



ISTITUTO NAZIONALE
di Oceanografia e di Geofisica Sperimentale



DOLCEVITA-1 CRUISE

31 January – 24 February 2003

REPORT OF DRIFTER-RELATED ACTIVITIES

by

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1. Introduction

As part of the ONR-sponsored DOLCEVITA project, releases of drifters were conducted in the northern Adriatic during the DOLCEVITA-1 cruise onboard R/V Knorr between 31 January and 24 February 2003. The drifter measurements were concentrated in selected mesoscale circulation features and were made in concert with towed vehicle, hydrographic, optical and turbulence measurements. This report contains a brief description of the drifter systems used, details about their deployments and recoveries, and a preliminary description and interpretation of the drifter results.

2. Instruments and Methods

2.1 Drifter Systems

Various drifter types were used during the cruise. They include:

- 1) CODE and CODE-GPS (Figure 1) surface drifters manufactured by Technocean, Cape Coral, FL, USA. which provide surface currents and sea surface temperature (SST). The GPS upgrade on some of the drifters allows positioning at hourly intervals.
- 2) SVP surface drifters (Figure 2) with a holey-sock drogue centered at 50-m nominal depth manufactured by Clearwater, Watertown, MA, USA. These instruments provide currents at 50 m and SST. For operations in shallow waters, the tether was reduced to center the drogue at 30-m depth. They are equipped with GPS receivers that sample position every half hour.
- 3) MINIMET (WOTAN) surface drifters with a holey-sock drogue centered at 15-m nominal depth manufactured by Pacific Gyre, Carlsbad, CA, USA. These drifters measure near-surface mixed-layer currents, SST, wind speed and direction.
- 4) SVP/OCM surface drifters (Figure 3) with a drogue centered at 15-m depth produced by Metocean Data Systems Limited, Dartmouth, Nova Scotia, Canada. These drifters measure near-surface currents, SST, upwelling radiance and downwelling irradiance at visible wavelengths. They also have GPS positioning at half-hour intervals.
- 5) CODE/Tz surface drifters (Figure 4) with a thermistor chain manufactured by Metocean. They have 10 thermistors to measure the water temperature at 5, 10, 15, 20, 25, 30, 35, 40, 45, 50 m. They also measure surface currents and SST. GPS fixes are sampled every half hour. For the applications in shallow water, the chain length was reduced to 30 m.

- 6) CMOD (XAN-3) surface drifters (Figure 5) with a thermistor chain manufactured by Metocean. In addition to the temperatures at various depths (2.5, 7.5, 10, 12.5, 17.5, 20, 25, 32.5, 40, and 50 m), these instruments measure surface currents, SST and surface air pressure and temperature. For the applications in shallow water, the chain length was reduced to 30 m.
- 7) Prototype CODE drifter equipped with two Nortek Aquadopp velocimeters, GPS receiver and an Argos transmitter (Figure 6). This instrument is mainly used to measure the shear of horizontal currents below the air-sea interface. It is also used to assess the water-following capabilities of CODE drifters by making direct observations of slippage under various wind and wave conditions.

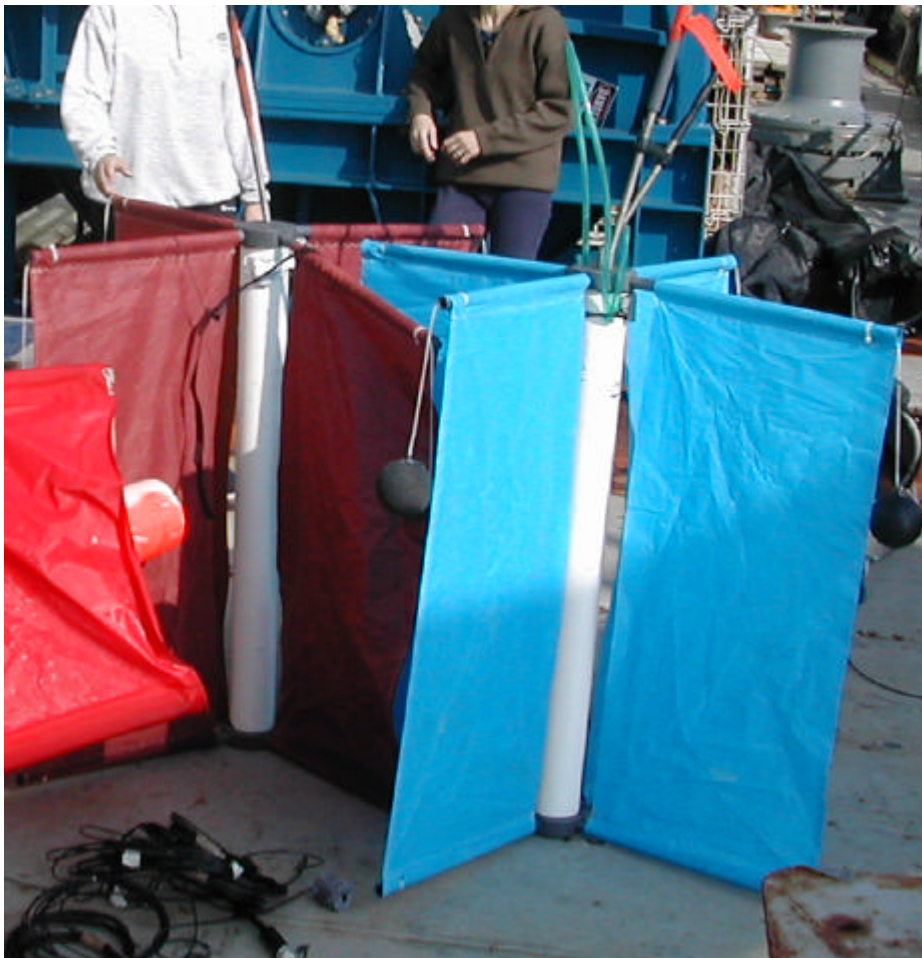


Figure 1. CODE (left) and CODE-GPS (right) drifters.



Figure 2. SVP drifter with holey-sock drogue, intermediate float (lower right) and surface ball (left).



Figure 3. SVP/OCM drifter with sock drogue. The irradiance meter can be seen on the top of the red surface ball.

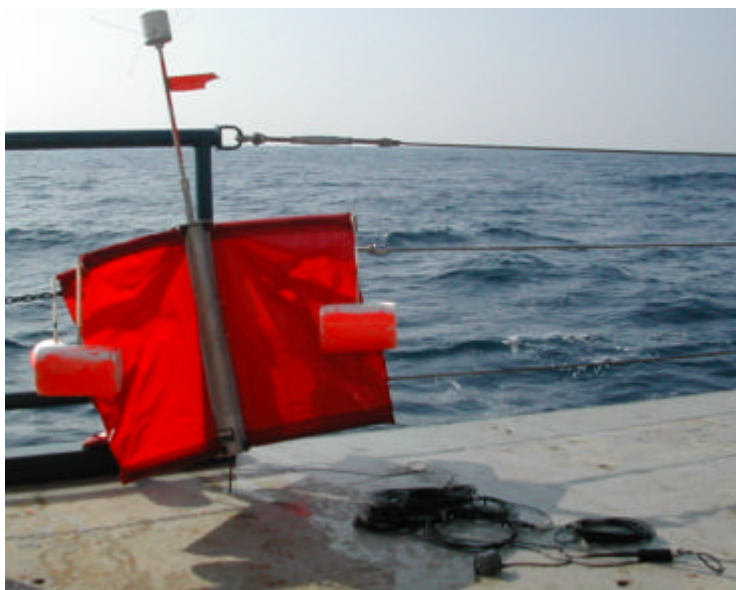


Figure 4. CODE/Tz drifter with thermistor chain.



Figure 5. CMOD (XAN-3) drifter with thermistor chain.



Figure 6. Prototype CODE drifter with two Nortek Aquadopp velocimeters, and the GPS and Argos antennas.

2.2 Drifter Deployment and Recovery Operations

The drifters were generally deployed at the beginning of the small-scale surveys conducted with the Trisoarus towed vehicle. These small-scale surveys were carried out in four areas of the northern and middle Adriatic: the Mid Adriatic Filament (MAF, or the northeastern part of the Mid Adriatic Pit), the North Adriatic Filament (NAF), the Western Adriatic Current (WAC) off Rimini-Pesaro and the Po Plume (Figure 7).

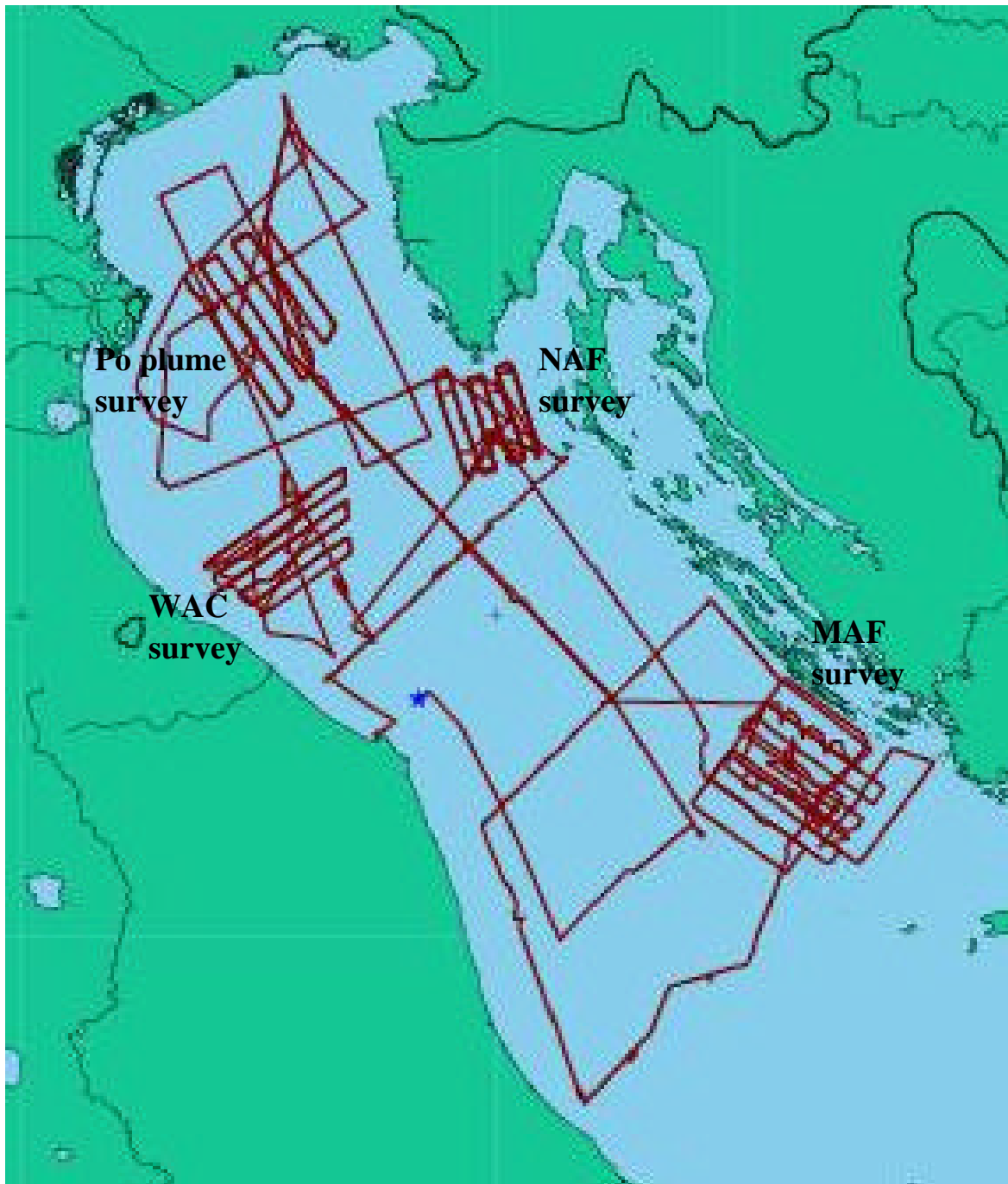


Figure 7. Ship track of R/V Knorr during the DOLCEVITA-1 cruise in the northern and middle Adriatic. The small-scale surveys are shown

They were either released before the towed vehicle was put in the water or during the first leg of the survey. All drifters were deployed upstream of the mesoscale features sampled so that they stayed in the vicinity of the towed vehicle. In this way the vehicle, shipboard ADCP and drifter data were all concentrated on the same features. CODE drifters in their cardboard boxes were deployed from the starboard side of the ship while the ship was steaming at ~6 knots and towing the vehicle. All the other drifters with drogues or thermistor chains were deployed from the stern at ship speeds varying in 1-2 knots (Figure 8). These deployments were performed with the Trisoarus vehicle on deck or in the water close to the ship.

