13.679	23/04/2012 11:15
CODE-OGS	SN00016	a9393356498829	45.668	13.679	23/04/2012 11:17
CODE UAEGEAN	Vas 10 - 3332	a393355231694	45.670	13.683	23/04/2012 11:30
CODE DBI		a300234010874510	45.650	13.593	23/04/2012 11:35
CODE UAEGEAN	Vas 9 - 3333	a393351855988	45.669	13.683	23/04/2012 11:46
CODE - Metocean	Metocean 2	a300234011756720	45.651	13.537	23/04/2012 11:54
CODE UAEGEAN	Vas 1 - 3331	a393351979749	45.669	13.684	23/04/2012 11:57
CODE-OGS	SN00006	a393356498840	45.668	13.683	23/04/2012 12:00
Oil spill	Oil spill 1	a393355895695	45.668	13.684	23/04/2012 12:05
Oil spill	Oil spill 2	a393351086488	45.668	13.684	23/04/2012 12:05
Prot-ICM	Tosca5	aTosca5	45.668	13.684	23/04/2012 12:05
Prot-ICM	Tosca4	aTosca4	45.668	13.684	23/04/2012 12:05
CODE - Metocean	Metocean 1	a300234011759700	45.689	13.537	23/04/2012 12:12
CODE-Elcon	00000FE7	a393356795486	45.687	13.711	23/04/2012 13:58
CODE-Elcon	00000FE9	a393356905138	45.668	13.739	23/04/2012 14:06
CODE-Elcon	00000FEA	a393356697564	45.650	13.711	23/04/2012 14:16
CODE-Elcon	00000FEB	a393356980992	45.633	13.683	23/04/2012 14:26
CODE-Elcon	00000FEC	a393356986728	45.648	13.665	23/04/2012 15:30
CODE-Elcon	00000FED	a393356966789	45.687	13.653	23/04/2012 16:16
CODE-Elcon	00000FEE	a393356966674	45.722	13.653	23/04/2012 16:24
CODE-Elcon	00000FEF	a393356991159	45.703	13.683	23/04/2012 16:35

Table 2. Drifter deployment information of the first day (23 April 2012).

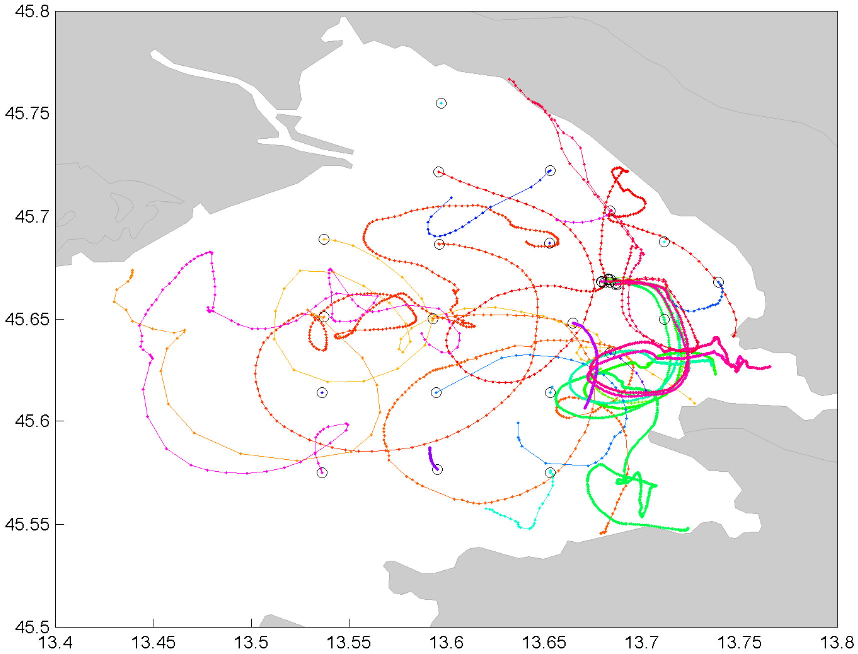

Fig. 13. Trajectories of all the drifters deployed during the first day. Deployment locations are shown with circles.

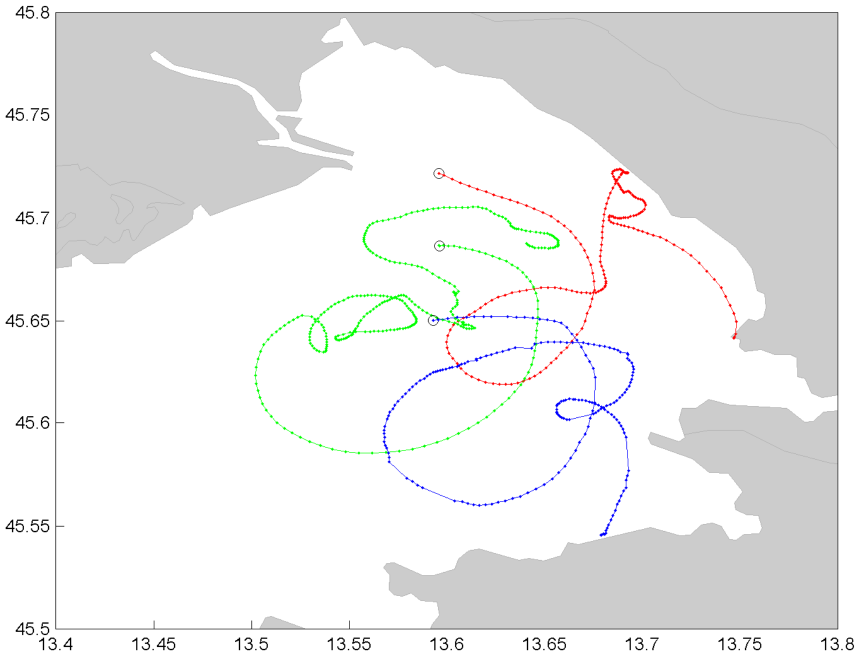

Fig. 14. Same as Fig. 13, but for the CODE DBI drifters.

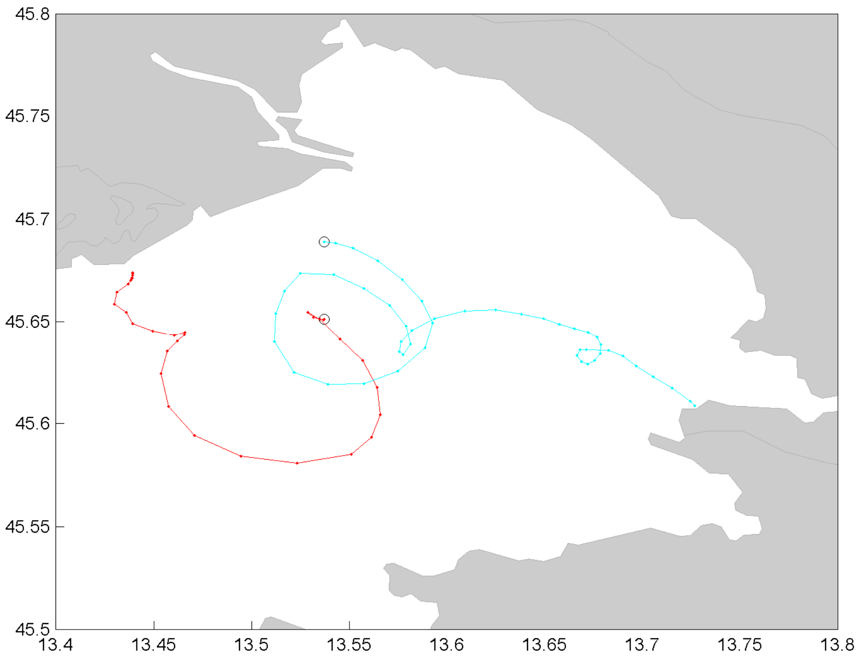

Fig. 15. Same as Fig. 13, but for the CODE Metocean drifters.

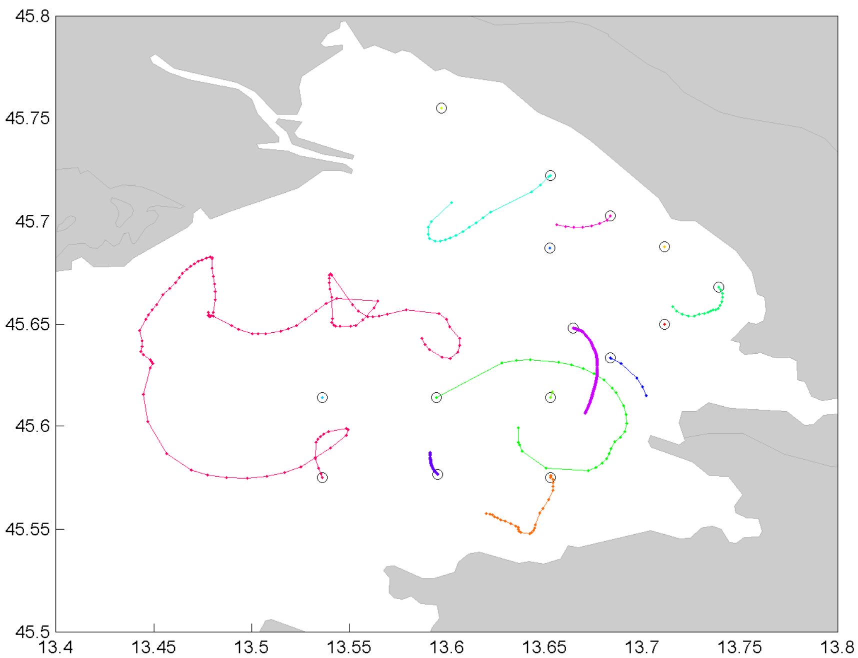

Fig. 16. Same as Fig. 13, but for the CODE ELCON drifters.

