DRIFTER MEASUREMENTS OF THE COASTAL CIRCULATION IN THE NORTH ADRIATIC SEA (DECEMBER 2014)

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Approved for release by: .....

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1. Introduction

This report describes the drifter activities carried out during the RITMARE campaign in the period 9-20 December 2014 in the north and central Adriatic Sea after a plume event from the Po River.

A total of 10 drifters were released from the R/V G. Dallaporta in strategic locations off the Po River delta on 11 December 2014 (Figure 1), and the recovery was carried out after about one week. All the instruments were recovered except one that stranded in shallow water (about 1 meter or less) near Goro and another one which collected data until February 2015 in the South Adriatic Sea.

Information on the instrumentation and data management are given in Chapter 2. Details about trajectories and measurements are reported in Chapter 3, and conclusions are in Chapter 4.

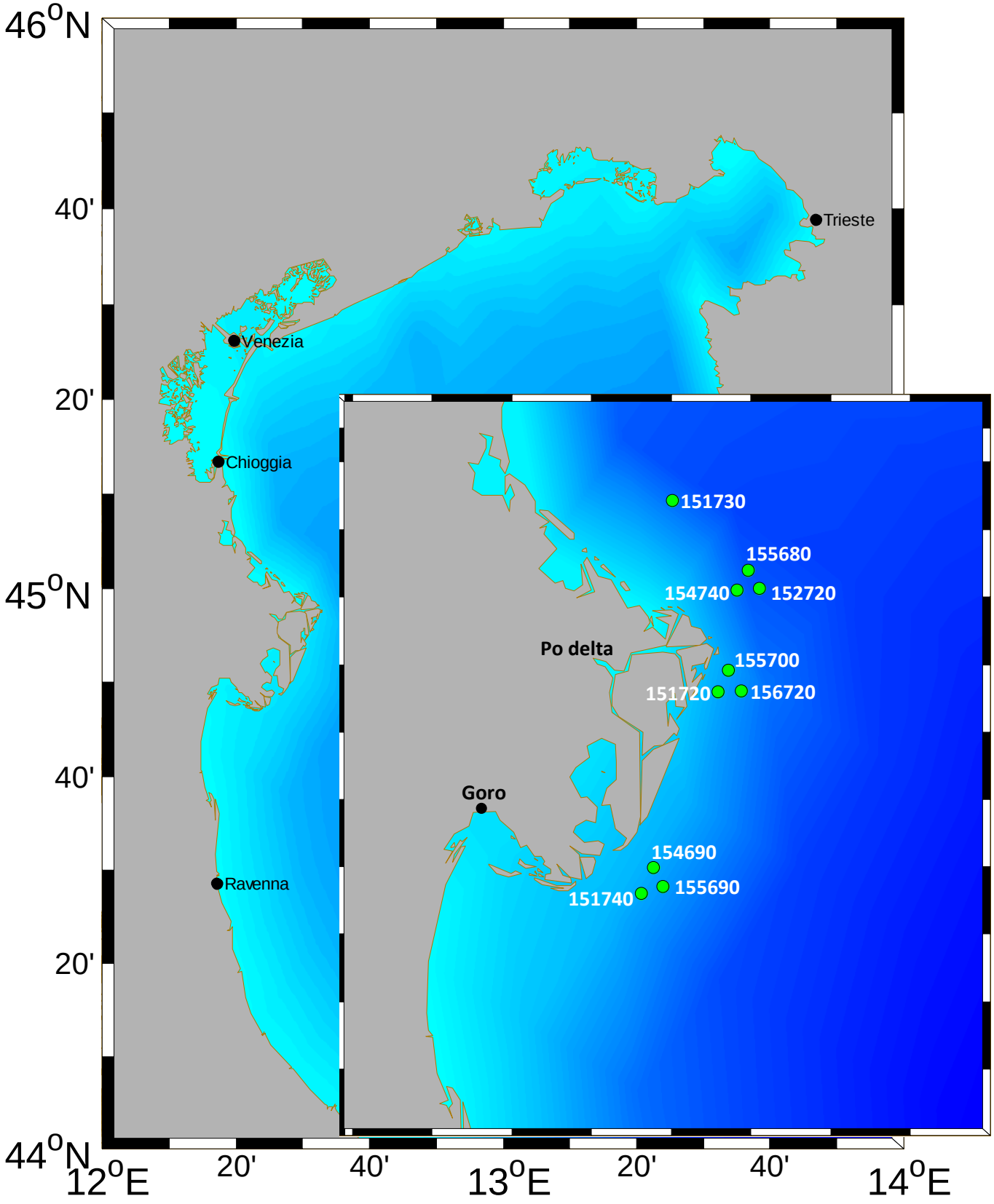

Figure 1. North Adriatic deployment area, green symbols represent drifter release positions with corresponding instrument numbers.

2. Drifters

The CODE (Coastal Ocean Dynamics Experiment) type drifter consists of a slender, robust tube whose length is about 1 m; four sails, rectangular shaped and specifically designed, allow the instrument to follow the current. Buoyancy is guaranteed by four spherical floats attached to the upper part of the vanes (Poulain, 1999).
The instrument is programmed to transmit every 1 hour by means of the Iridium SBD satellite system, it is in fact equipped with a protruding GPS antenna that has been painted in orange in order to facilitate the recovery operations. The instrument is left drifting so that the surface (from surface down to about 1.5 m) current can be estimated and sea surface temperature can be registered with accuracy of ±1° C.