Some drifters were recovered after the vehicle had performed once or many times the full small-scale survey. The drifter data were downloaded from the Argos telnet data distribution system using cellular and Inmarsat telephony at least on a daily basis. These provided information on the drifter location with a few hours delay. Once the ship was in the vicinity of the drifters (1-2 nm), the IESM direction finder mounted near the ship's bridge provided us with up-to-date GPS locations for the drifters equipped with GPS receivers. For the other drifters, range and direction information was used to locate them. All drifters recovered were taken out of the water using grapnels and hooks on the starboard side of the ship (Figure 9).



Figure 8. Deploying an optical drifter (SVP/OCM) from the stern.

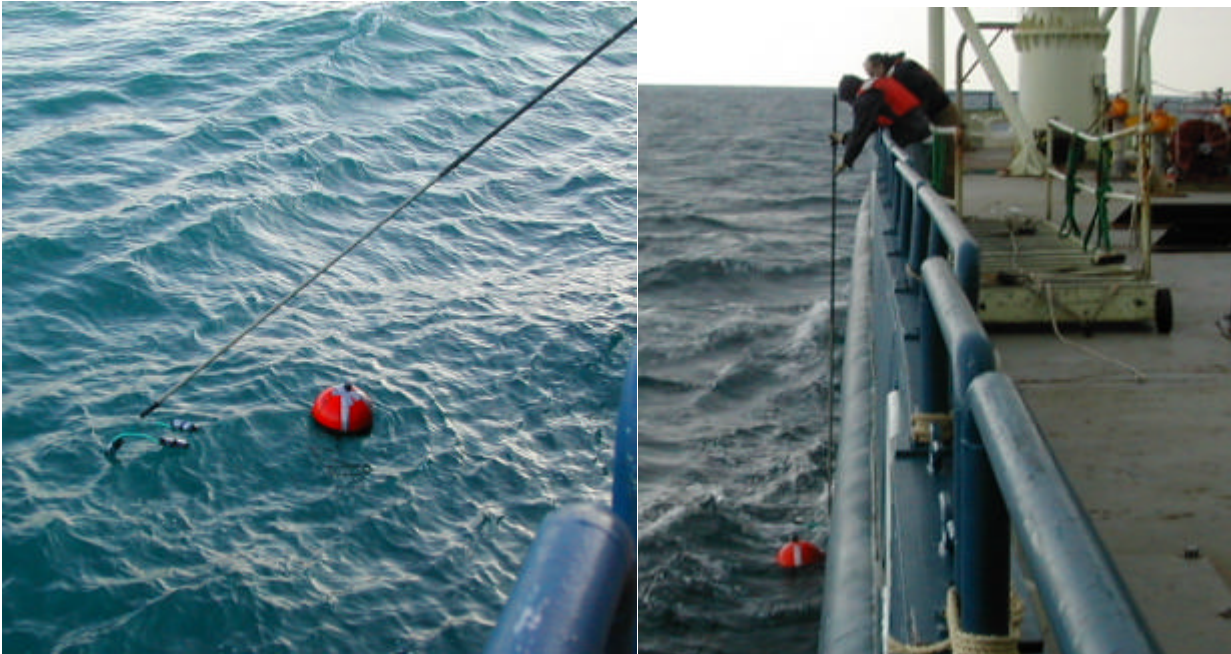


Figure 9. Recovery of a SVP/OCM drifter.

2.3 Details about Drifter Deployment and Recoveries

Three regular CODE drifters were deployed off the Istrian Peninsula during the initial basin-wide survey on 2 February 2003. The deployment locations were close to the ones where drifters were deployed in fall 2002 during the ADRIA02 cruise. The deployment coordinates are listed in Table 1.

DOLCEVITA_1-NA Deployments			Deployment				
Number	Type	Status	On	GMT time	Lat	Lon	SST
37740	Technocean CODE	new	1-Feb	2/2/2003 2:50	44 43.8	13 47.9	10.5
37741	Technocean CODE	new	1-Feb	2/2/2003 4:22	44 42.03	13 41.36	10.47
37742	Technocean CODE	new	1-Feb	2/2/2003 8:31	44 40.09	13 35.51	10.4

Table 1. Deployment information for the drifters deployed off Istria.

A total of 13 drifters were deployed during the mesoscale survey on the northeastern flank of the MAP (or Jabuka Pit) on 7 February 2003 to survey the MAF. Seven drifters were successfully recovered on 8 February after having spent about 36 hours in the water. Upon recovery, we noted that one of the CODE-GPS drifter deployed with its carton box had a sail still folded on the main tubular body. Unfortunately, the Argos transmitter on the prototype drifter with the acoustic velocimeters failed to operate. We searched in the vicinity of the CODE-GPS drifters launched with the prototype drifter on 8 February afternoon and on the next morning without success. The deployment and recovery details for all the drifters deployed near the MAP are listed in Tables 2 and 3.

DOLCEVITA_1 – JABUKA DEPLOYMENTS

Number	Type	Status	On	GMT time	Lat	Lon	SST	SSS
34882	Technocean CODE-GPS	old	6-Feb	7/2/2003 2:26	43 38.1275	15 18.5529	13.921	38.623
35498	Technocean CODE-GPS	old	6-Feb	7/2/2003 2:26	43 38.1275	15 18.5529	13.921	38.623
P1	CODE+Aquadopp Nortek		6-Feb	7/2/2003 2 :25	43 38.1130	15 18.542	13.921	38.62
37686	Technocean CODE-GPS	new	6-Feb	7/2/2003 0:10	43 44.4496	15 11.0778	13.812	
37688	Technocean CODE-GPS	new	6-Feb	7/2/2003 1:33	43 40.5642	15 16.6947	13.581	38.63
37689	Technocean CODE-GPS	new	6-Feb	7/2/2003 3:05	43 37.6120	15 22.378	14.196	38.669
37690	Technocean CODE-GPS	new	6-Feb	7/2/2003 4:28	43 34.7734	15 27.9113	14.268	38.781
29361	WOTAN (Minimet)	new	6-Feb	7/2/2003 2:02	43 37.1681	15 17.5373	13.83	38.66
3999	Clearwater SVP 50 m	new	6-Feb	7/2/2003 1:12	43 42.0098	15 13.9494	13.765	38.694
4001	Clearwater SVP 50 m	new	6-Feb	7/2/2003 2:44	43 38.1001	15 19.5423	14.183	38.69
4002	Clearwater SVP 50 m	new	6-Feb	7/2/2003 3:58	43 36.1825	15 25.0442	14.27	38.788
33355	Metocean SVP/OCM	new	6-Feb	7/2/2003 0:44	43 44.0681	15 11.9005	14.017	38.712
33356	Metocean SVP/OCM	new	6-Feb	7/2/2003 3:30	43 34.3331	15 23.1448	14.249	38.718

Table 2. Deployment information for the drifters deployed near Jabuka Pit.

DOLCEVITA_1 – JABUKA RECOVERIES

Number	GMT time	Lat	Lon
34882	11/2/2003 06:50	43 35.2082	14 52.0229
35498	8/2/2003 13:11	43 32.5764	15 14.0978
37686	8/2/2003 15:13	43 35.0164	15 15.5278
37688	8/2/2003 16:51	43 30.8974	15 14.4145
3999	8/2/2003 16:03	43 34.3854	15 14.5804
33355	8/2/2003 14:09	43 34.6356	15 13.2065
33356	8/2/2003 15:40	43 36.6399	15 14.91

Table 3. Recovery information for the drifters deployed near Jabuka Pit.

Twelve drifters were released off the southern tip of the Istrian Peninsula (off Pula) as part of the mesoscale survey to sample the NAF during and after a strong Bora event. They were released on 11 February 2003 and some of them were retrieved on 15 February 2003 after about 4 days in the water. Since the local bathymetry varied near 40 m, the CMOD XAN-3 and the CODE\Tz thermistor chains were reduced to a length of 30 m. Likewise the tether of the SVP drifters were shorten to center the drogue at about 30-m depth. Deployment and recovery details are listed in Tables 4 and 5.

DOLCEVITA_1- PULA DEPLOYMENTS Deployment

Number	Type	Status	On	GMT time	Lat	Lon	SST	SSS
34882	Technocean CODE-GPS	old	15:32	11/2/2003 21:44	44 29.9461	14 10.7994	12.479	38.826
37686	Technocean CODE-GPS	new	15:31	11/2/2003 20:53	44 34.6880	14 08.7109	13.812	38.756
37688	Technocean CODE-GPS	new	15 :30	11/2/2003 20 :02	44 39.4191	14 06.5200	10.026	38.218
37676	Technocean CODE-GPS	new	12:41	11/2/2003 19:17	44 44.2354	14 04.2871	9.8613	38.205
29360	WOTAN (Minimet)	new		11/2/2003 20:25	44 37.0567	14 07.6346	11.805	38.763
3999	Clearwater SVP 30 m	new	15:35	11/2/2003 19:40	44 41.7934	14 05.4044	10.144	38.269
4010	Clearwater SVP 30 m	new	15:34	11/2/2003 21:19	44 32.3114	14 09.6946	12.24	38.744
33355	Metocean SVP/OCM	new	15:09	11/2/2003 17:10	44 31.5903	14 05.8641	12.3375	38.784
33356	Metocean SVP/OCM	new	15:09	11/2/2003 18:25	44 40.988	14 01.6880	11.291	38.644
33353	Metocean GPS-CODE/Tz	new	16:05	11/2/2003 17:48	44 36.2148	14 03.8053	10.487	38.487
11440	CMOD Thermistor chain	new	13:24	11/2/2003 16:30	44 29.1305	14 07.0591	12.5817	38.837
11497	CMOD Thermistor chain	new	13:30	11/2/2003 18:51	44 43.4294	14 00.6325	9.832	38.231

Table 4. Deployment information for the drifters deployed south of Pula.

DOLCEVITA_1- PULA RECOVERIES

Number	GMT time	Lat	Lon	Comments
37686	15/2/2003 14 :38	44 5.0374	13 21.3955	SST=11.098
33355	15/220/03 13:28	44 6.5793	13 18.8879	SST=10.347
33356	15/220/03 16:43	44 21.6173	13 6.9859	SST=10.440
33353	15/2/2003 11:54	43 54.8332	13 28.9677	SST=11.753

Table 5. Recovery information for the drifters deployed south of Pula.

In the next survey concentrated on the WAC in front of Rimini –Pesaro, we deployed 4 drifters along the first transect of the Trisoarus during the night of 15-16 February 2003 and two optical drifters (SVP/OCM) a day later on 17 February 2003. The two SVP/OCM were deployed near the 50 and 30-m isobaths because the drogue of these drifters extends down to about 20 m. These two drifters were recovered on 18 February after more than 36 hours in the water. Drifter 33355 was recovered in water depth less than 18 m meaning that the drogue dragged on the bottom. Significant wear of the straps connecting the top of the drogue to the tether was evident for both drifters. More information about the deployment and recoveries of these drifters are provided in Tables 6 and 7.

DOLCEVITA_1- PESARO DEPLOYMENTS Deployment

Number	Type	Status	On	GMT time	Lat	Lon	SST	SSS
37687	Technocean CODE-GPS	new	15/2/2003 17:55	15/2/2003 23:28	44 14.470	12 56.925	10.88	38.766
37686	Technocean CODE-GPS	used		15/2/2003 21 :55	44 08.417	12 46.125	8.268	37.915
37677	Technocean CODE-GPS	new	15/2/2003 21:38	16/2/2003 01:11	44 21.151	13 10.050	12.50	38.838
37678	Technocean CODE-GPS	new	15/220/03 21:35	16/2/2003 02:36	44 26.650	13 21.169	11.94	38.838
33355	Metocean SVP/OCM	new	16/220/03 21:30	17/2/2003 00:20	44 09.735	12 51.232	9.978	38.568
33356	Metocean SVP/OCM	new	16/2/2003 21:30	16/2/2003 23:17	44 13.993	12 59.995	9.943	38.451

Table 6. Deployment information for the drifters deployed near the WAC off Rimini-Pesaro.

DOLCEVITA_1- PESARO RECOVERIES

Number	GMT time	Lat	Lon	Comments
33355	18/2/2003 12.55	43 56.4191	13 2.4049	SST=9.456, SSS=38.5498
33356	18/2/2003 14.18	43 51.8010	13 19.0563	SST=10.4276, SSS=38.7144

Table 7. Recovery information for the drifters deployed near the WAC off Rimini-Pesaro.