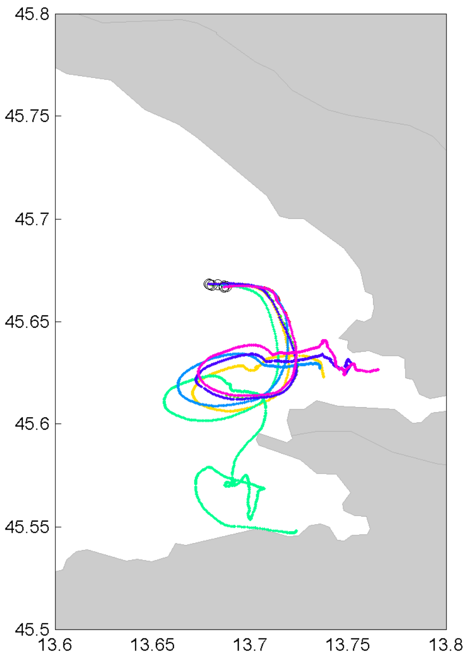

Fig. 17. Same as Fig. 13, but for the CODE drifters modified by OGS.

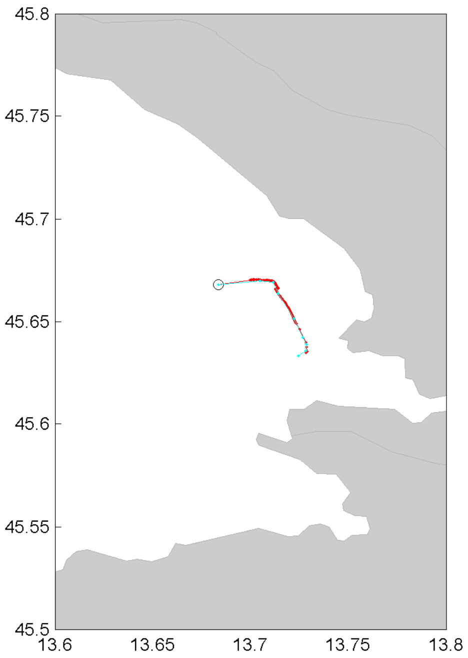

Fig. 18. Same as Fig. 13, but for the Oil Spill drifters.

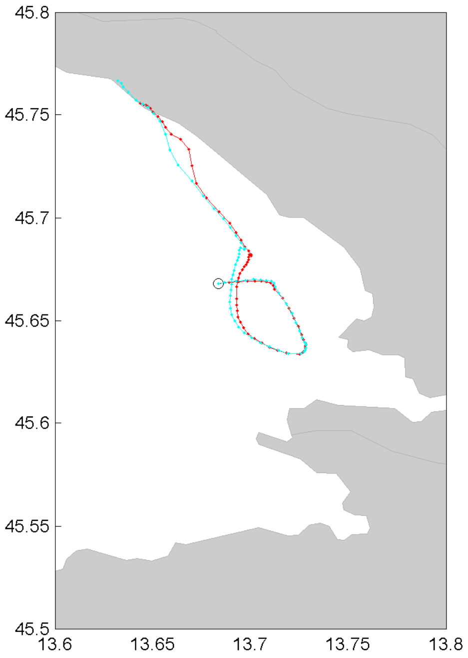

Fig. 19. Same as Fig. 13, but for the ICM prototype drifters.

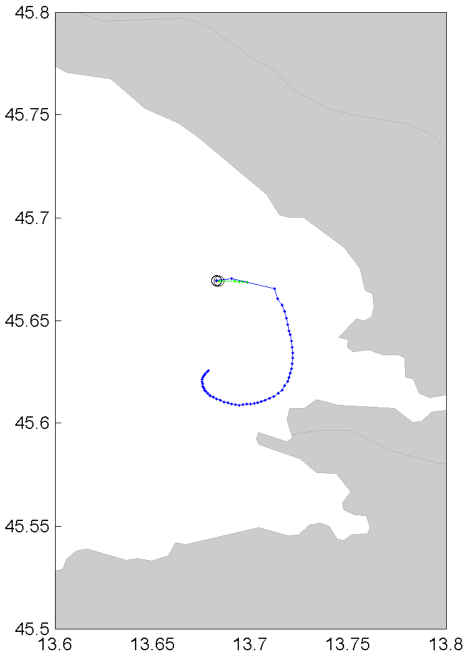

Fig. 20. Same as Fig. 13, but for the UAEGEAN CODE drifters.

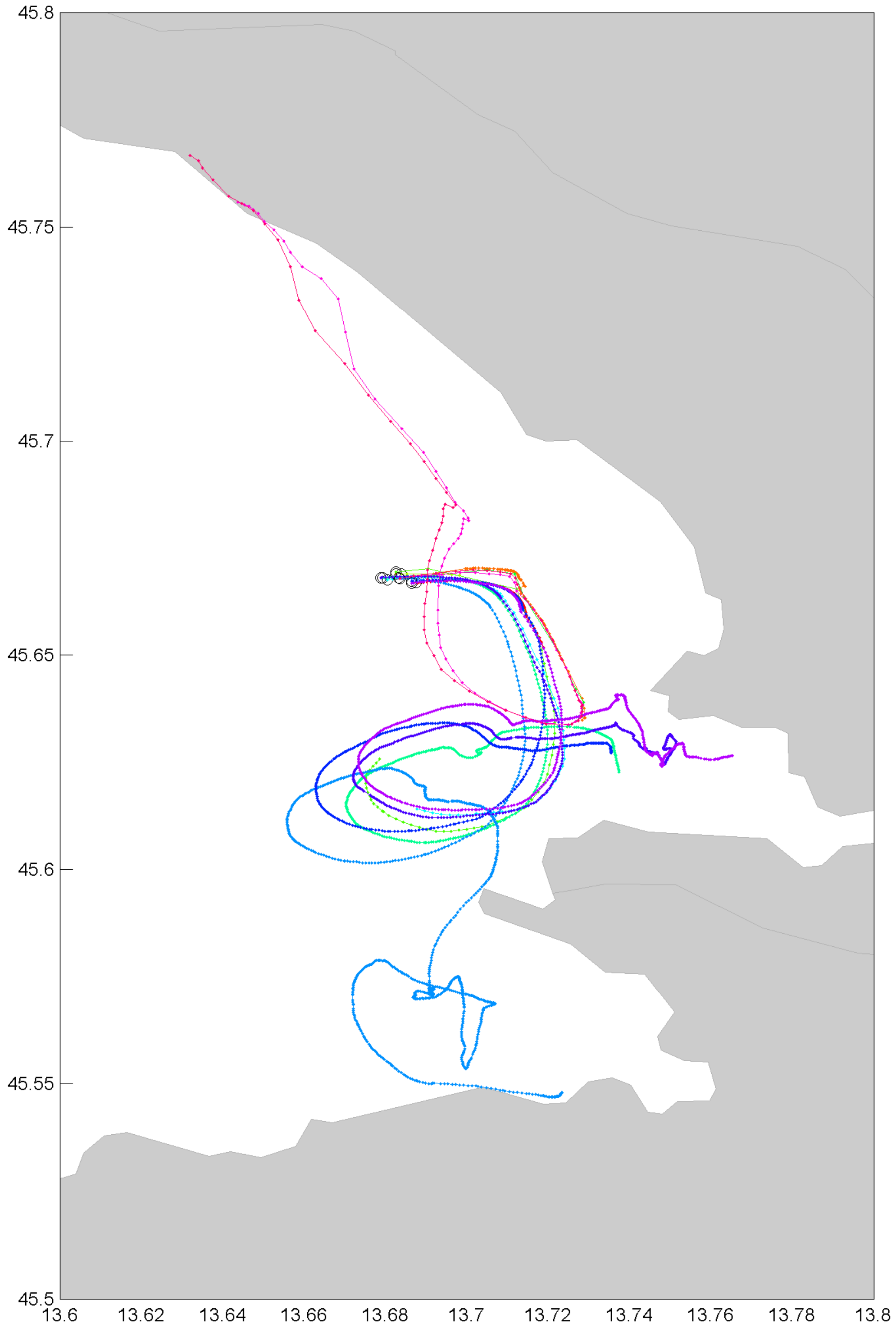

Fig. 21. Trajectories of all the drifters deployed for the dispersion experiment during the first day (23 April 2012). Circle symbols denote deployment locations.