The drifters were manufactured by Technocean and DBI in Florida, USA.
Data, once in OGS, must by decoded, processed and then stored on UNIX machines, these parameters include sea surface temperature (SST), voltage and GPS positions.
For this type of drifter the message is binary (SBD format, an efficient network transport capability for transmitting short messages between equipment and centralized host computer systems).
Our procedure receives these data via email from SBD service, creates a backup, decodes them, cut the data before deployment and after recovery and removes spikes. After the automatic editing, if it's needed, the oceanographic operator removes spikes manually (the system saves the removed data for next process required by procedure). Subsequently the kriging filter is applied (1h, 2h, 3h, 6h, filtered) to interpolate values using an optimal method that works on variance allowing to characterize the accuracy of predictions.
Concerning the web part, static images and trajectories (png format) are generated; Google Earth graphics is also provided (kml, kmz formats).
If needed, the operator can switch between data decoding and editing, to remedy for strange behaviors when drifter is caught by ship or simply stolen.

Figure 2. Drifters on the deck of the research vessel G. Dallaporta.

Figure 3. Drifter ready to be deployed. One of the antennas has been painted in orange to facilitate the recovery.

The recovery operation requires both visual and motion prediction skills. Forecasting the drifter position is especially crucial since transmissions have a period of one hour. In this campaign this task was partly supported by coastal surface modeled currents provided from CNR-ISMAR colleagues (Bellafiore and Umgiesser, 2010).