Three CODE drifters were deployed in the Northern Adriatic near the Gulf of Trieste. The deployment locations (see Table 8) were chosen to match those where drifters were deployed during the ADRI02 cruise in fall 2002.

DOLCEVITA_1- TRIESTE DEPLOYMENTS

Number	Type	Status	On	Deployment				
				GMT time	Lat	Lon	SST	SSS
37743	Technocean CODE	new	20/2/2003 00.01	20/2/03 3.31	45 33.0487	13 6.713	8.3789	38.358
37744	Technocean CODE	new	19/2/2003 23.58	20/2/03 3.57	45 28.4962	13 9.4089	8.8354	38.4129
37745	Technocean CODE	new	19/220/03 23.59	20/2/03 4.22	45 23.7336	13 11.5059	8.5127	38.3215

Table 8. Deployment information for the drifters deployed near the Gulf of Trieste

A total of 5 drifters were deployed along the first Trisoarus leg of the Po plume small-scale survey on 20 February 2003. The drifters with optical sensors and thermistor chain were deployed in the plume of cold and low-salinity water. All drifters were deployed with the vehicle in the water which represents a significant time saving. The Trisoarus was brought closer to the ship and the ship decreased its speed to 2 knots for the deployments off the stern (drifters with drogue or thermistor chain). Three drifters were recovered on 21 February 2003 after more than 36 hours in the water. Information about the deployments and recoveries is provided in Tables 9 and 10, respectively.

DOLCEVITA_1- PO PLUME DEPLOYMENTS

Number	Type	Status	On	Deployment				
				GMT time	Lat	Lon	SST	SSS
37679	Technocean CODE-GPS	new	19/2/2003 23.57	20/2/03 9.15	44 49.1955	12 52.7659	8.1232	38.345
37681	Technocean CODE-GPS	new	19/2/2003 23.57	20/2/03 10.51	44 40.9948	13 00.5613	8.7405	38.288
33355	Metocean SVP/OCM	new	19/2/2003 23.56	20/2/03 10.17	44 44.3423	12 57.393	6.4033	36.336
33356	Metocean SVP/OCM	new	19/2/2003 23.56	20/2/03 9.50	44 45.8865	12 55.9261	6.2458	36.158
33353	Metocean GPS-CODE/Tz	new	19/2/2003 23.55	20/2/03 10.05	44 45.0259	12 56.6495	6.7792	36.946

Table 9. Deployment information for the drifters deployed during the Po Plume survey.

DOLCEVITA_1- PO PLUME RECOVERIES

Number	GMT time	Lat	Lon	Comments
33355	21/02/2003 15:57	44 50.4852	12 58.1811	SST=7.0314 SSS=37.0966
33356	21/02/2003 15:14	44 46.865	12 57.9953	SST=7.0689 SSS=36.7911
33353	21/02/2003 15:35	44 48.5536	12 56.7142	SST=7.4863 SSS=37.7824

Table 10. Recovery details for the three drifters recovered during the Po Plume survey.

On the last day of the cruise, 24 February 2003, a SVP 50-m drifter was recovered south of Ancona. Details are listed in Table 11.

DOLCEVITA_1 - LAST RECOVERY

Number	Type	GMT time	Lat	Lon	Comments
4001	Clearwater SVP 50 m	24/2/2003 5:27	42 59.4897	14 16.0812	SST=13.1717, SSS=38.7752

Table 11. Recovery details for the SVP drifter recovered south of Ancona.

3. Preliminary Results and Interpretation

3.1 Drifter tracks

Five-day long drifter trajectory segments in the northern and middle Adriatic basins are shown in Figure 10 for four consecutive periods spanning most of the cruise. Star symbols represent deployment locations, open circles denote the last drifter position for the time period considered. Black solid symbols represent recovery locations. Note that the trajectory segment may be shorter than 5 days if the drifter was deployed or if it was recovered during the period considered. Only the positions provided by the Argos Doppler system and the positions of deployment/recovery are plotted.

Figure 11 shows the deployment locations for the drifters released at the beginning of the first small-scale survey on the northeastern wall of the Jabuka Pit (in the MAF). The tracks of these drifters are displayed for the period 6-10 February 2003. Most drifters moved in the southwest direction. The drifters launched at the southern extremity of the array remained trapped in loops (probably inertial currents). Two drifters escaped the domain to the north and eventually turned cyclonically before splitting and showing north and southward motion trends.

The deployment locations for the drifters released on 11 February 2003 during the first occupation of the small-scale survey located south of the Istrian Peninsula (off Pula in the NAF) are shown in Figure 12. Their tracks until 15 February 2003 are also depicted. All drifters moved rapidly westward with a typical speed of 50 cm/s in response to the strong Bora wind forcing. Upon reaching the middle of the basin, some drifters (essentially those deployed south of the front) started to veer in the south and southeast direction as they joined the WAC. Those deployed north of the front slowed down and showed some signature of northward motion.

The deployment locations and the tracks of the drifters deployed on 15-16 February 2003 upstream of the small scale survey concentrating on the WAC off Rimini and Pesaro are displayed in Figure 13. Tracks are shown until 20 February 2003. All drifters eventually joined the WAC and moved southeastward with relatively large speeds (reaching 50 cm/s). There is a tendency for the drifters to converge just offshore of Ancona. Two drifters east of the WAC showed some slow northwestward motion in the open sea.

The final set of deployments took place during the first leg of the first small-scale survey of the Po plume on 20 February 2003 (see Figure 14). The two optical drifters and the CODE/Tz were deployed in the center of the plume in relatively cold and low-salinity waters. They moved to the northeast with speeds around 10-20 cm/s. The two CODE-GPS drifters that were released on each side of the plume did not move rapidly during the first day after deployment. They eventually (not shown) veered to the southwest direction.

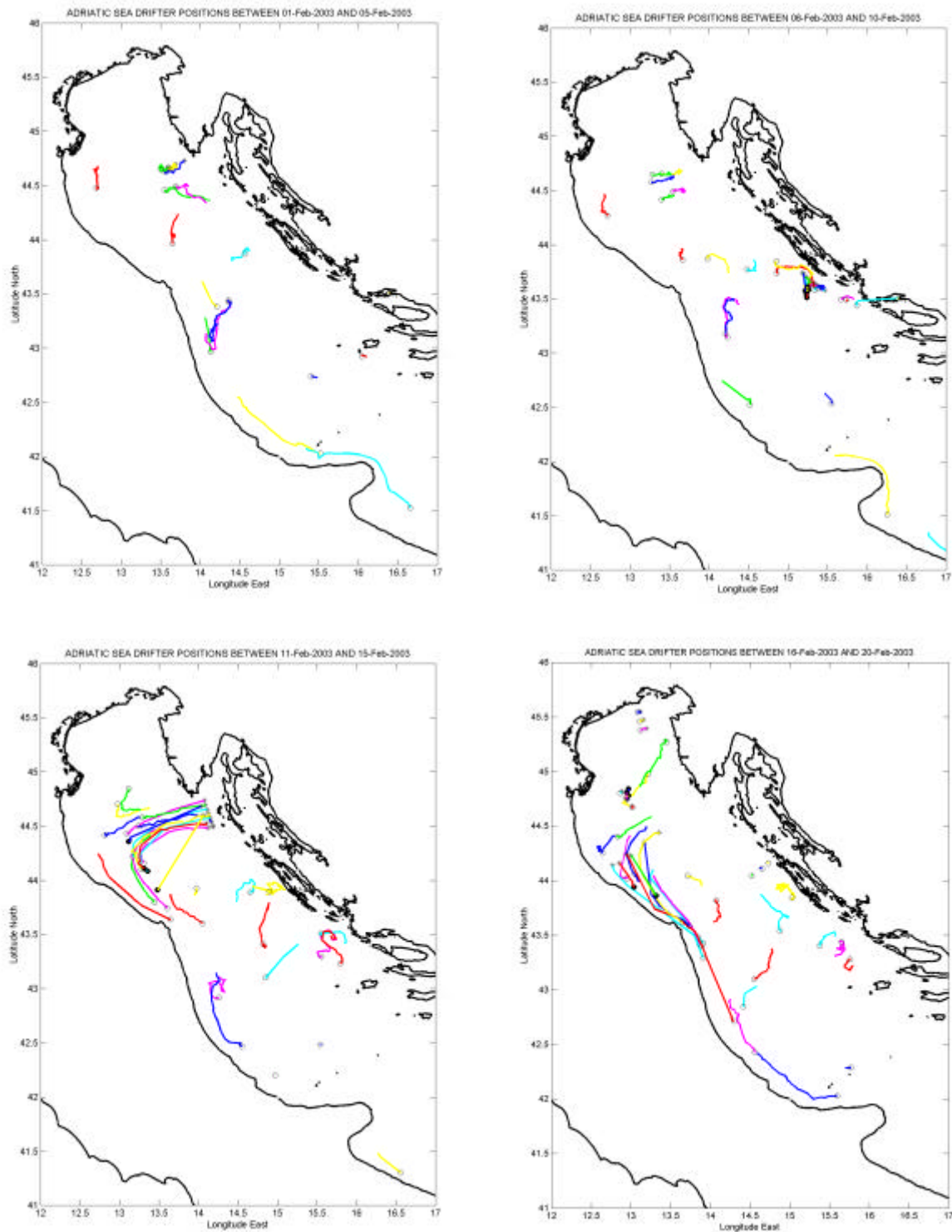


Figure 10. 5-day long trajectory segments of the drifters in the northern and middle Adriatic Sea for consecutive periods ending on 5 Feb (top left), on 10 Feb (top right), on 15 Feb (bottom left) and on 20 Feb 2003 (bottom right). See text for details.

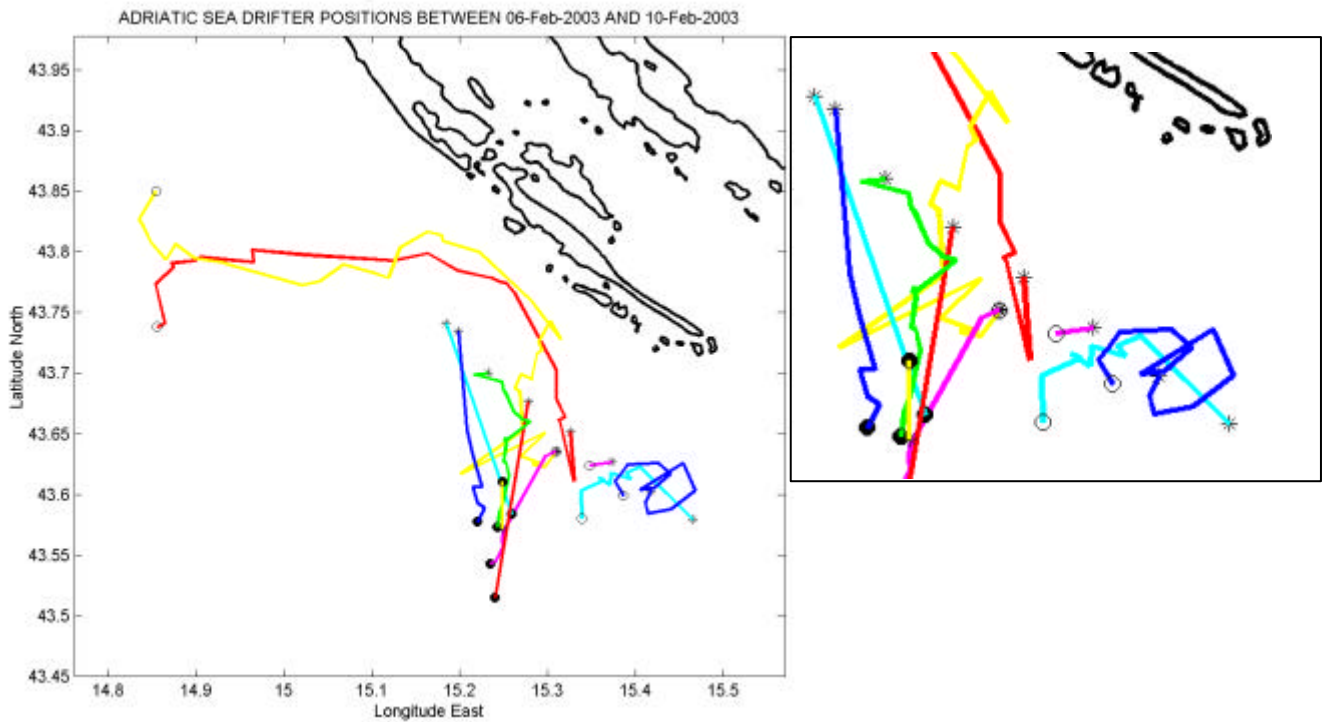


Figure 11. Drifter tracks of the drifters deployed during the first small-scale survey near Jabuka pit for the period 6-10 Feb 2003, and of any other drifter in the vicinity.