4.2. Tuesday 24/04/2012

Due to the bad weather conditions, the second day of the experiment was spent at OGS from where we monitored the drifter trajectories and fixed minor problems related to the decoding of the drifter data.

4.3. Wednesday 25/04/2012

On Wednesday, we began to recover the drifters that arrived too close to the coast or were trapped inside the mussel cultures (Fig. 22).

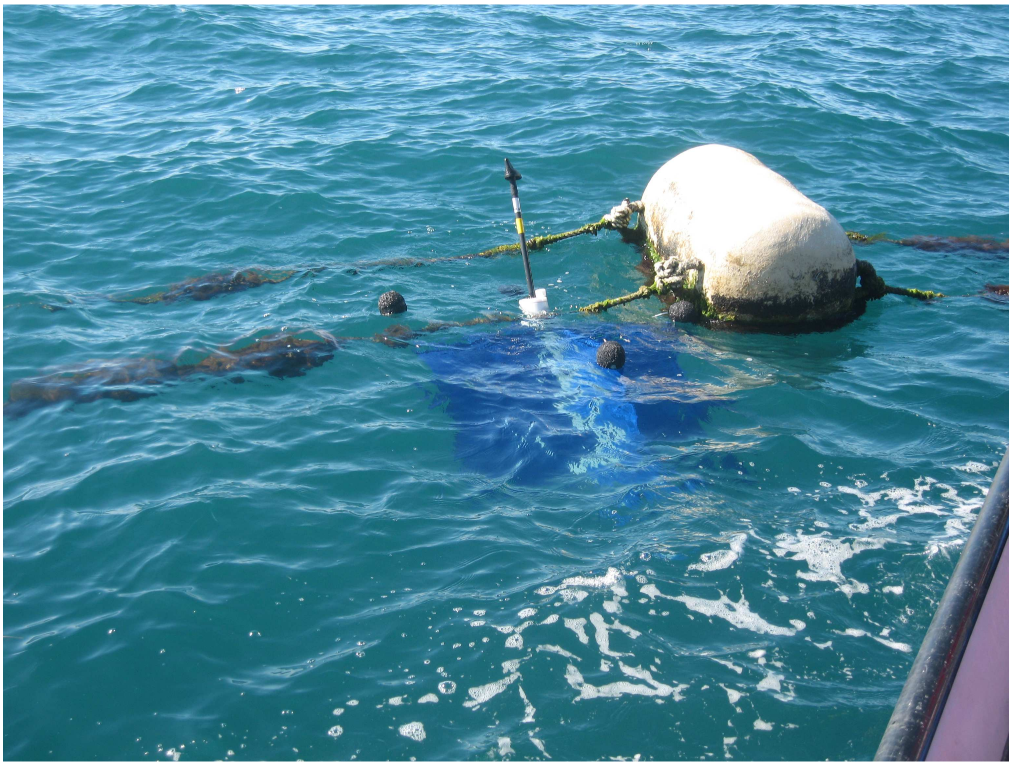

Fig. 22. One CODE drifter entangled in the mussel culture.

The ICM prototype named Tosca 5 was recovered near Sistiana cave in the morning and redeployed together with the 4 I-sphere drifters, the 2 prototype CODE drifters equipped with the ADCP and one CODE drifter by Technocean (Table 3) at station 17 (see Fig. 1 for the exact location and Figs. from 23 to 32 for the detailed drifter trajectories). After these launches, a Waverider buoy was moored close to station 17 and a CTD cast was performed.

drifter type	drifter id	drifter file name	depl lat	depl lon	depl time (GMT)
CODE-ADCP	Vas 12 - ADCP	a939335218340	45.711	13.763	25/04/2012 10:09
CODE-ADCP	SN00014	a9393290608548	45.668	13.684	25/04/2012 10:19
CODE Technocean		c300034013313360	45.668	13.683	25/04/2012 10:19
Isphere	ISPHERE	a300034012578040	45.668	13.684	25/04/2012 10:21
Isphere	ISPHERE	a300034012480560	45.670	13.684	25/04/2012 10:22
Isphere	ISPHERE	a300034012489470	45.668	13.684	25/04/2012 10:22
Isphere	ISPHERE	a300034012659810	45.668	13.684	25/04/2012 10:23
Prot-ICM	Tosca5	bTosca5	45.668	13.684	25/04/2012 10:23
CODE DBI		b300234010470090	45.687	13.695	25/04/2012 17:21
CODE - Metocean	Metocean 1	b300234011759700	45.687	13.695	25/04/2012 17:22
CODE-OGS	SN00008	b393356388212	45.687	13.695	25/04/2012 17:23
CODE-OGS	SN00012	c393356496545	45.687	13.695	25/04/2012 17:24
CODE-OGS	SN00004	b393356699978	45.687	13.695	25/04/2012 17:25
CODE-OGS	SN00013	b9393356695106	45.687	13.695	25/04/2012 17:26

Table 3. Drifter deployment information of the third day (25 April 2012).

During the day, several drifters were recovered (Table. 4). In particular, 2 CODE drifter modified by OGS were recovered in water in the nearby of the pier number 7. One ELCON drifter was accidentally found upside down near the wavebreaker Other 2 CODE drifter modified by OGS were found entrapped in the mussels culture close to Punta Sottile together with one Metocean CODE. Finally, another ELCON drifter was recovered, again upside down, near the military beach in Lazzaretto, one modified CODE was found stranded nearby Punta Sottile and one DBI was recovered in water near Riva Traiana Terminal (UN RO-RO terminal).

The DBI CODE, the 4 modified CODE and the Metocean CODE were redeployed in the evening about 1 nm from Miramare (Table 3).

Three of the four I-sphere drifters were finally recovered during the night in Sacchetta Marina (Table. 4).

drifter type	drifter id	drifter file name	recovery time (GMT)	information
Prot-ICM	Tosca5	aTosca5	25/04/2012 morning	Nearby Sistiana cave
CODE-OGS	SN00016	a9393356498829	25/04/2012 12:04	In water broken
CODE-OGS	SN00013	a9393356695106	25/04/2012 13:04	In water
CODE-Elcon	?	?	?	near the wavebreaker
CODE-OGS	SN00008	a393356388212	25/04/2012 14:15	in the Punta Sottile mussels culture
CODE-OGS	SN00012	a393356496545	25/04/2012 14:20	in the Punta Sottile mussels culture
CODE - Metocean	Metocean 1	a300234011759700	25/04/2012 14:29	in the Punta Sottile mussels culture
CODE-Elcon	?	?	?	near the military beach in Lazzaretto
CODE-OGS	SN00004	a393356699978	?	nearby Punta Sottile
CODE DBI		a300234010470090	25/04/2012 17:00	in water near Riva Traiana Terminal
Isphere	ISPHERE	?	25/04/2012 night	in Sacchetta Marina
Isphere	ISPHERE	?	25/04/2012 night	in Sacchetta Marina
Isphere	ISPHERE	?	25/04/2012 night	in Sacchetta Marina

Table 4. Drifter recovery information of the third day (25 April 2012).

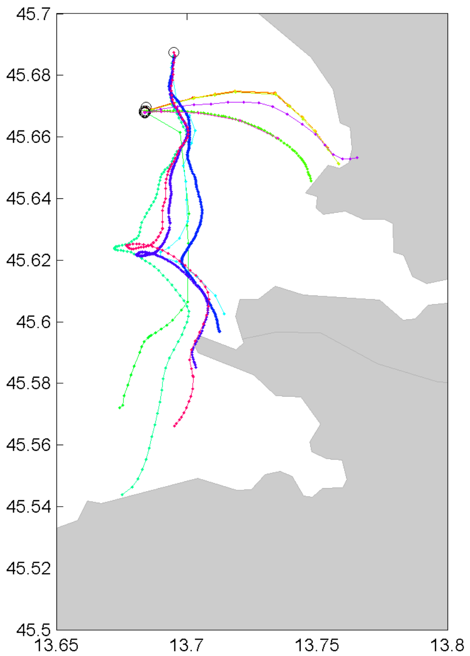

Fig. 23. Trajectories of all the drifters deployed during the third day.

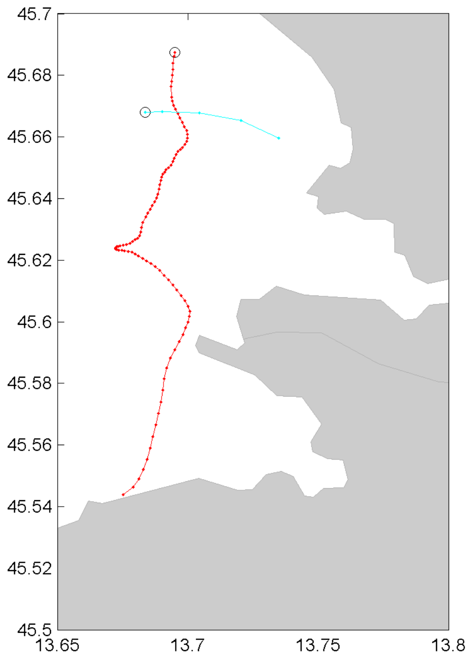

Fig. 24. Same as Fig. 23, but for the GPS CODE drifters.