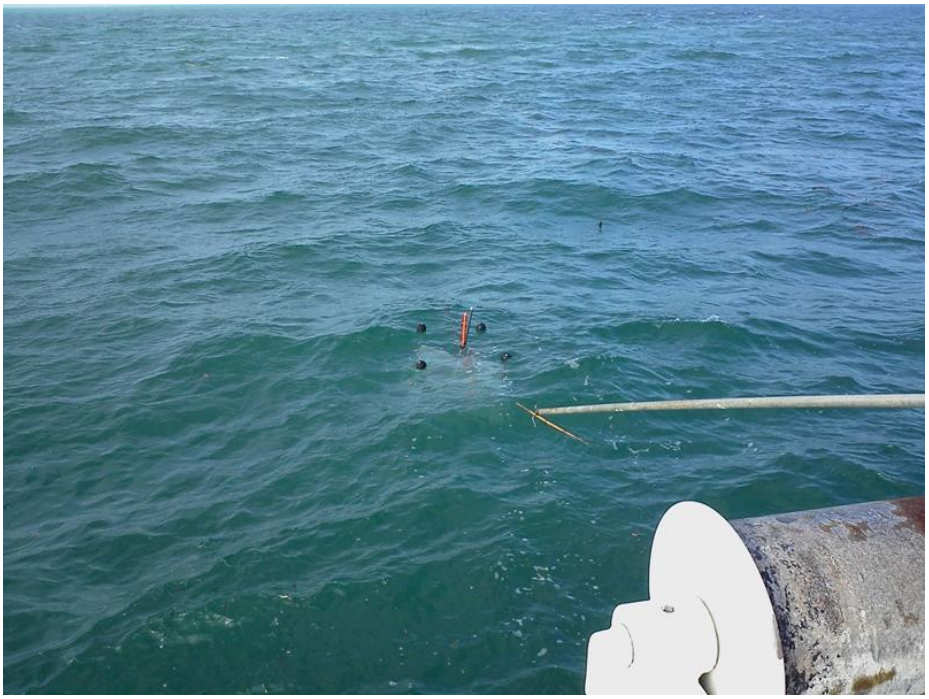

Figure 4. Drifter recovery operation.

Figure 5. Drifter on board.

3. Trajectories

The drifters were released according to the positions reported in Table 1 and shown in Figure 1.

Drifter number	Lat.	Lon.	Time (UTC)
151720	44° 55.801'	012° 32.907'	11/12/2014 10:06
151730	45° 04.285'	012° 30.500'	11/12/2014 20:36
151740	44° 47.118'	012° 28.116'	11/12/2014 09:00
152720	45° 00.372'	012° 35.510'	11/12/2014 21:11
154690	44° 47.964'	012° 28.800'	11/12/2014 09:10
154740	45° 00.328'	012° 34.145'	11/12/2014 21:19
155680	45° 01.176'	012° 34.847'	11/12/2014 21:05
155700	44° 56.772'	012° 33.563'	11/12/2014 10:13
156720	44° 55.847'	012° 34.378'	11/12/2014 10:21
155690	44° 47.118'	012° 29.484'	11/12/2014 09:08

Table 1. Drifter deployment information.

Recovery operation started on 15 December and subsequently the ship stayed for 2 days in the harbor due to adverse wheather conditions. In Table 2 more details are described.

Drifter number	Lat.	Lon.	Time (UTC)	Covered distance (km)
151720	43° 10.380'	014° 01.242'	18/12/2014 13:25	282
151730	44° 35.361'	012° 26.462'	15/12/2014 08:00	78
151740	43° 10.480'	014° 04.520'	18/12/2014 11:16	261
152720	43° 21.893'	013° 59.851'	19/12/2014 07:28	263
154690	43° 29.185'	013° 38.503'	19/12/2014 10:03	244
154740	43° 21.002'	014° 00.818'	19/12/2014 07:46	231
155680	Not recovered			655
155700	43° 11.712'	014° 00.528'	18/12/2014 13:01	288
156720	43° 11.778'	014° 00.504'	18/12/2014 13:00	283
155690	44° 48.042'	012° 19.140'	stranded 18/12/2014	111

Table 2. Drifter recovery information.

In Figure 6 the drifter trajectories show a prevailing current towards south with a tendency to reach the coast in the vicinity of Marina di Ravenna. In one case, drifter 155690, there was a subsequent local northward coastal current that moved the drifter into shallow water, near Goro. In another case, drifter 154740, the GPS position

transmission failed for a long distance (about 95 km) for about four days, after this period the instrument operated fine.

Looking at the estimated speed graphs it is worth noting two distinct trends: the first from deployment position till about 150 km, showed speeds between 20 and 60 cm/s while the second one, from 150 km till the recovery, showed the speed to increase over 40 cm/s up to 80 cm/s. These graphs reveal that the trajectories were affected by inertial or tidal motions; these trends particularly apply to drifters 151720, 151740, 152720, 154690, 155700.