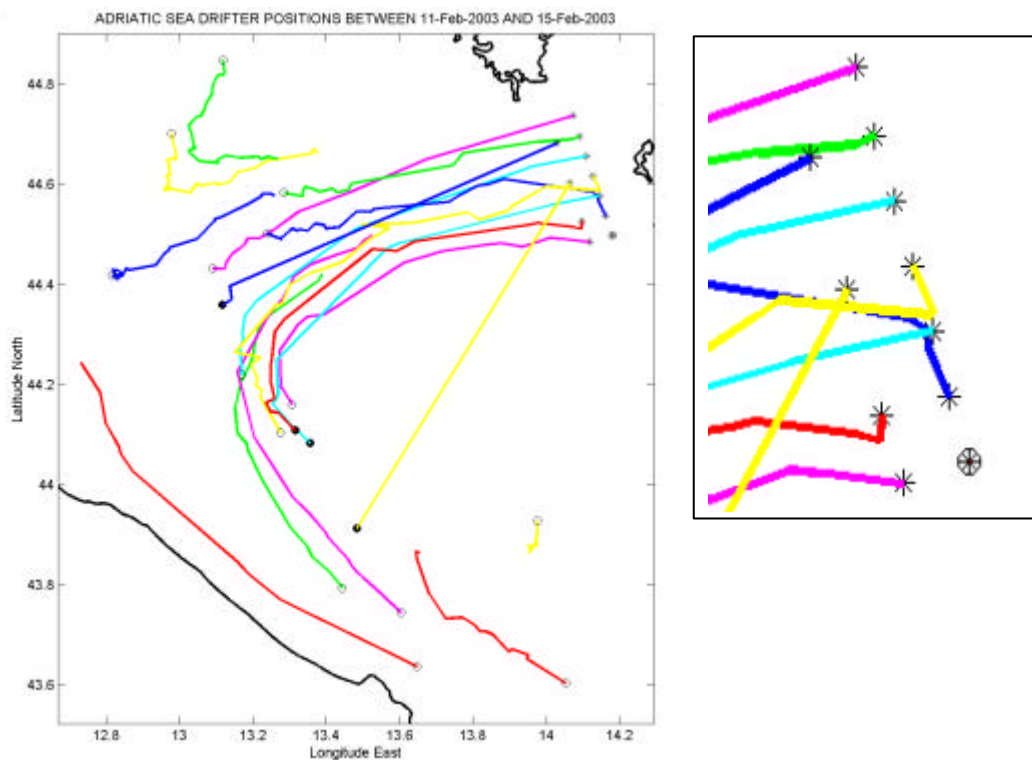


Figure 12. Drifter tracks of the drifters deployed during the small-scale survey south of the Istrian Peninsula (off Pula) for the period 11-15 February 2003, and of any other drifters in the vicinity.

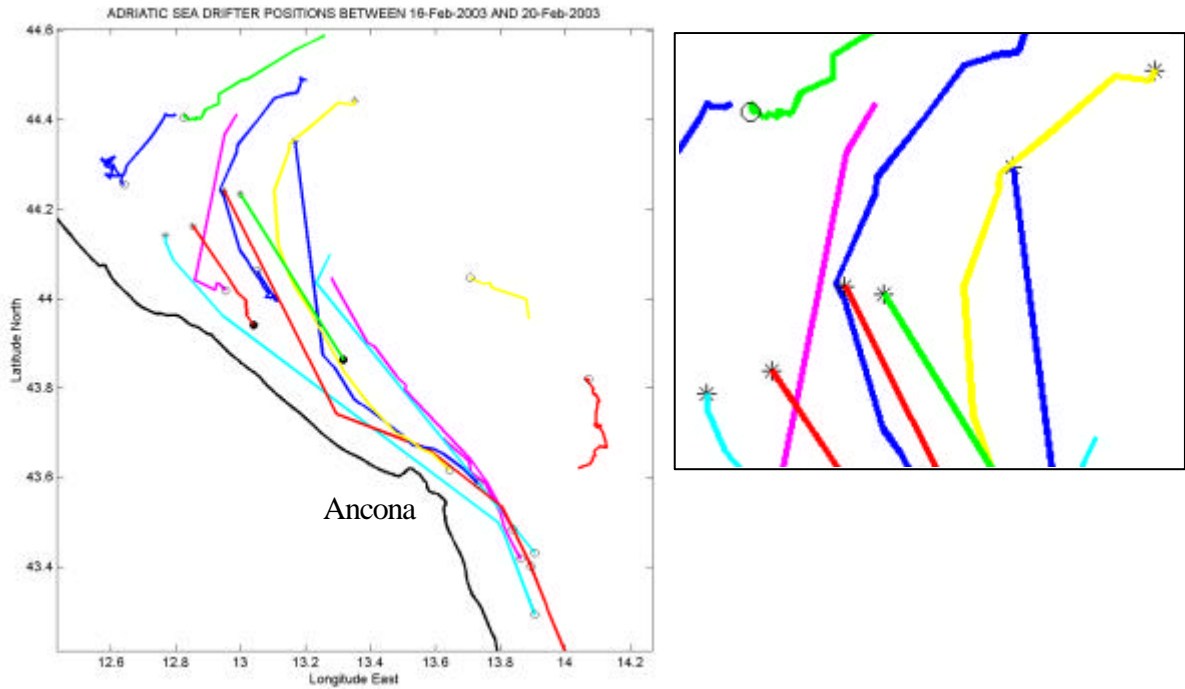


Figure 13. Drifter tracks of the drifters deployed during the small-scale survey near the WAC off Rimini-Pesaro for the period 16-20 Feb 2003, and of any other drifters in the vicinity.

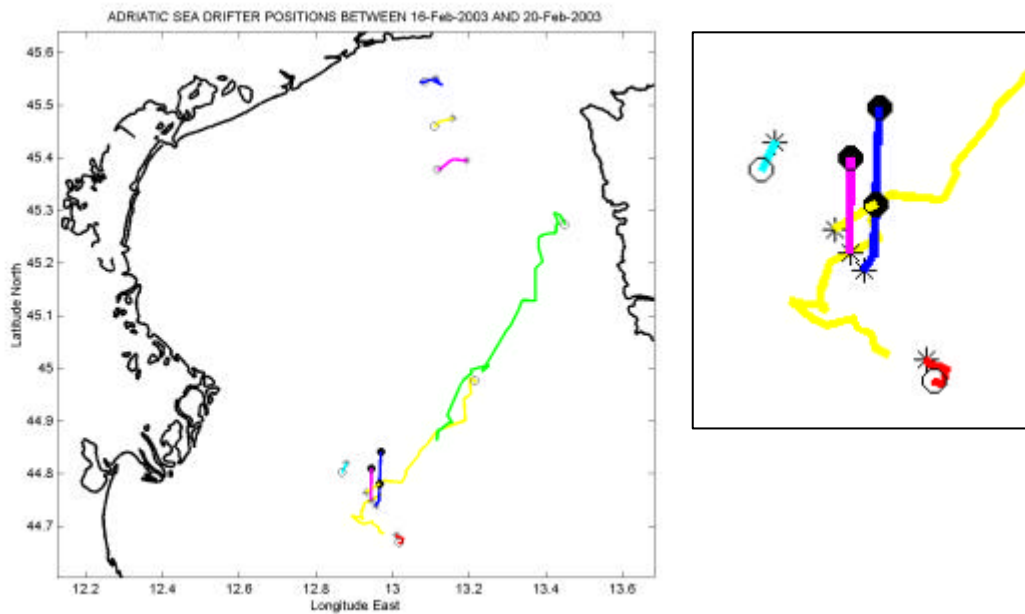


Figure 14. Drifter tracks of the drifters deployed during the small-scale survey of the Po plume for the period 16-20 Feb 2003, and of any other drifters in the vicinity.

3.2 Drifter tracks and other Data Sets

For the surveys in the northern Adriatic, concentrating on the NAF front and on the Po plume, partially clear satellite images were available. Sequences of AVHRR-derived sea surface temperature images and of SeaWiFS chlorophyll concentration maps, with superimposed drifter tracks and ADCP near-surface currents are presented to describe the temporal evolutions of the features at daily intervals.

3.2.1 Drifter Tracks and AVHRR images

Figure 15 to 21 show SST images with 5-day long drifter trajectory segments for the northern Adriatic from 11 through 23 February 2003. The temporal evolution of the instabilities (intrusions) of the NAF thermal front south of Pula and of the Po cold plume is striking.

3.2.2 Drifter Tracks, AVHRR images, Ship-borne ADCP data and Ship SST

Three examples of SST images with overlaid currents derived from the ship-borne ADCP are shown in Figures 22 and 23. The ADCP data represent currents in a 4 m height cell centered at 11.85 m depth. The ship track is also color-coded with the SST measured by the ship underway pumping system. For the Po plume survey (Figure 23 bottom), the agreement between the satellite SST, the ship SST, and the circulation patterns estimated by the shipborne ADCP and drifters, is remarkable. Fast northeastward currents are concentrated in (and south) of the plume.

3.2.3 Drifter Tracks and SeaWiFS images

A sequence of SeaWiFS images of the northern Adriatic (color-coded chlorophyll concentration) is shown as Figures 24-26 for the period 18-22 February 2003. The evolution of the Po plume (high chlorophyll concentration signature) is evident.

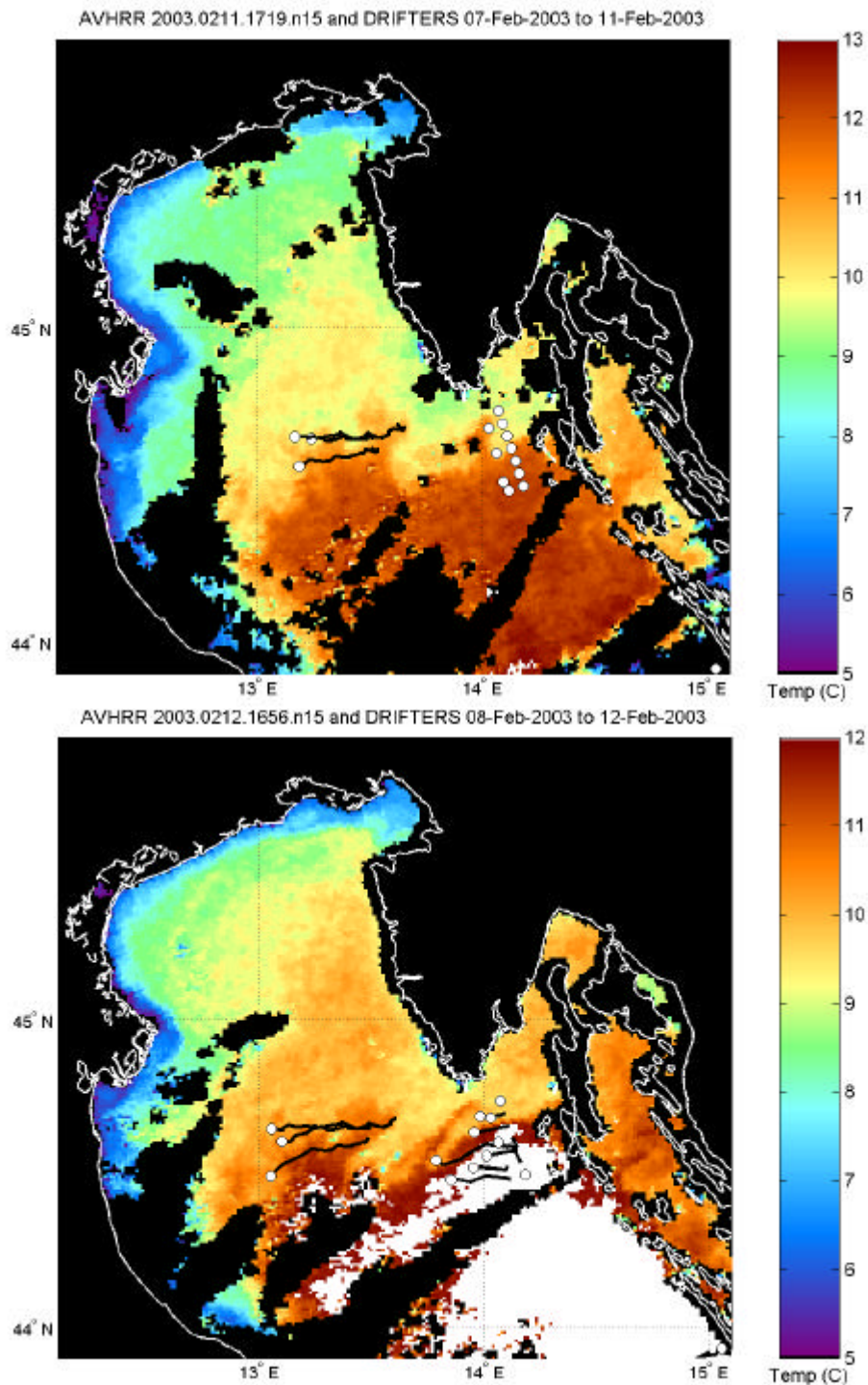


Figure 15. Color-coded satellite images of AVHRR-derived SST of the northern Adriatic. Tracks of the drifters deployed during the cruise are overlaid for a period of 5 days before the day of the satellite images. White circles represent the last drifter locations on the last day considered. Top (11 February 2003) and bottom (12 February 2003).