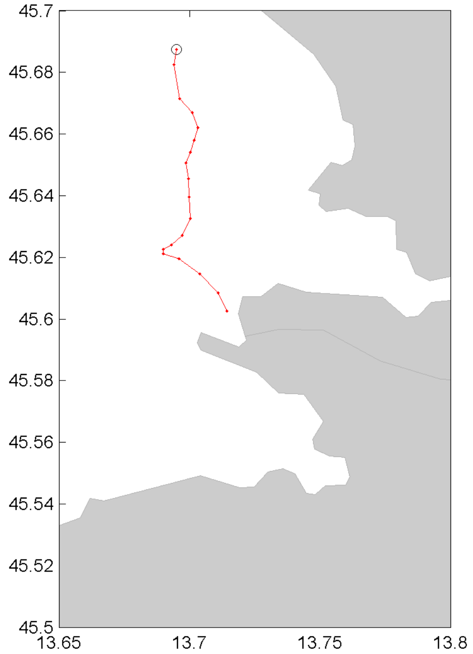

Fig. 25. Same as Fig. 23, but for the Metocean CODE drifter.

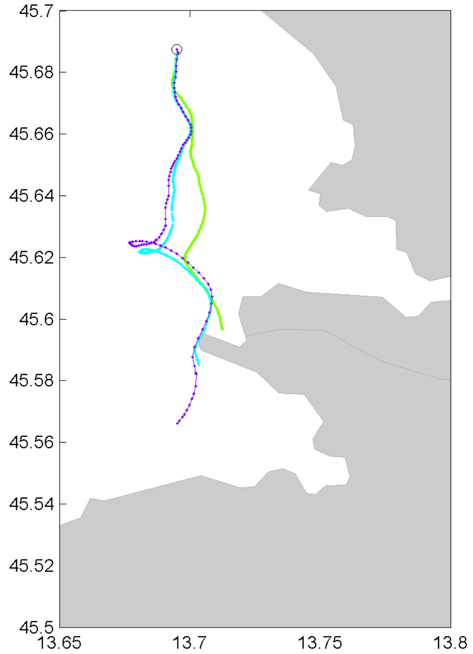

Fig. 26. Same as Fig. 23, but for the CODE drifters modified by OGS.

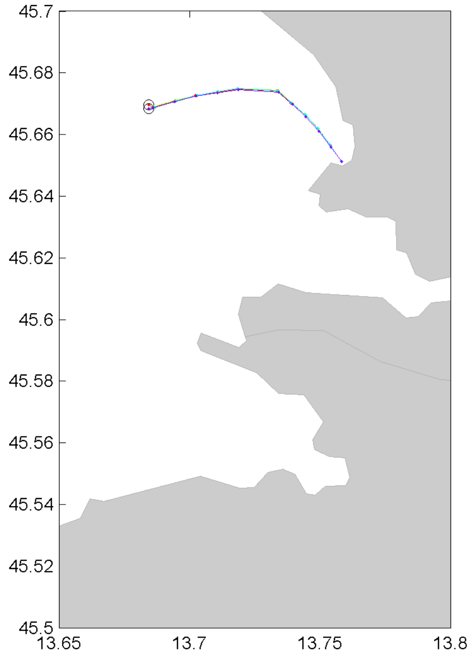

Fig. 27. Same as Fig. 23, but for the 4 I-sphere drifters.

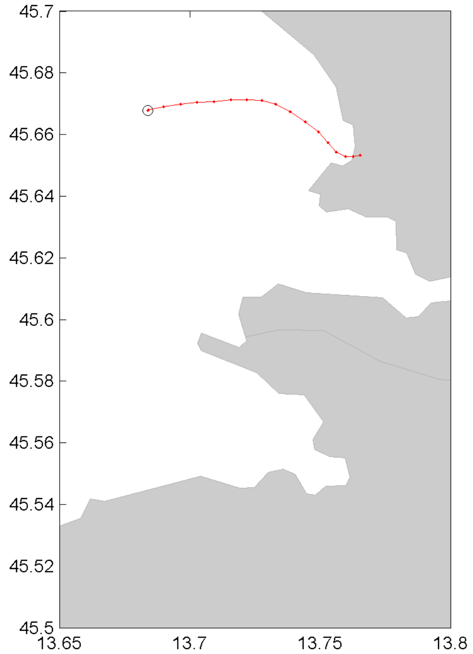

Fig. 28. Same as Fig. 23, but for the ICM prototype drifter.

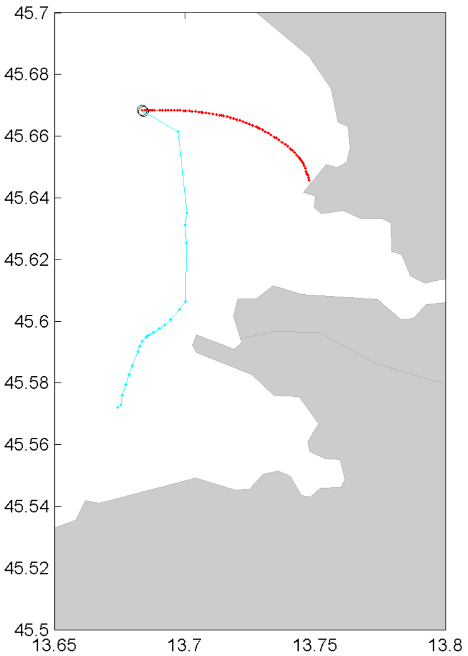

Fig. 29. Trajectories of the two prototype CODE drifters equipped with the ADCPs deployed during the third day.

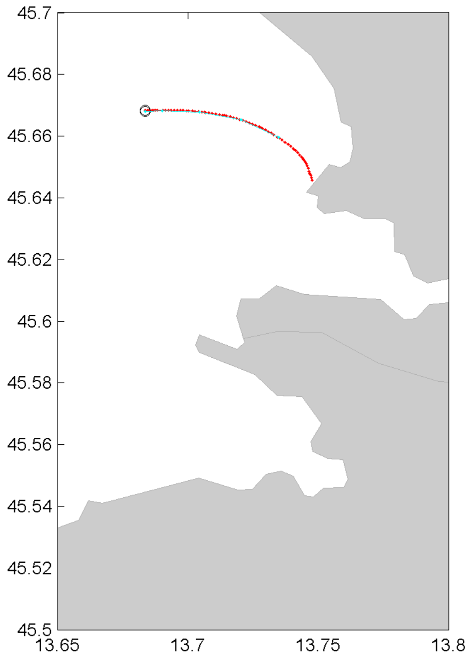

Fig. 30. Comparison of the trajectories of the OGS prototype CODE drifter equipped with the ADCP and of one CODE GPS drifter deployed at the same location.

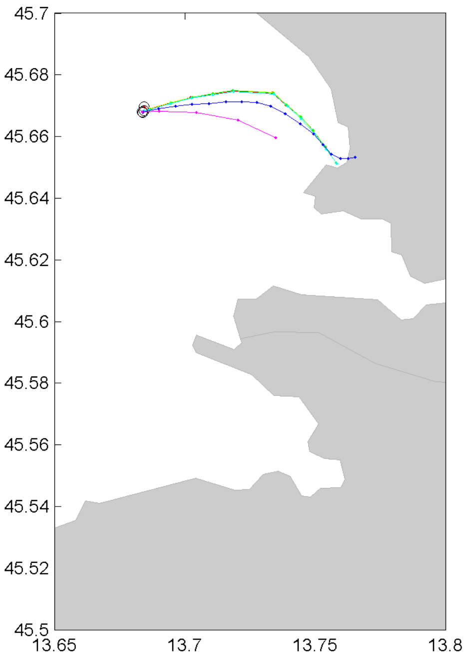

Fig. 31. Trajectories of all the drifters deployed for the first dispersion experiment (3rd day).

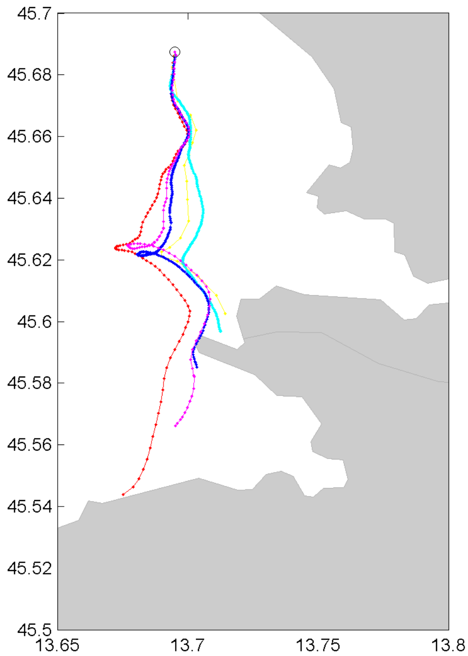

Fig. 32. Trajectories of all the drifters deployed for the 2nd dispersion experiment (3rd day).