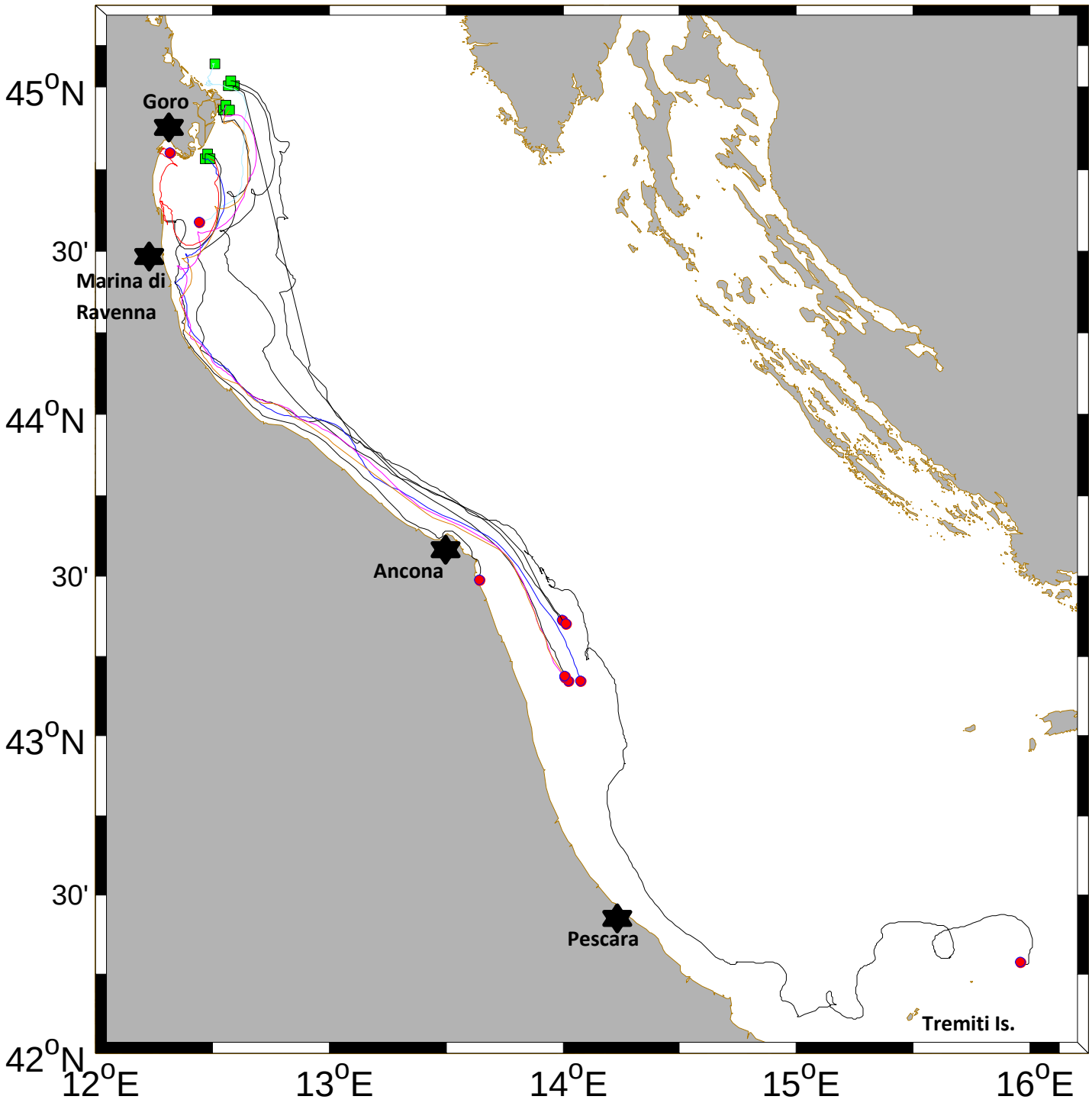

Figure 6. Drifter trajectories with deployment (green) and recovery (red) points.