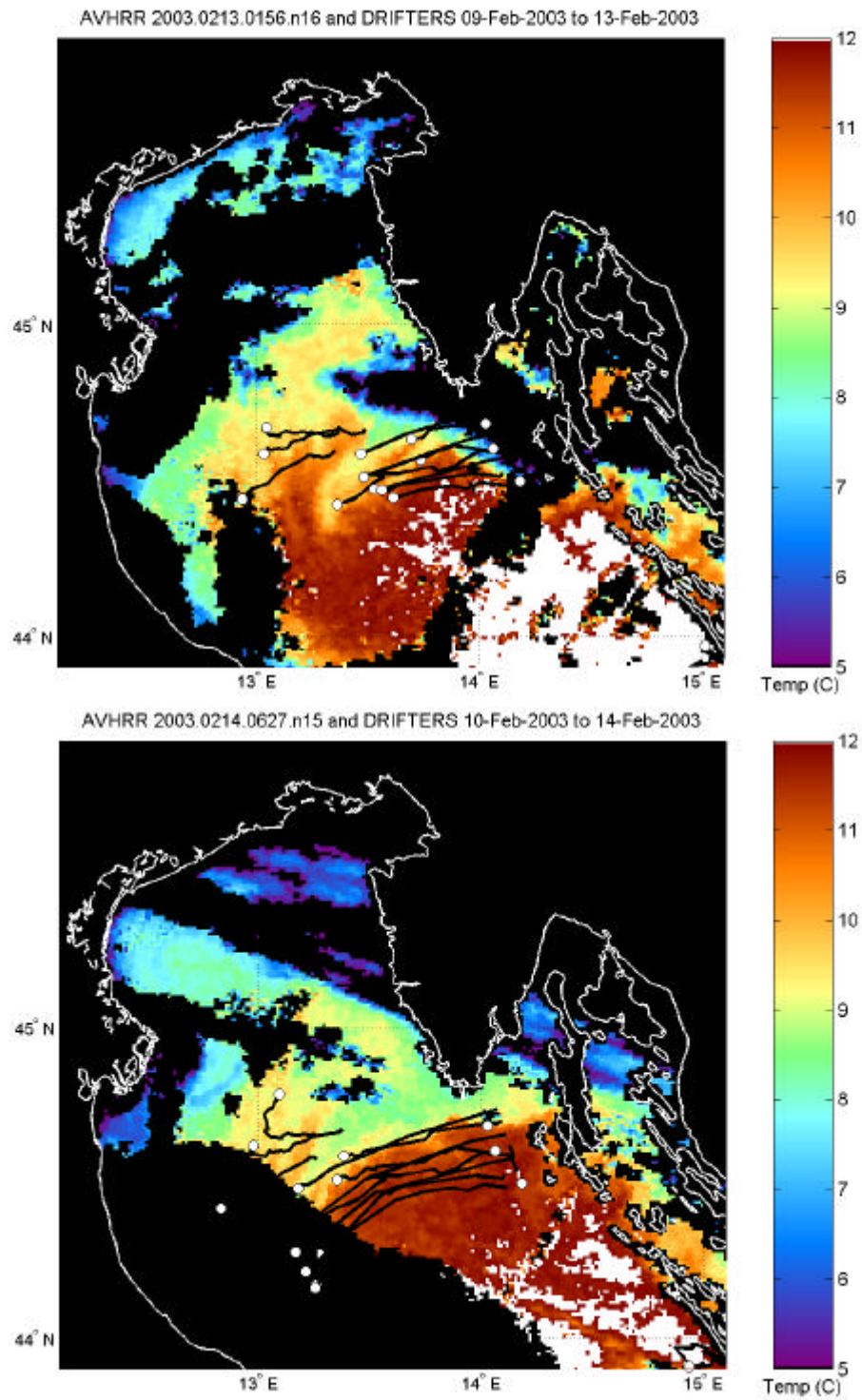


Figure 16. Same as in Figure 15 but for 13 February 2003 (top) and 14 February 2003 (bottom).

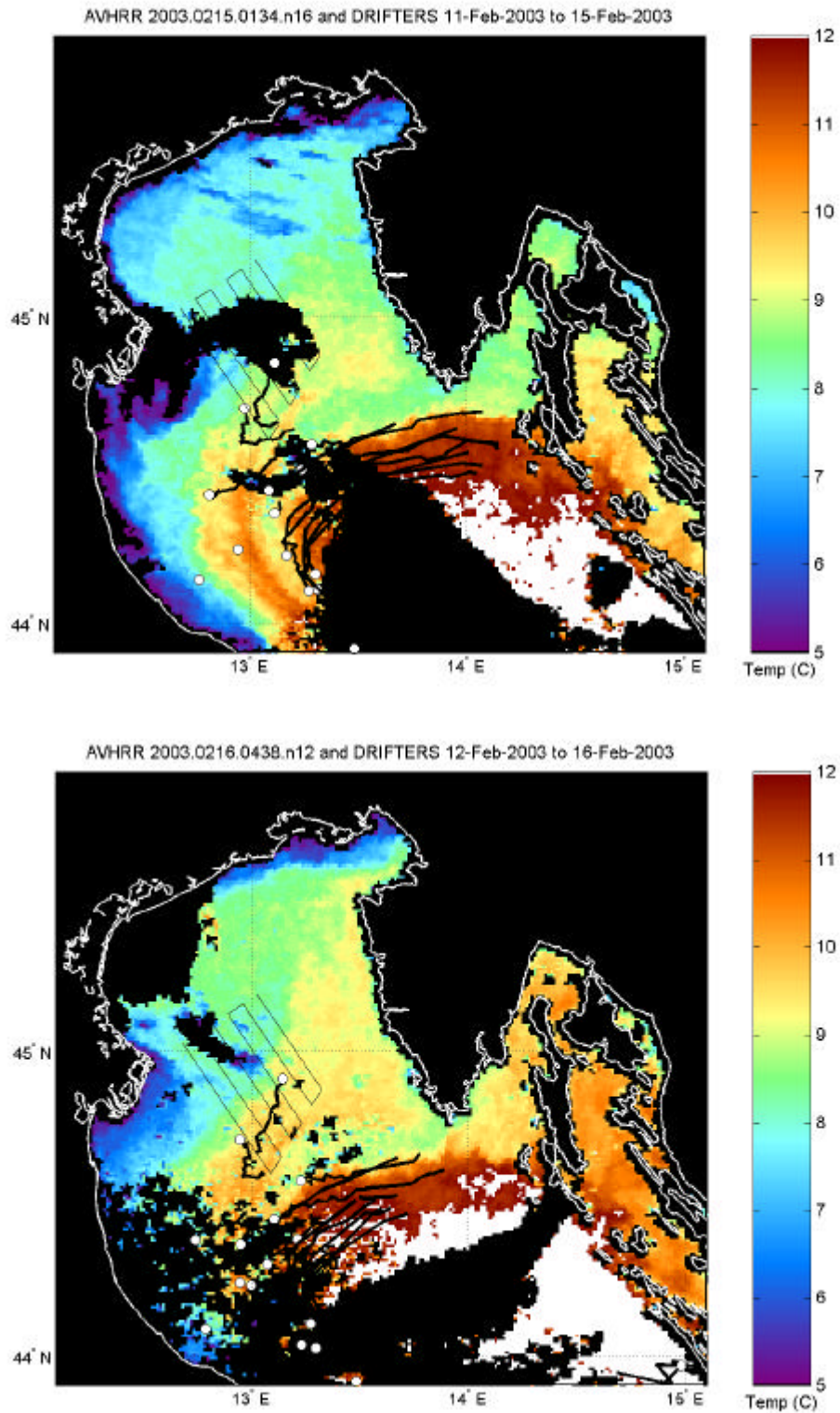


Figure 17. Same as in Figure 15 but for 15 February 2003 (top) and 16 February 2003 (bottom). The ship track of the small-scale survey of the Po plume is also displayed.

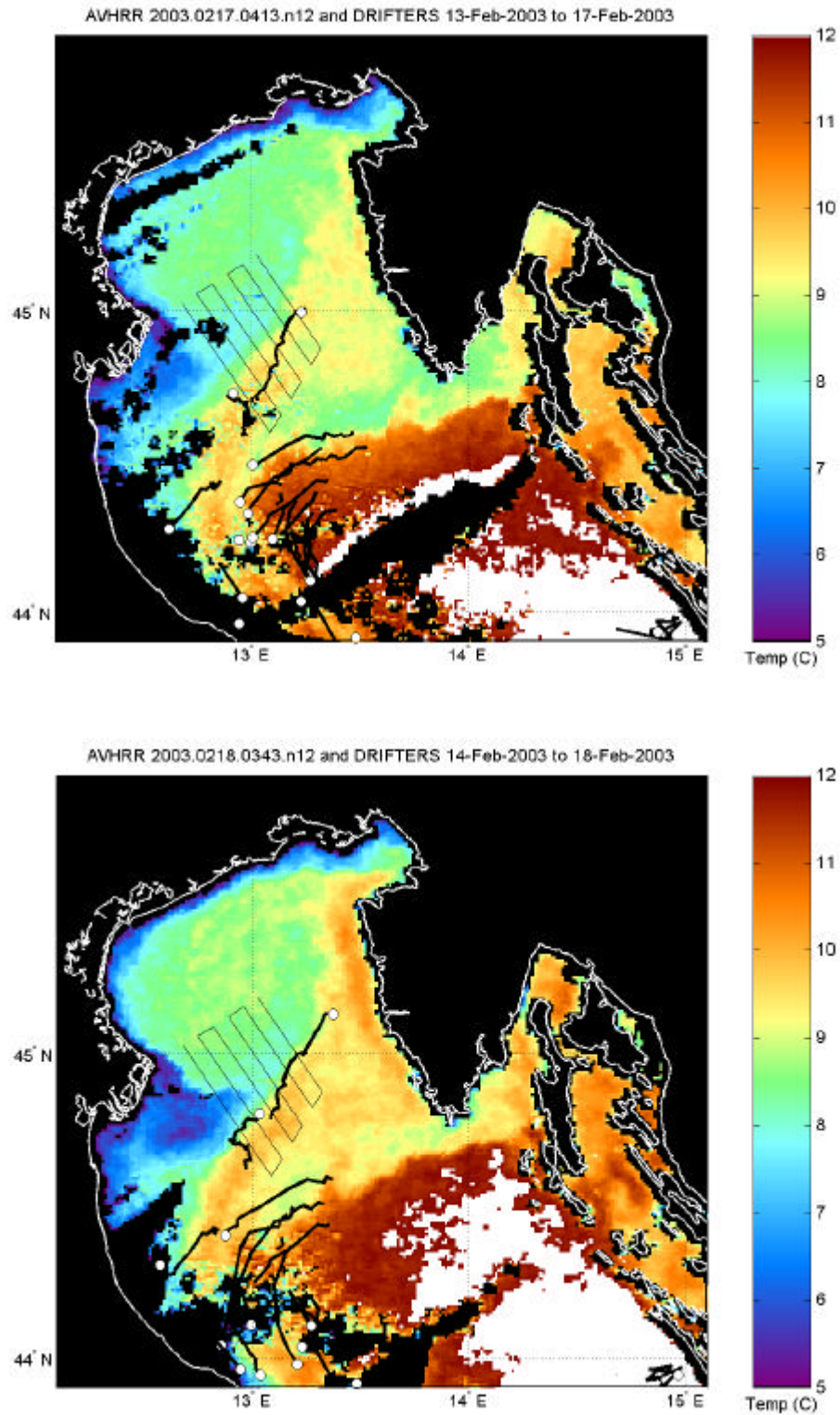


Figure 18. Same as in Figure 17 but for 17 February 2003 (top) and 18 February 2003 (bottom).