4.4. Thursday 26/04/2012

During the fourth day of the experiment, we recovered several drifters in the morning and the early afternoon (Table 5). In late afternoon a new dispersion experiment was carried out deploying all the functioning recovered drifters about one mile from Miramare (Table 6).

drifter type	drifter id	drifter file name	recovery time (GMT)	information
CODE DBI		a300234010874510	26/04/2012 morning	Near Isola beach
CODE-Elcon	?	?	26/04/2012 morning	At Barcola rubber boat club
Prot-ICM	Tosca5	bTosca5	26/04/2012 12:50	At Porto Nuovo
Isphere	ISPHERE	?	26/04/2012 early afternoon	in Sacchetta Marina
CODE-Elcon	?	?	26/04/2012 13:50	Near Ferriera/SIOT
CODE - Metocean	Metocean 1	b300234011759700	26/04/2012 14:25	in the Lazzaretto mussels culture
CODE-OGS	SN00004	b393356699978	26/04/2012 14:30	in the Lazzaretto mussels culture
CODE-ADCP	Vas 12 - ADCP	a939335218340	26/04/2012 14:50	In the Gulf of Koper
CODE-OGS	SN00013	b9393356695106	26/04/2012 15:32	In the Gulf of Koper
CODE-OGS	SN00008	b393356388212	26/04/2012 15:50	in the Lazzaretto mussels culture

Table 5. Drifter recovery information of the fourth day (26 April 2012).

drifter type	drifter id	drifter file name	depl lat	depl lon	depl time (GMT)
CODE DBI		b300234010874510	45.575	13.594	26/04/2012 10:50
SVP-OGS	SN00004	c393356699978	45.687	13.695	26/04/2012 16:49
SVP-OGS	SN00013	c9393356695106	45.687	13.695	26/04/2012 16:49
Code - Metocean	Metocean 1	c300234011759700	45.687	13.695	26/04/2012 16:50
Isphere	ISPHERE	b300034012578040	45.687	13.695	26/04/2012 16:51
Isphere	ISPHERE	b300034012659810	45.687	13.695	26/04/2012 16:51
Isphere	ISPHERE	b300034012489470	45.687	13.695	26/04/2012 16:52
Isphere	ISPHERE	b300034012480560	45.687	13.695	26/04/2012 16:52
Prot-ICM	Tosca5	cTosca5	45.687	13.695	26/04/2012 16:53

Table 6. Drifter deployment information of the fourth day (26 April 2012).

The trajectories of the drifter deployed during the fourth day can be seen in Figs. 33 to 39.

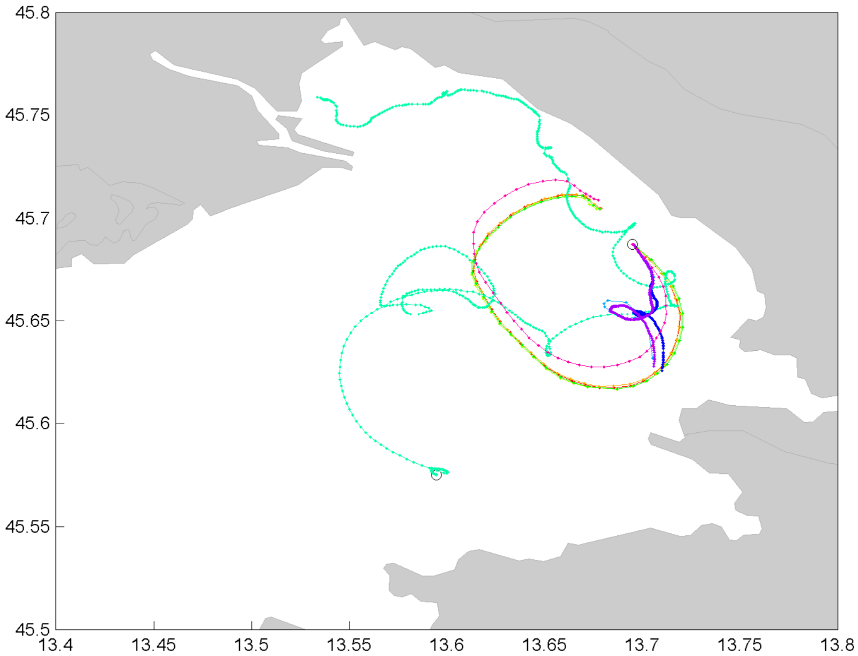

Fig. 33. Trajectories of all the drifters deployed during the fourth day. Circle symbols denote deployment locations.

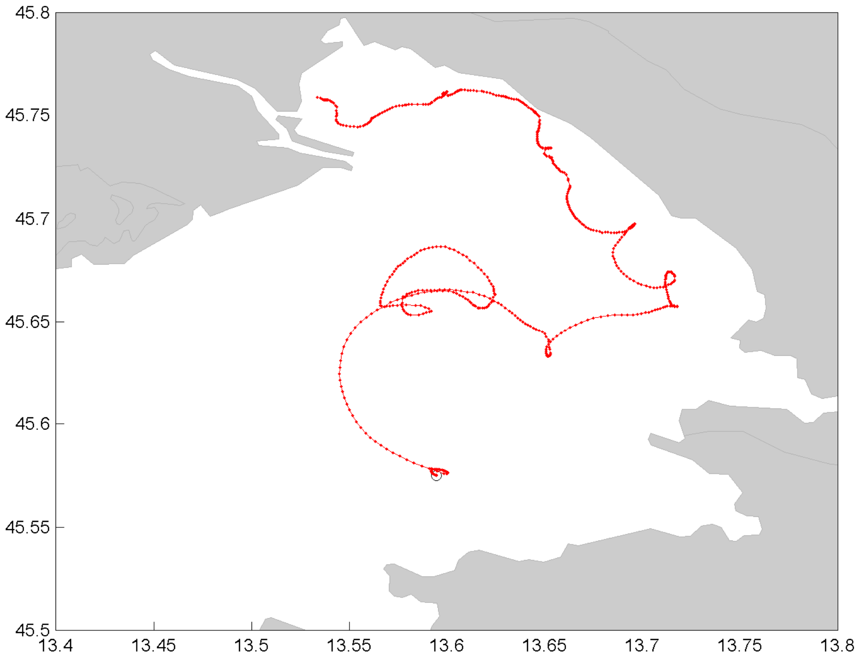

Fig. 34. Same as Fig. 33, but for the GPS CODE drifter.

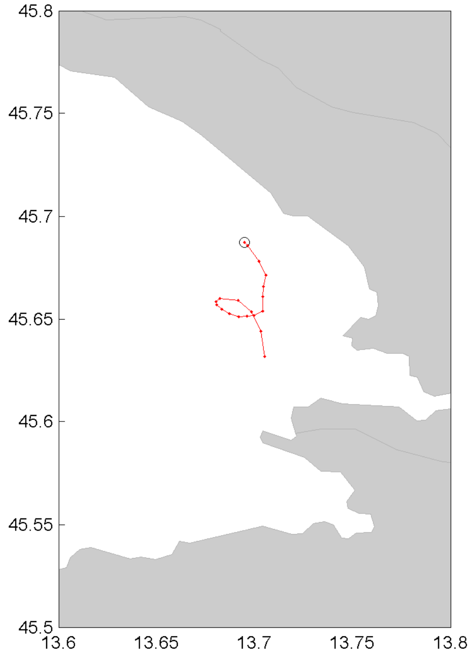

Fig. 35. Same as Fig. 33, but for the Metocean CODE drifter.

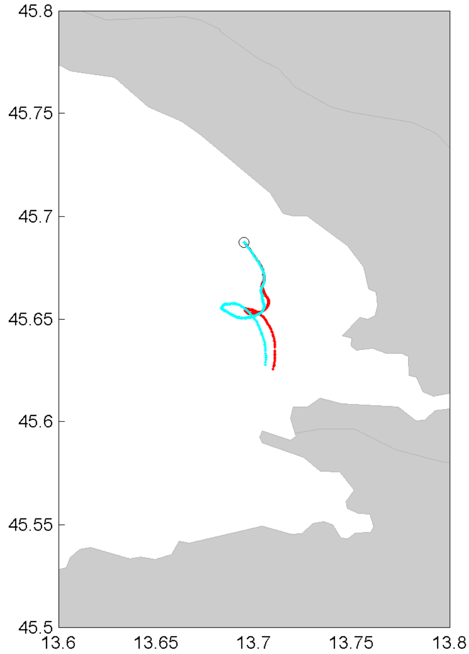

Fig. 36. Same as Fig. 33, but for the CODE drifters modified by OGS.