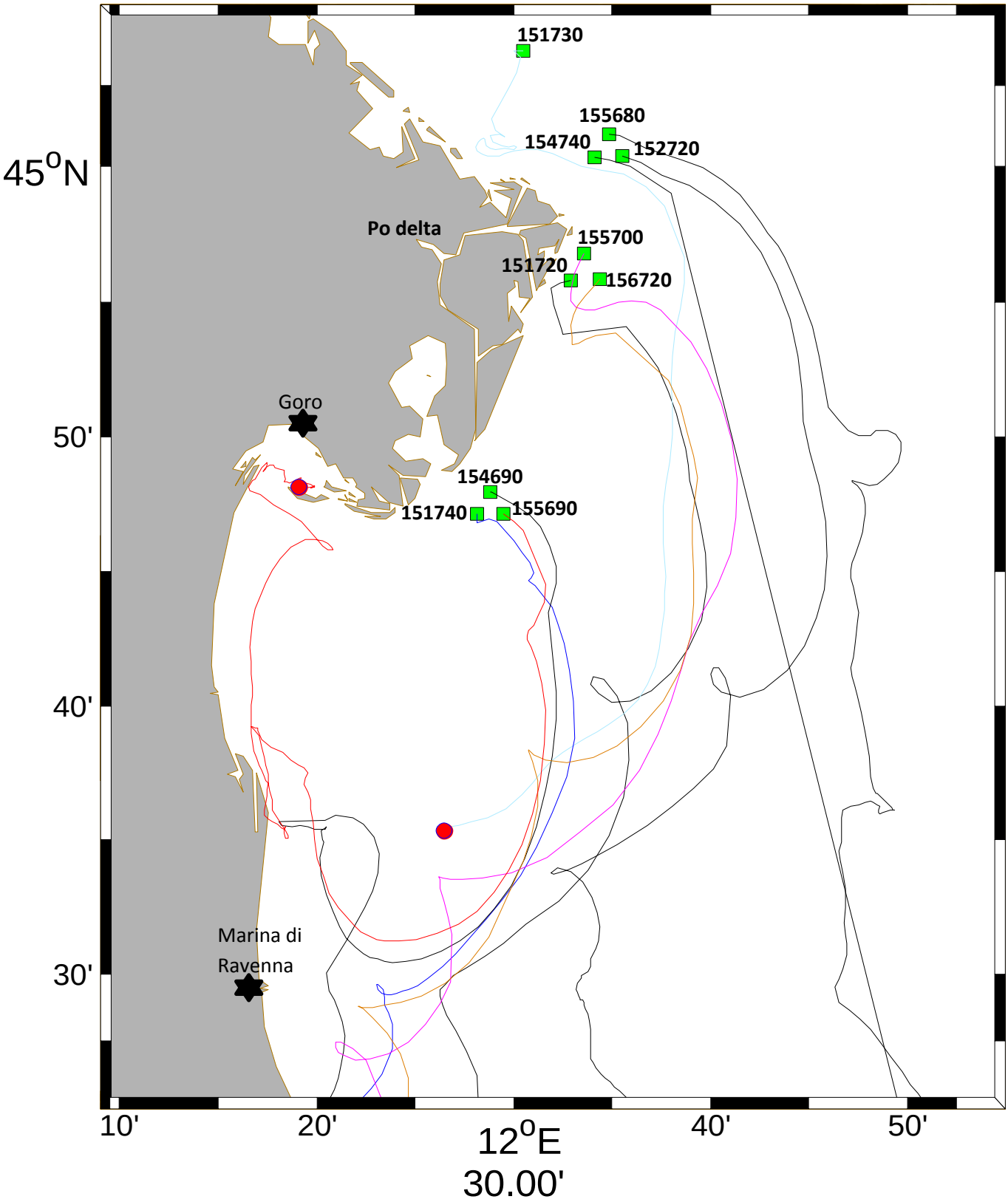

Figure 7. Drifter trajectories in the vicinity of the Po River delta.