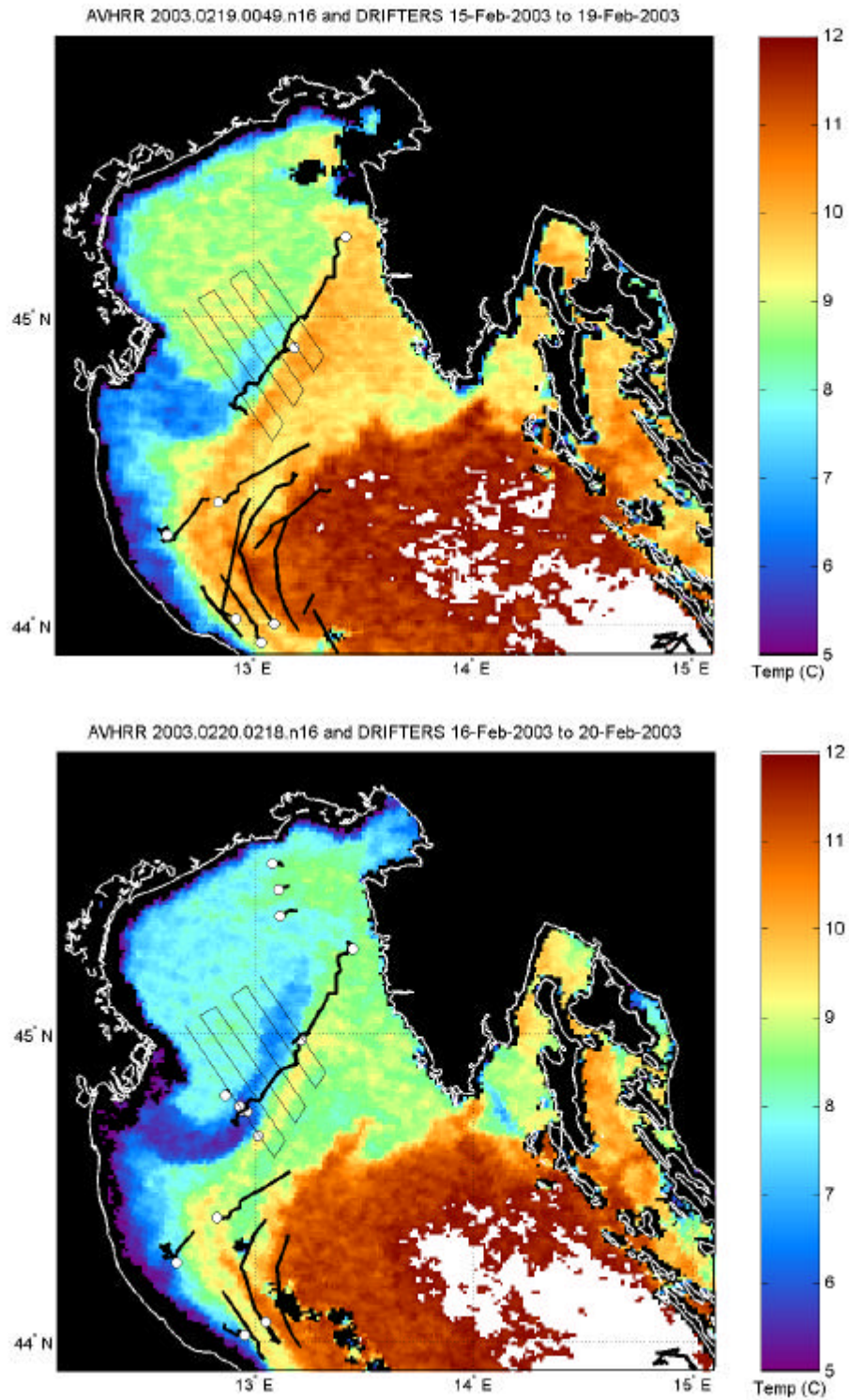


Figure 19. Same as in Figure 17 but for 19 February 2003 (top) and 20 February 2003 (bottom).

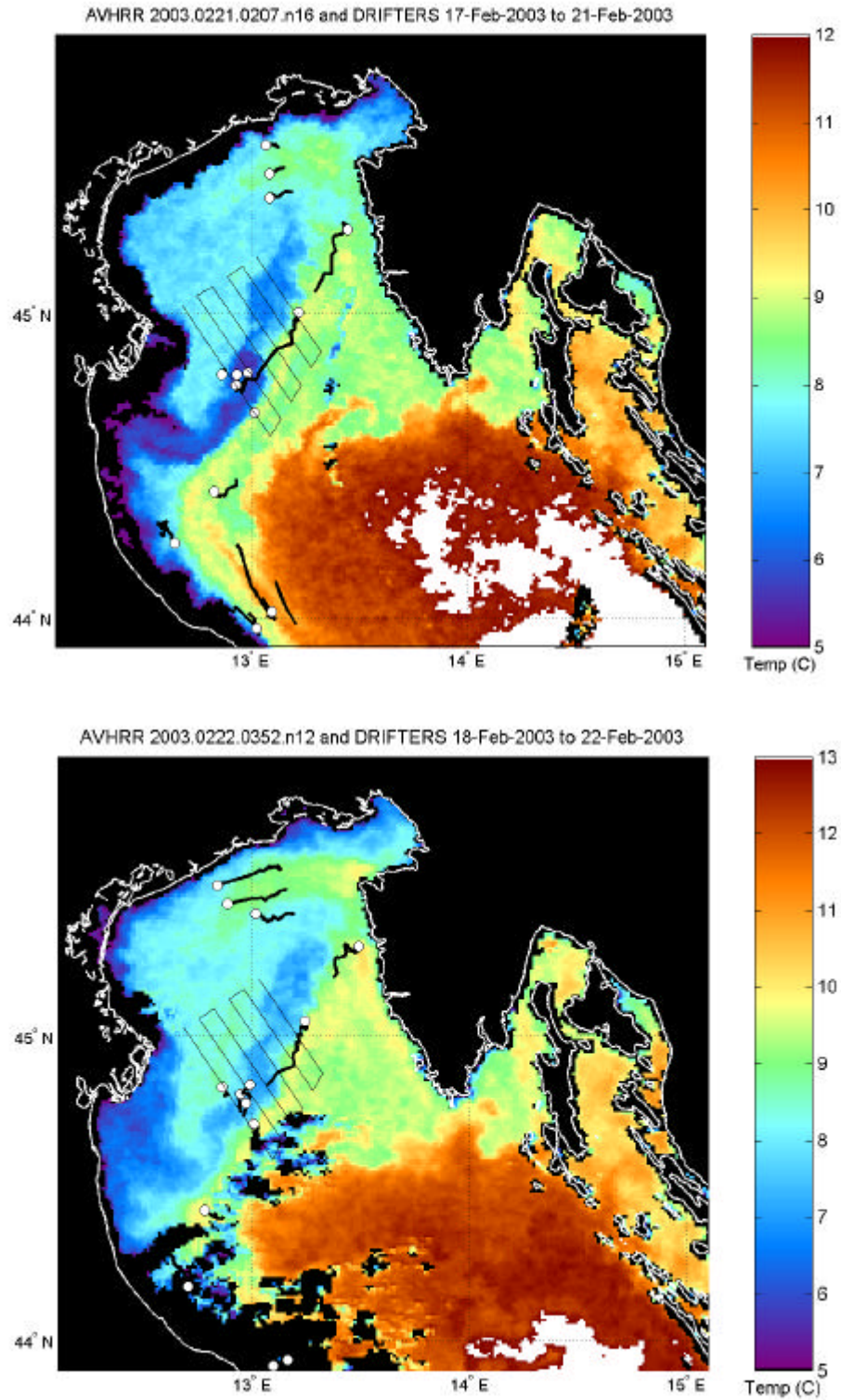


Figure 20. Same as in Figure 17 but for 21 February 2003 (top) and 22 February 2003 (bottom).

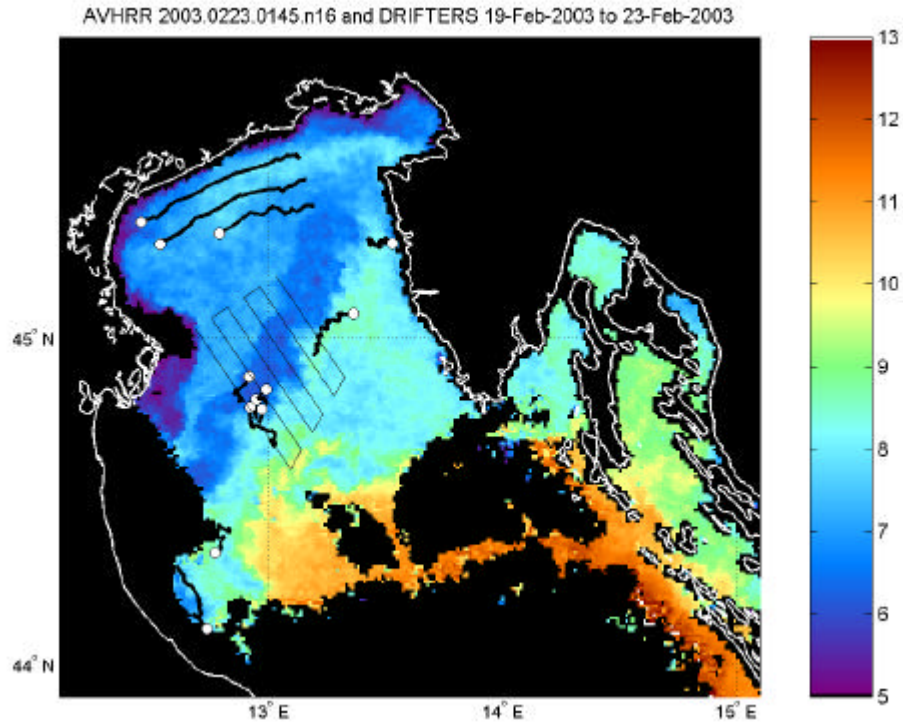


Figure 21. Same as in Figure 17 but for 23 February 2003.

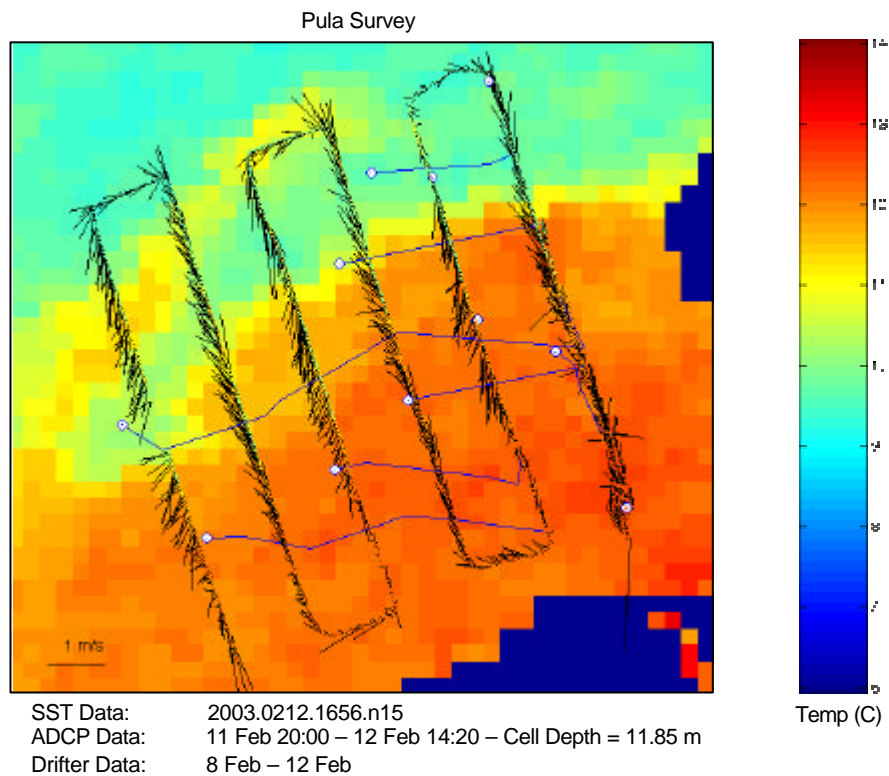


Figure 22. Color-coded SST map of the NAF front south of Pula with ship track of small-scale survey, ADCP near surface currents, and drifter tracks (solid white circles represent the last positions on 12 Feb). The ship track is color-coded with the ship underway SST.