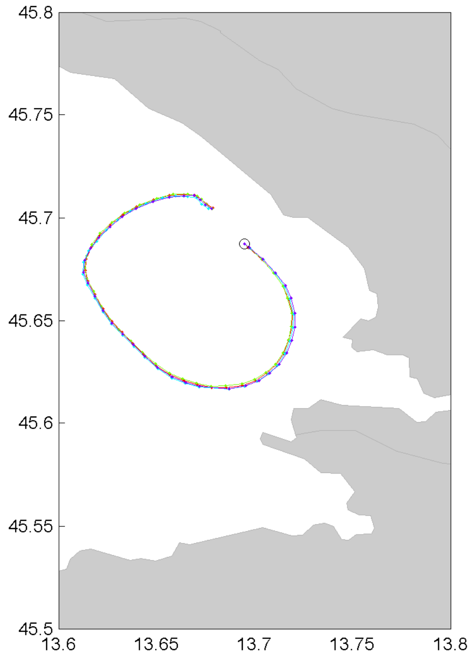

Fig. 37. Same as Fig. 33, but for the 4 I-sphere drifters.

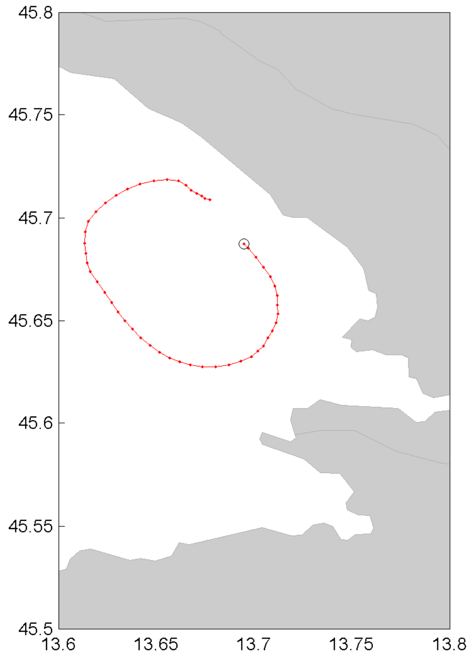

Fig. 38. Same as Fig. 33, but for the ICM prototype drifter.

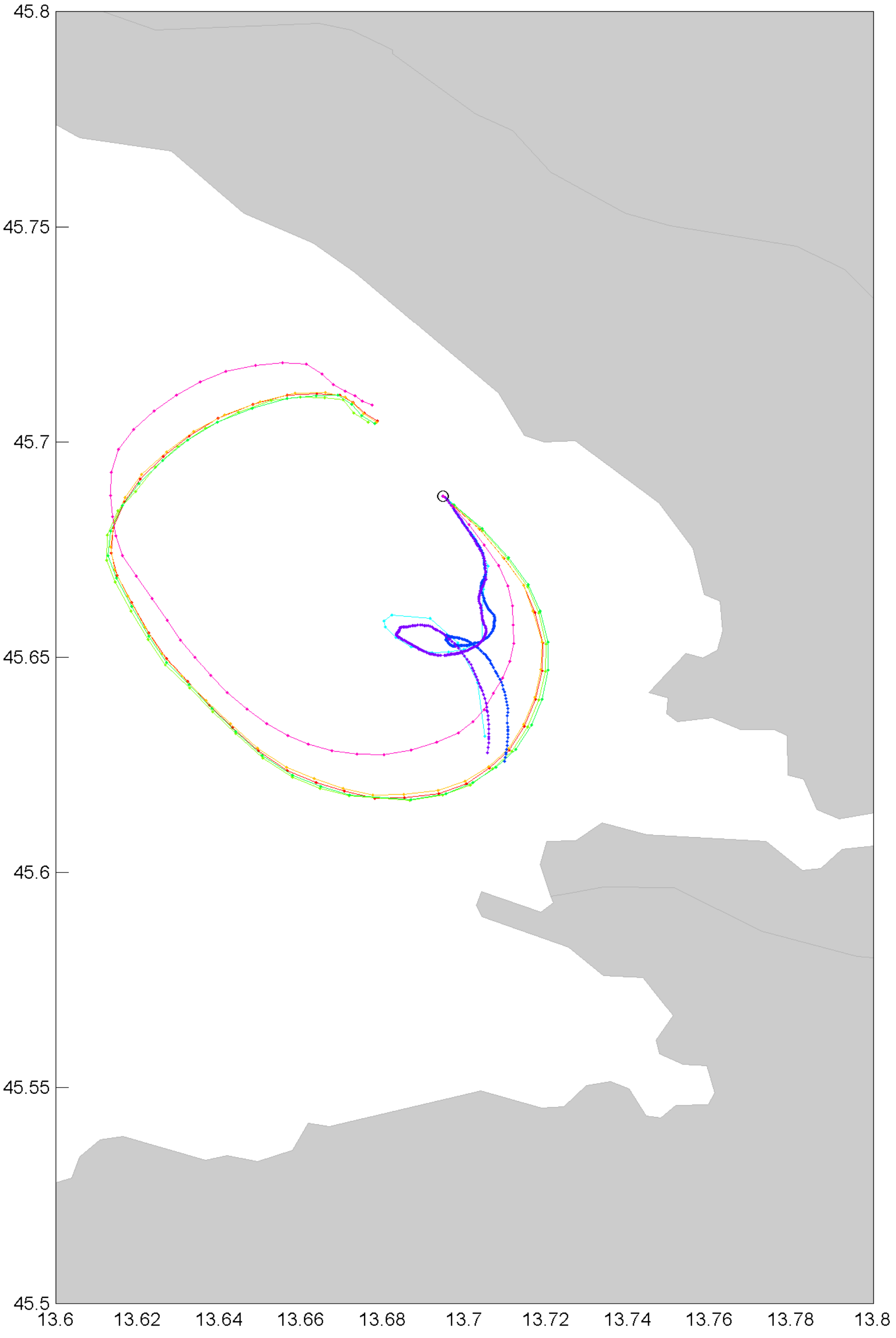

Fig. 39. Trajectories of all the drifters deployed for the dispersion experiment during the fourth day.

4.5. Friday 27/04/2012

During this day we recovered the majority of the remaining drifters at sea (Table 7).

drifter type	drifter id	drifter file name	recovery time (GMT)	information
CODE Technocean		c300034013313360	27/04/2012 9:53	
SVP-OGS	SN00004	c393356699978	27/04/2012 12:10	
SVP-OGS	SN00013	c9393356695106	27/04/2012 12:15	
Code - Metocean	Metocean 1	c300234011759700	27/04/2012 12:17	
Isphere	ISPHERE	b300034012578040	27/04/2012 12:39	
Isphere	ISPHERE	b300034012659810	27/04/2012 12:40	
Isphere	ISPHERE	b300034012489470	27/04/2012 12:41	
Isphere	ISPHERE	b300034012480560	27/04/2012 12:42	
Prot-ICM	Tosca5	cTosca5	27/04/2012 12:44	
Prot-ICM	Tosca4	aTosca4	27/04/2012 12:10	On beach near Hotel Europa

Table 7. Drifter recovery information of the fifth day (27 April 2012).

4.6. Other days

On the following days, other drifters were recovered (Table 8).

drifter type	drifter id	drifter file name	recovery time (GMT)	information
CODE DBI		b300234010470090	28/04/2012	Nearby Isola
CODE-ADCP	SN00014	a9393290608548	30/04/2012	near Riva Traiana Terminal
CODE-Elcon	00000FE6	a393356891535	02/05/2012	on La Caravella beach
CODE - Metocean	Metocean 2	a300234011756720	04/05/2012	on Grado Pineta beach
CODE DBI		b300234010874510	04/05/2012	On Punta Barene (Staranzano)
CODE-Elcon	?	?	?	Recovered by police scuba divers
CODE-OGS	SN00006	a393356498840	?	Koper
CODE DBI		a300234010755110	?	by Capitaneria di Porto of Cervia
CODE-Elcon	?	?	?	On Banco d'Orio (Grado)
CODE-OGS	?	?	?	?

Table 8. Drifter recovery information of other days.

5. Remarks

Some drifters had problems in the data communication. Their trajectories were splitted in two pieces. The first part was included in the previous chapter, while the second part (considered as a new drifter deploy) was not described in chapter 4 as the deployment of the splitted drifters is not referable to a particular day of experiment.

The splitted drifter are reported in Table 9 and their trajectories are represented in Fig. 40.

drifter type	drifter id	drifter file name	"depl." lat	"depl." lon	"depl." time (GMT)
CODE-OGS	SN00012	b393356496545	45.6242	13.7196	24/04/2012 14:30
CODE-Elcon	00000FEE	b393356966674	45.7691	13.6176	24/04/2012 14:30
CODE DBI		b300234010755110	45.6871	13.6941	28/04/2012 00:17
CODE-OGS	SN00012	d393356496545	45.6405	13.4027	29/04/2012 18:30

Table 9. Splitted drifter information.