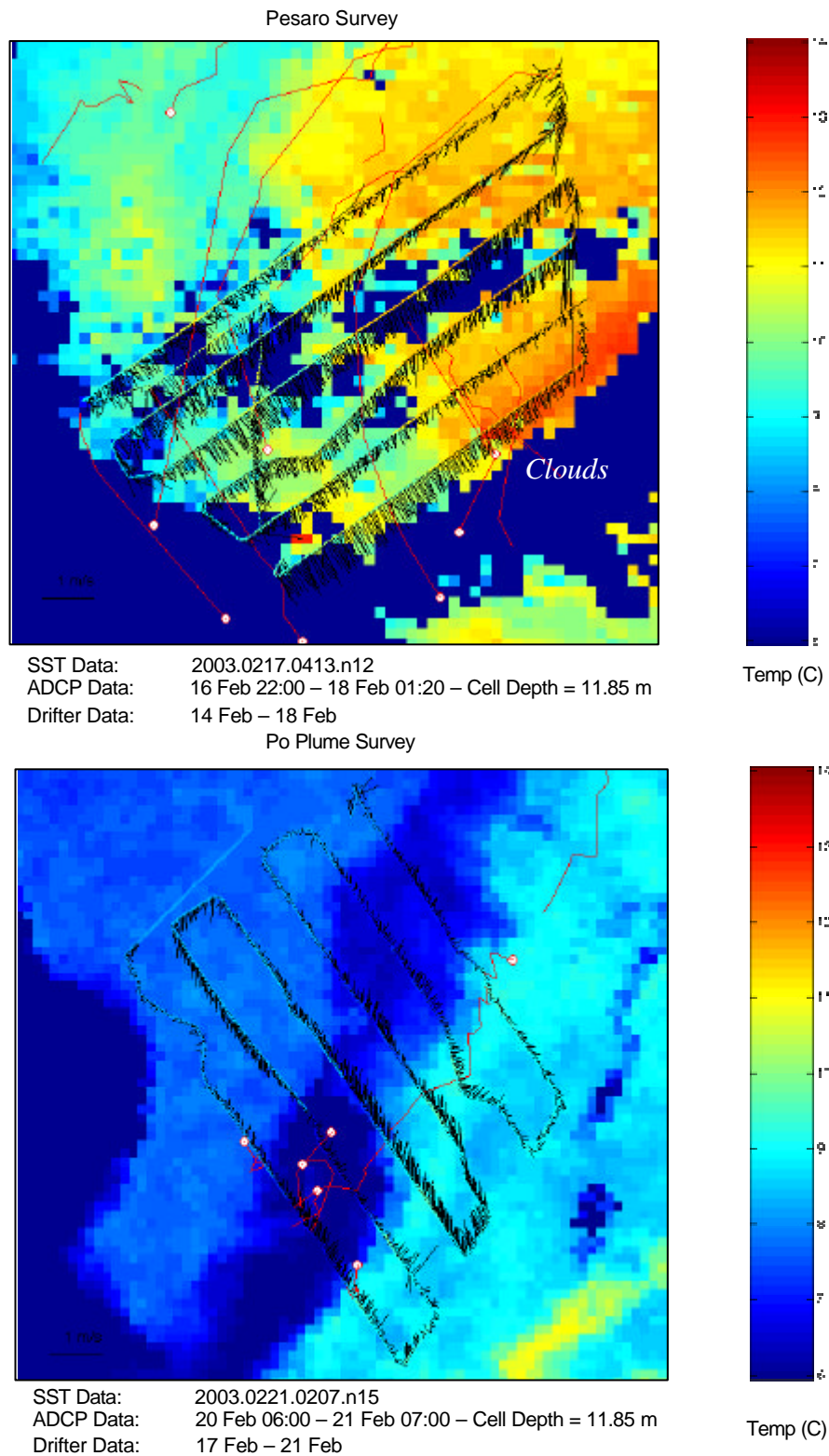


Figure 23. Same as Figure 22 but for the WAC (off Rimini-Pesaro, top) and the Po plume (bottom) small-scale surveys.

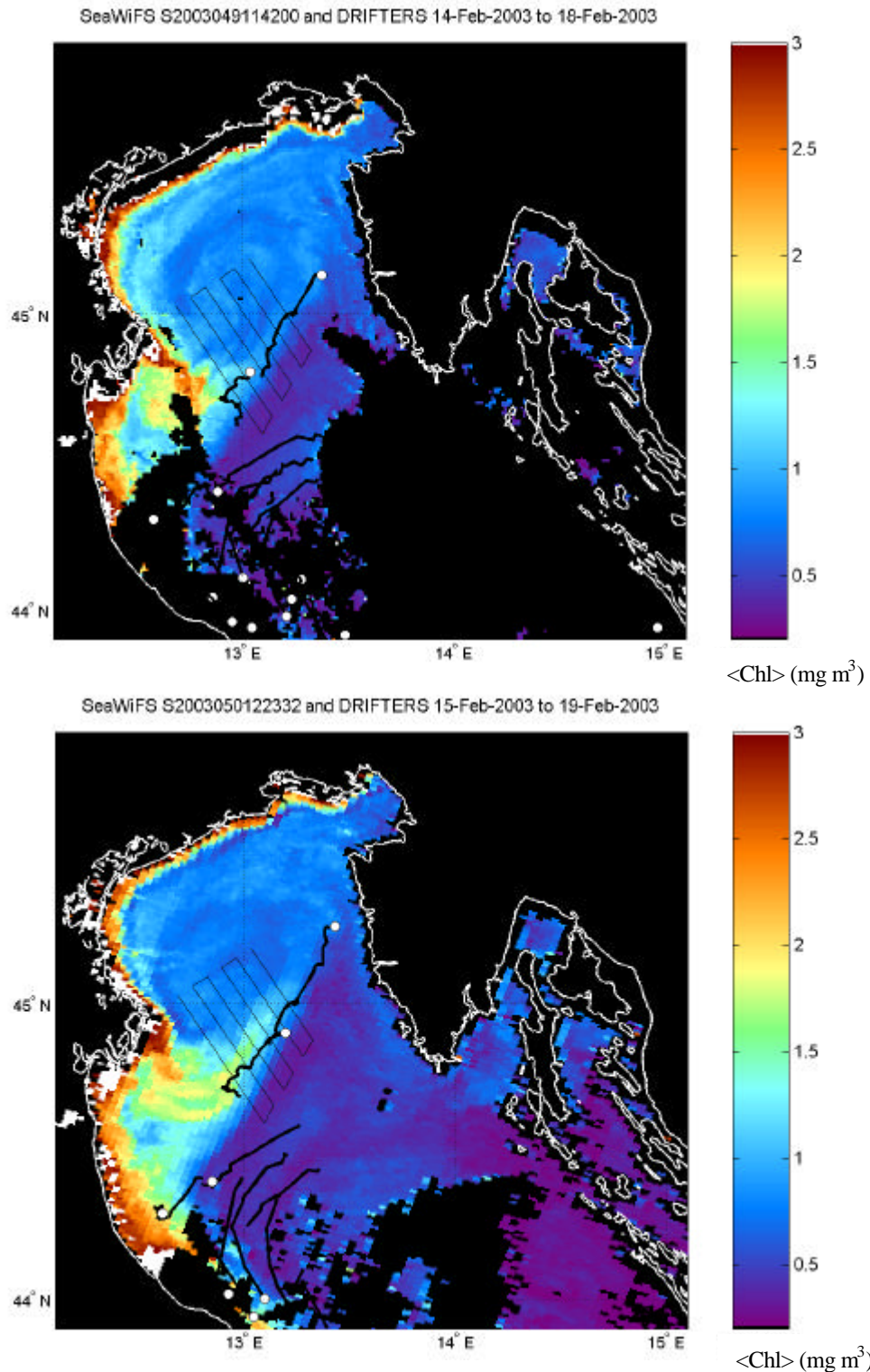


Figure 24. Color-coded satellite images of SeaWiFS-derived chlorophyll concentration of the northern Adriatic. Tracks of the drifters deployed during the cruise are overlaid for a period of 5 days before the day of the satellite images. White circles represent the last drifter locations on the last day considered. Top (18 February 2003) and bottom (19 February 2003). The ship track of the small-scale survey of the Po plume is also displayed.

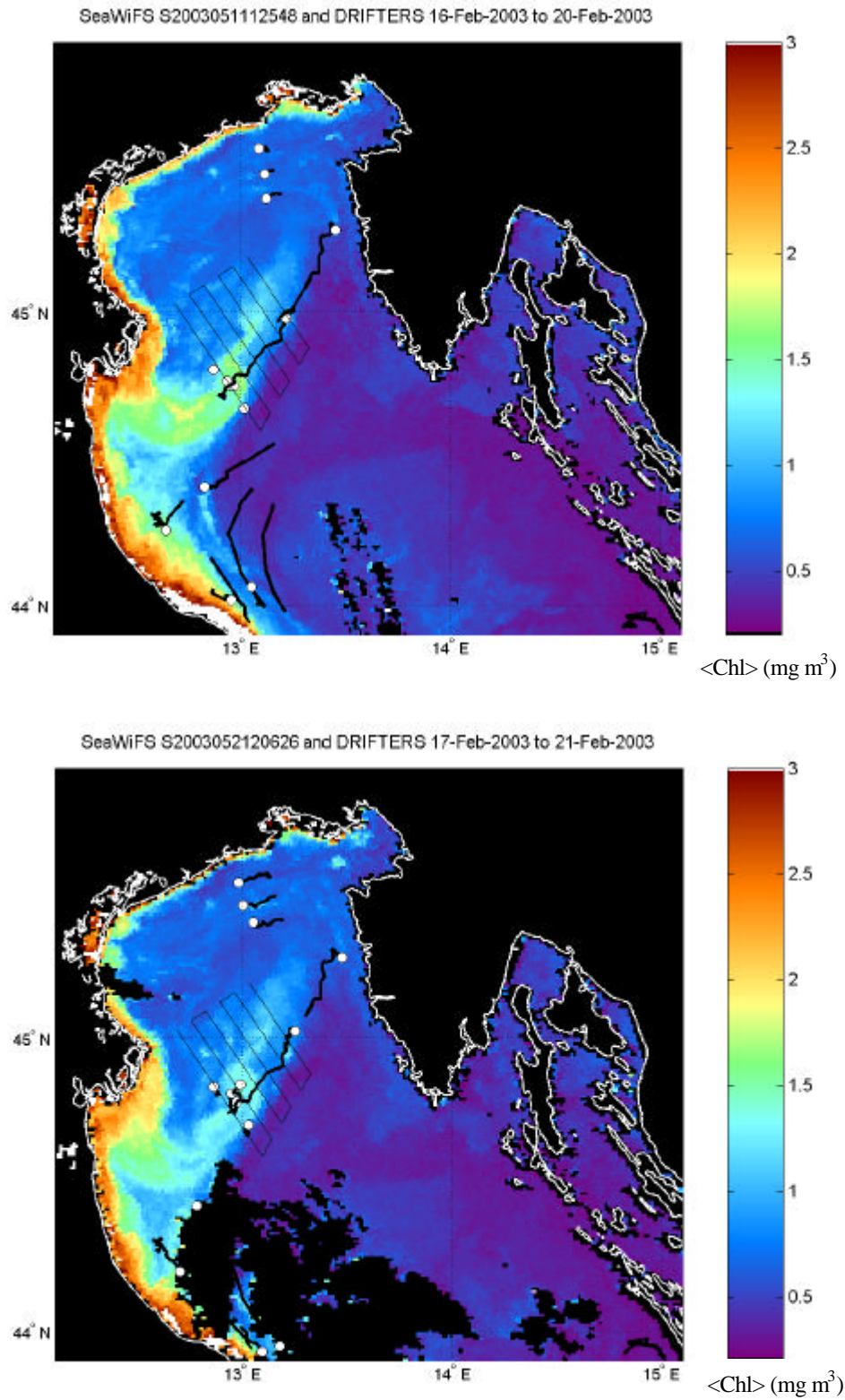


Figure 25. Same as in Figure 22 but for 20 February 2003 (top) and 21 February 2003 (bottom).