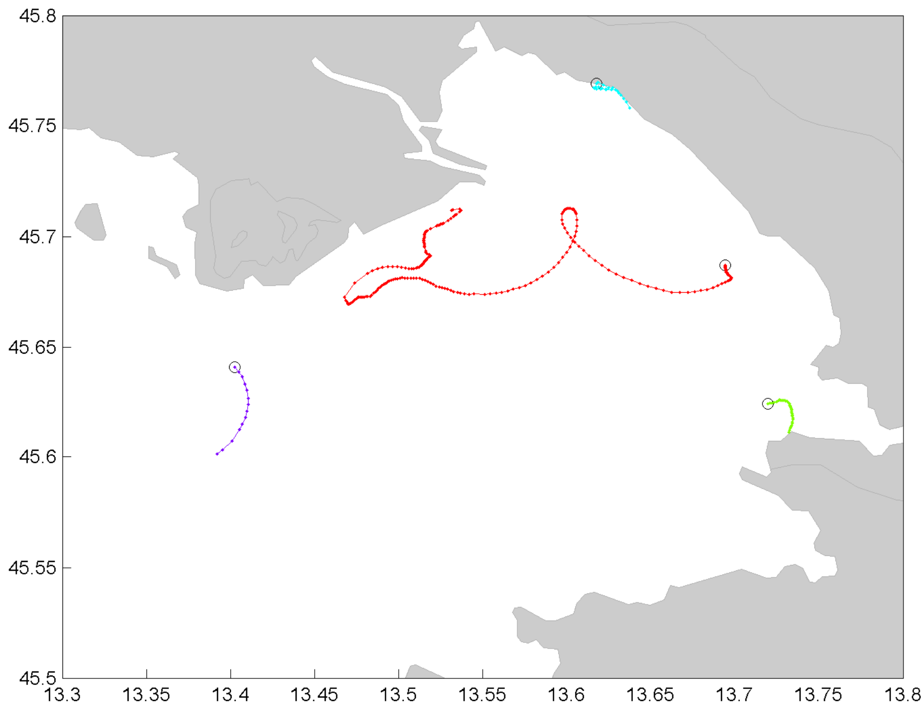

Fig. 40. Trajectories of the splitted drifters.

6. Problems and preliminary results

As reported in Table 10, Elcon drifters had a lot of failures mainly due to leakage from the antennas (Gerin et al., 2012) and 8 units were lost at sea. It seems that some drifters had a frozen GPS position for some days. In the case of some CODE drifters modified by OGS we retrieved the data and integrated them in the files thanks to the fact that the data were also stored inside the units and only the transmissions were affected by the problem. Some other drifters were simply splitted in two (see chapter 5). Three UAEGEAN CODE drifters were also lost at sea probably because of a bad buoyancy or the slide of the central structure with respect to the 4 arms with the floating discs. This fact caused the transmission module to go underwater and the impossibility to transmit the data on land. Some other drifters (one Technocean CODE drifter and the Albatros drifters) were intentionally not deployed due to transmission or setting problems. The Oil spill drifters were both lost at sea probably because of the nearly instant consumption of the battery. Finally the CODE drifter modified by OGS and equipped with the ADCP and current meter was lost under an industrial pier for about 5 days. Fortunately it came out from under the pier and transmit its position before the end of the battery.

Type	Problems
CODE-Elcon	Buoyancy, transmissions -> loss of 9 units out of 15
CODE-DBI	Frozen GPS positions at the end -> loss of 1 unit
OGS CODE-ADCP	Loss under industrial pier for 5 days, recovered on 30/4
CODE-OGS	Loss of transmissions due to bad GSM roaming near Slovenia? Loss of 1 unit due to unknown reason
CODE-Technocean	No transmission for 1 unit -> not deployed
CODE-UAEGEAN	Buoyancy? -> loss of all 3 units
UAEGEAN CODE-ADCP	Loss of some positions due to transmission problems
OILSPILL	Tranmission/battery -> loss of all 2 units
ALBATROS	Transmission/setting test problems -> not deployed

Table 10. Drifter failures and problems.

The 41 drifters used were physically deployed (excluding the splitted drifters) 57 times. The life of the drifters in the Gulf of Trieste is very short. Even though we performed additional deployments after the first day of experiment, the number of observations (i.e. the transmission received at OGS + the data stored inside the drifter) decreases almost exponentially during the experiment (Fig. 41).

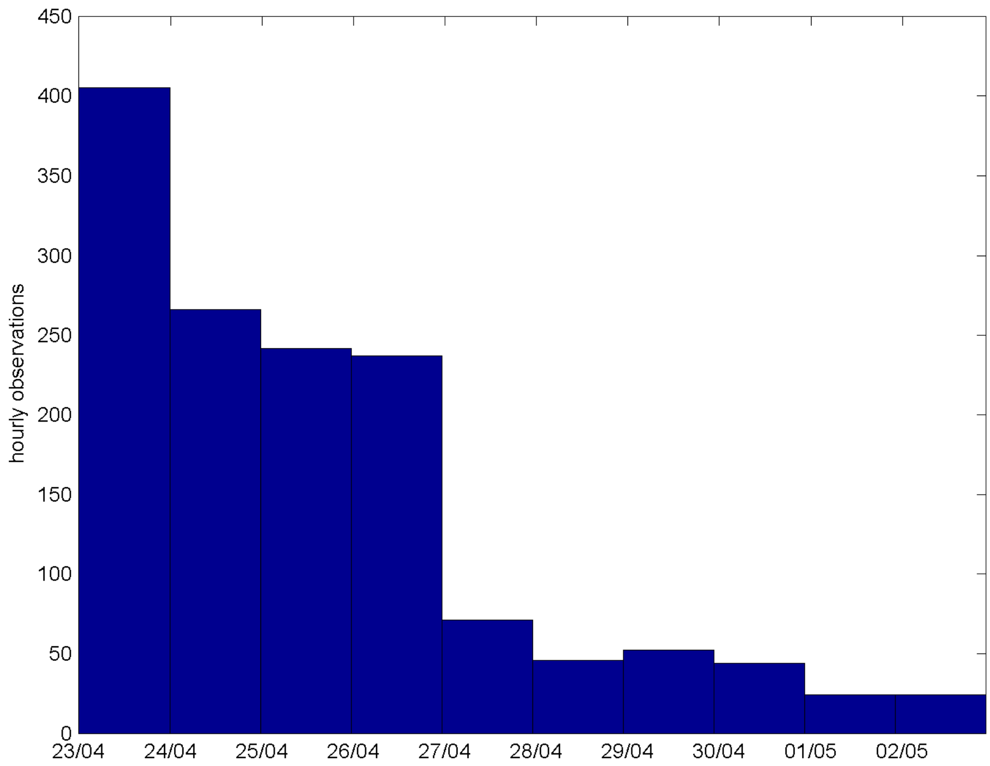

Fig. 41. Number of hourly drifter observations during the experiment.

The edited drifter data can be found on http://doga.ogs.trieste.it/sire/drifter/database/TOSCA/data/. Fig. 42 shows the trajectories of the drifters during all the experiment period (edited data).

The winds during the period of the experiment were breezes except for about 1.5 day of moderate Scirocco starting from the afternoon of the first day (wind intensity and direction can be seen at http://nettuno.ogs.trieste.it/mambo/jungo/DIAGR/1204_MAMBO.pdf and http://nettuno.ogs.trieste.it/mambo/jungo/DIAGR/1205_MAMBO.pdf). The preliminary results show a general surface circulation that seems reversed with respect to the "normal" circulation of the Gulf of Trieste. Drifters were expected to exit the Gulf of Trieste near Grado, but rather they remain mainly inside the Gulf and moved southeastward. One of the possible cause of this reversal was the Isonzo plume that invaded a large area of the Gulf of Trieste for several days.

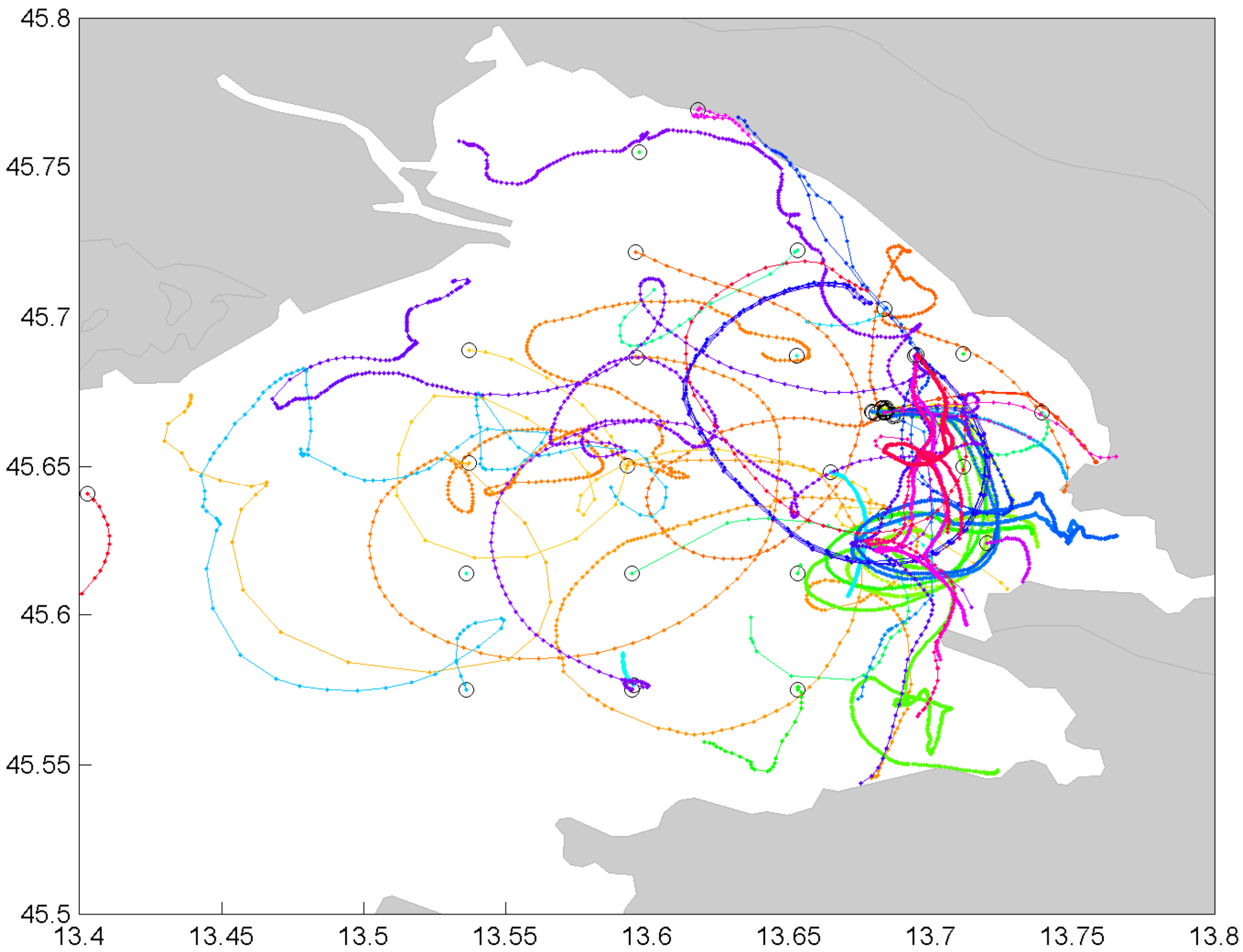

Fig. 42. Trajectories of the drifters during the experiment period, Circles indicate the deployment locations.

The dispersion experiments display a coherent motion of all the similar drifters.

In particular, all the drifters deployed the first day (Fig. 21) moved together and describe an anticyclonic loop. The CODE/CODE-like drifters (Figs. 17 and 20) describe a loop centered in 45.62°N and 13.69°E and then proceeded southward, while the more superficial drifters (Oil Spill drifters and ICM prototypes, Figs. 18 and 19, respectively) closed the loop more to the north and then moved northwestward toward Sistiana.

During the third day, two dispersion experiment were carried out (launches: one in the morning and one in the evening, Figs. 31 and 32). The drifters deployed during the morning moved eastward (Fig. 31). The I-sphere drifters remaining together and went inside the Sacchetta Marina (Fig. 27). The ICM prototype moved very close to them (Fig. 28). In this occasion we deployed also the two drifters with the ADCPs and one CODE. The two ADCP drifters separated nearly immediately after the deployment (Fig. 29). They were substantially different since one was centered at a nominal depth of 50-60 cm and the other one at about 2 m (OGS and UAEGEAN ADCPs drifters, respectively). The OGS ADCP drifter moved as the CODE drifter deployed in the same location nearly contemporaneously (Fig. 30). The drifters deployed during the evening were all CODE type drifters and moved southward (Figs. 25, 26 and 32).

The fourth day, the behaviour of the CODE drifters deployed within the dispersion experiment (Figs. 35, 36 and 39) was very similar to the one displayed the day before by other CODE drifters, while the I-sphere and the ICM prototype moved together (particularly the I-sphere drifters, Figs. 37, 38 and 39) in a anticyclonic loop.

Finally, the CODE drifters with the GSM telemetry allow us to produce a map of the received signal strength indicator (RSSI: 0=low; 100=high, Fig. 43) and of the regional roaming (Fig. 44) in the Gulf of Trieste.

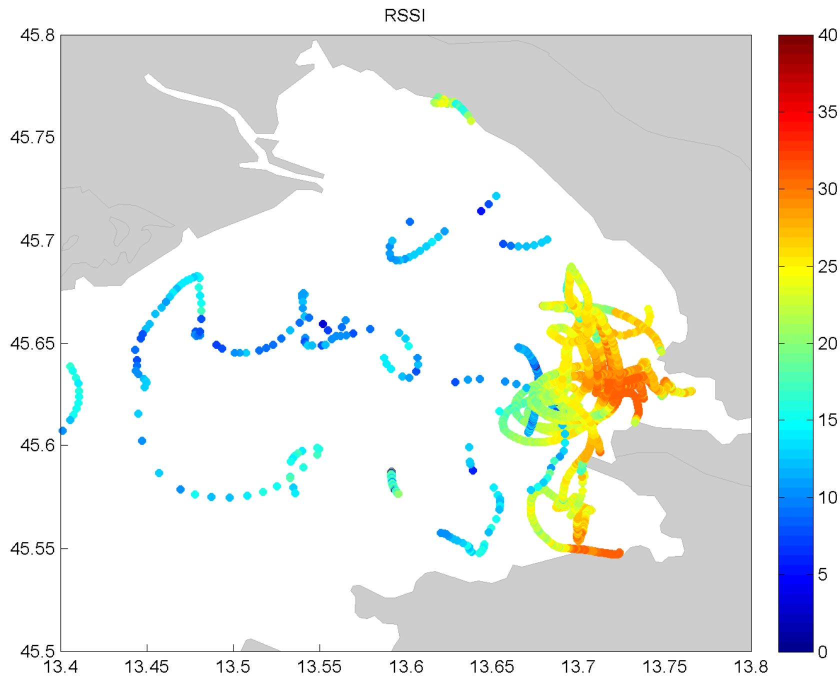

Fig. 43. Received signal strength indicator from the CODE drifters with GSM telemetry during the experiment in the Gulf of Trieste.

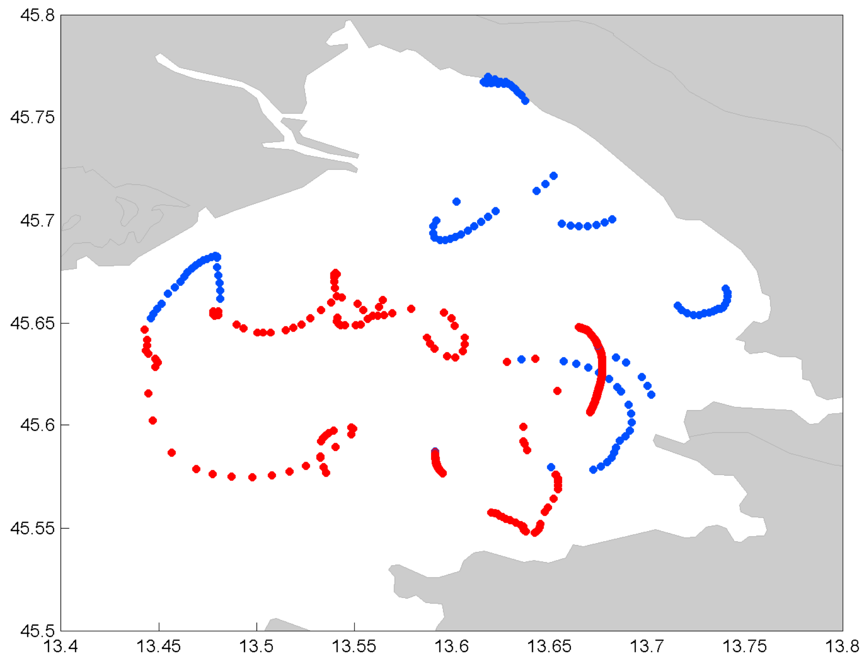

Fig. 44. Regional roaming from the CODE drifters with GSM telemetry during the experiment in the Gulf of Trieste (blue dots = Italian provider; red dots = foreign provider).

7. Acknowledges

The authors would like to thank the colleagues and all the people involved in the TOSCA experiment in the Gulf of Trieste, in particular: Riccardo Jungwirth, Diego Cotterle, Enrico Vinzi, Saul Ciriaco, the staff of Sistiana beach and Sistiana pit and the SIOT staff.

8. References

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