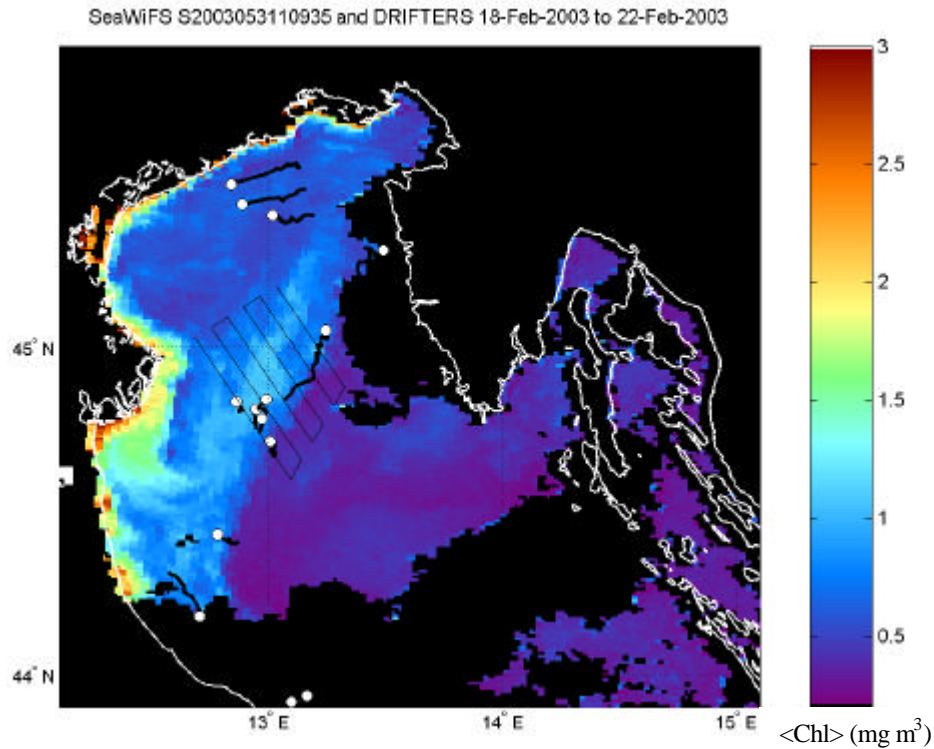


Figure 26. Same as in Figure 24 but for 22 Feb 2003.

3.3 Drifter GPS Location Data

Some of the drifters were equipped with GPS receivers to measure their location at hourly or half-hour intervals. An example of the drifter raw GPS data is displayed in Figure 27 during the small-scale survey of the WAC off Rimini and Pesaro. It can be seen that the GPS data can be quite noisy for some drifters (see for example the yellow dots). Meticulous editing will be needed to sort out these data sets. In addition, the GPS data time series are not continuous. Intervals spanning a few hours without data are often seen. This is essentially due to the fact that the number of Argos messages per satellite pass is rather limited (2-3) with respect to what was expected (6-7).

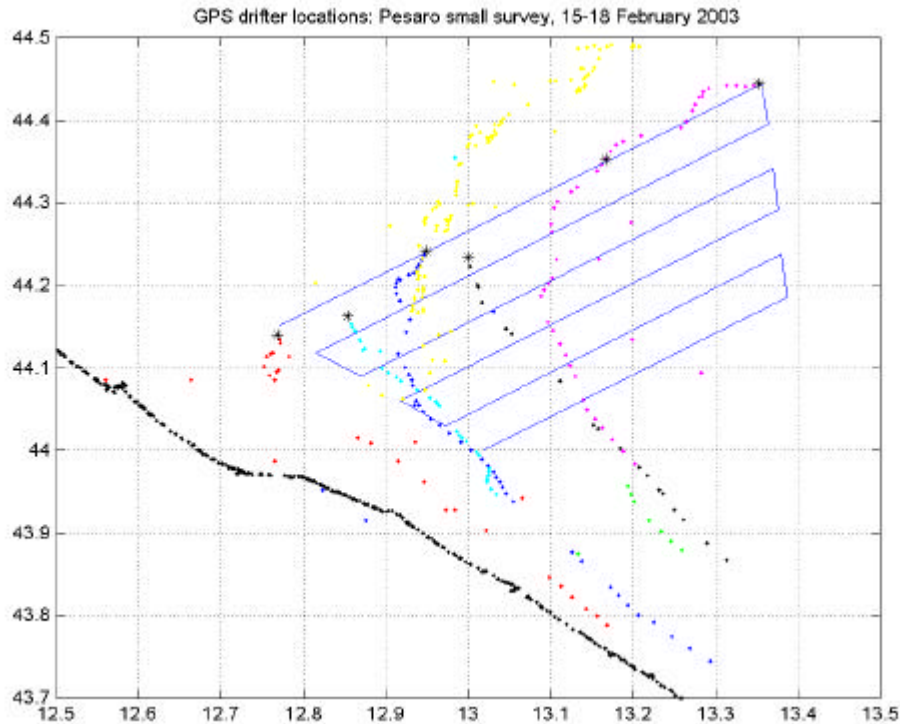


Figure 27. GPS locations of the drifters launched during the small-scale survey in the WAC off Rimini and Pesaro. Star symbols indicate deployments and GPS locations (colored dots) are typically at half-hour or hourly intervals.

3.4 Drifter Optical Data

The two optical drifters (SVP/OCM) were operated on 7-8, 11-15, 17-18 and 20-21 February 2003 during various small-scale surveys in the northern Adriatic. Examples of the processed data are illustrated in Figures 28 to 30. Spectra of the upwelling radiances are typical of oligotrophic waters for the Pula survey (Figure 28) whereas in the Po plume (Figure 29) they delineate clearly the shift of color towards green. When scaled by the downwelling irradiance, the spread of the lines due to the different hours of the day is much reduced as expected. The irradiances were calculated from the measured value at 490 nm (see an example of their daily variation in Figure 30) and the ratio computed from optical data measured by a MicroSAS instrument installed on the ship's bow (courtesy of B. Jones).

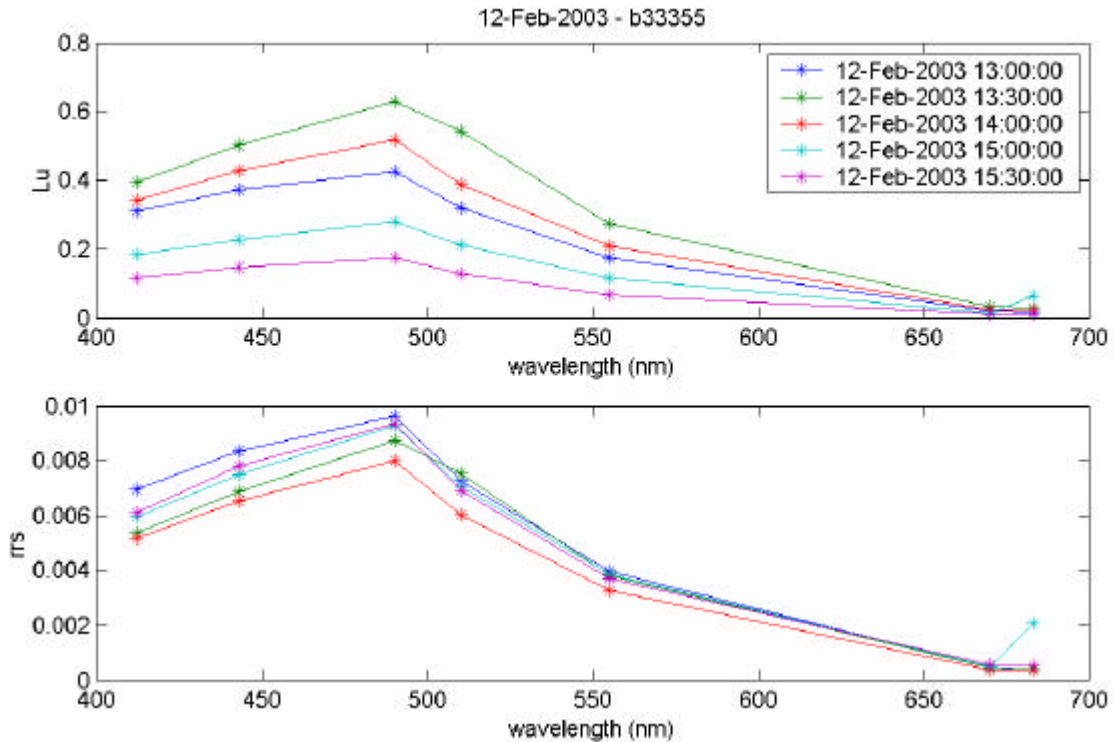


Figure 28. Upwelling radiance ($\text{mW}/\text{cm}^2/\text{nm}/\text{sr}$) data for drifter PTT ID 33355 on 12 February 2003 for 7 channels in the visible band (top). Corresponding spectra of remote sensing reflectance (bottom).

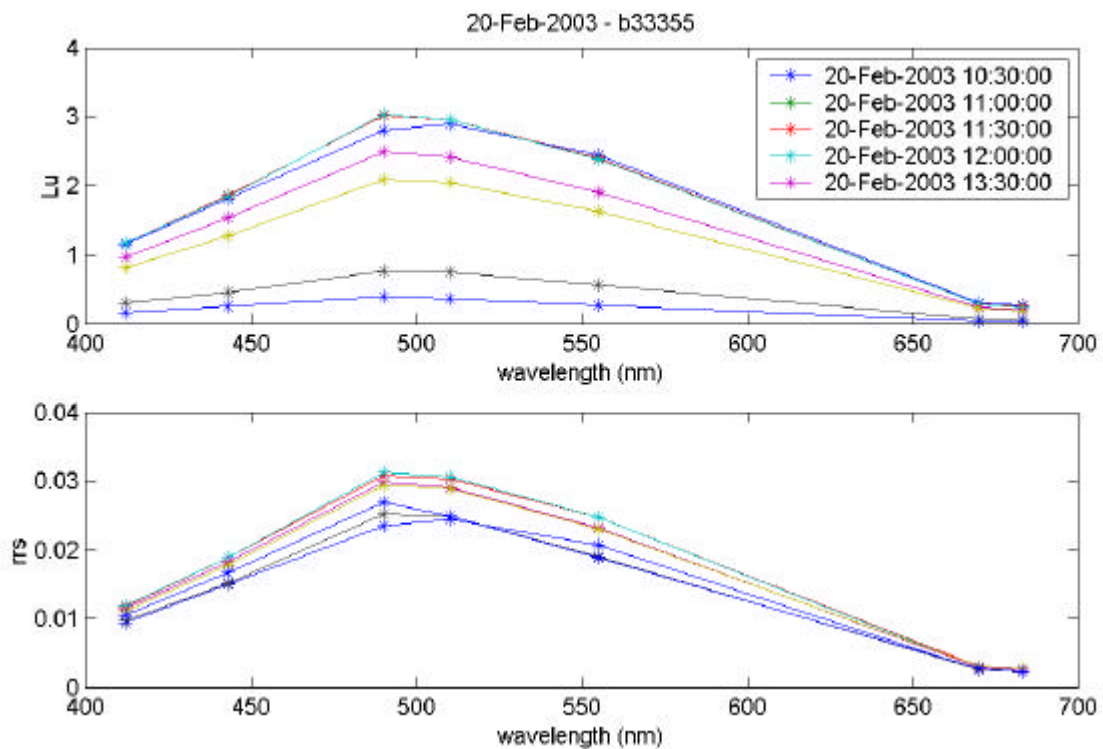


Figure 29. Same as Figure 28 but for drifter PTT ID 33355 on 20 February 2003.

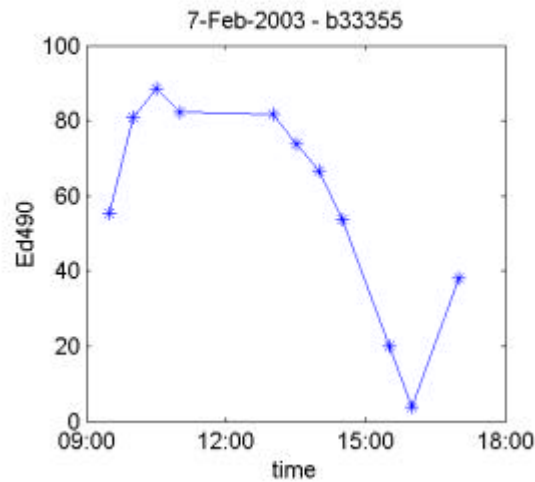


Figure 30. Downwelling irradiance ($\text{mW/cm}^2/\text{nm}$) data for drifter PTT ID 33355 on 7 February 2003 versus GMT time.

3. Conclusions

In general, drifter operations during the DOLCEVITA-1 cruise were successful. Drifter deployment and recovery operations were very efficient, especially near the end of the cruise. A total of 42 deployment and 17 recovery operations were conducted. Twenty five drifters were left in the water.

Some serious problems with the Metocean optical and thermistor drifters were observed. In particular, the data time series were not continuously sampled at 0.5 hour intervals as requested. The main problem is the low number of Argos message per satellite pass. We will work with Metocean to solve or reduce these problems in order to have better drifters for the DOLCEVITA-2 cruise in May-June 2003.