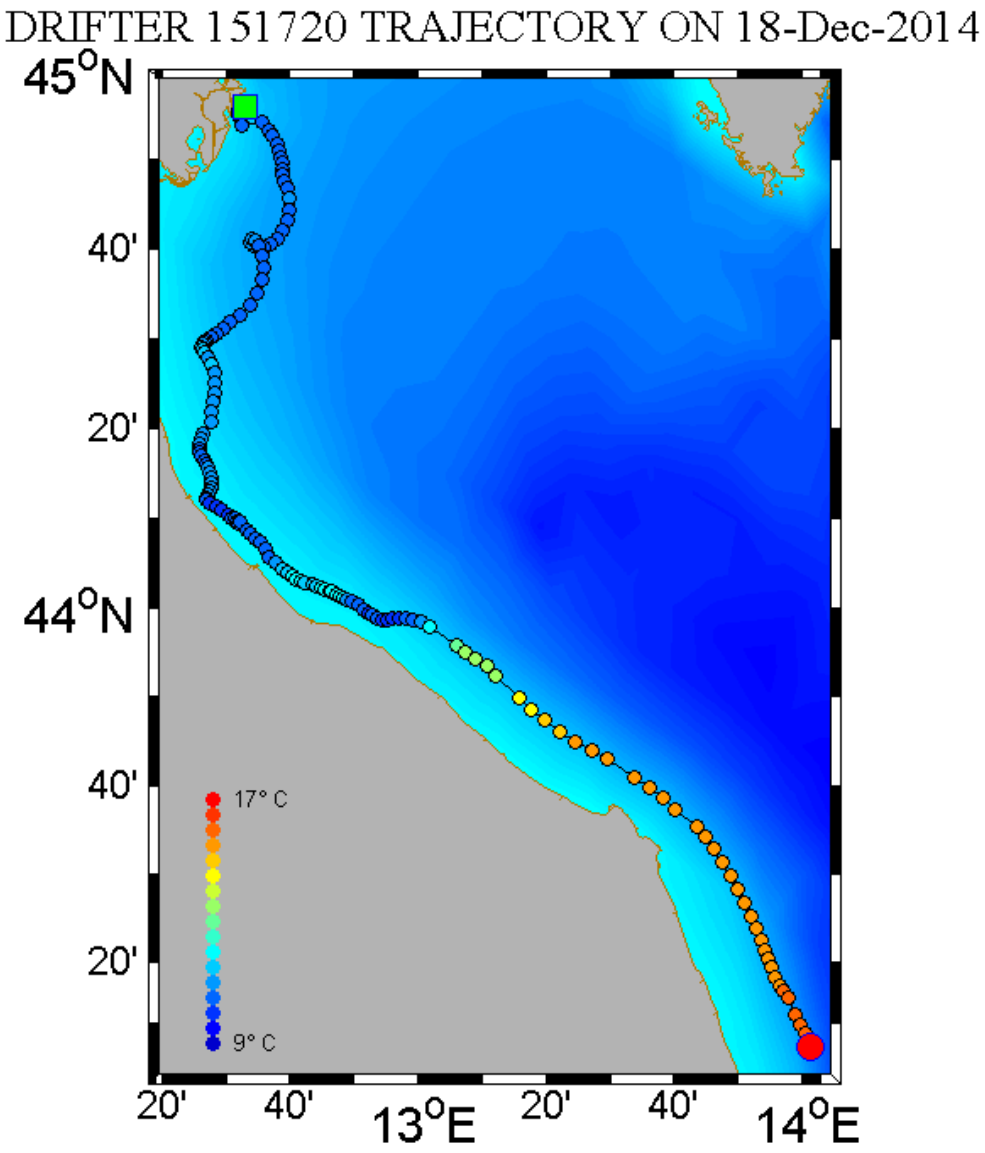

Figure 8. Drifter trajectory and sea surface temperature (color coded).

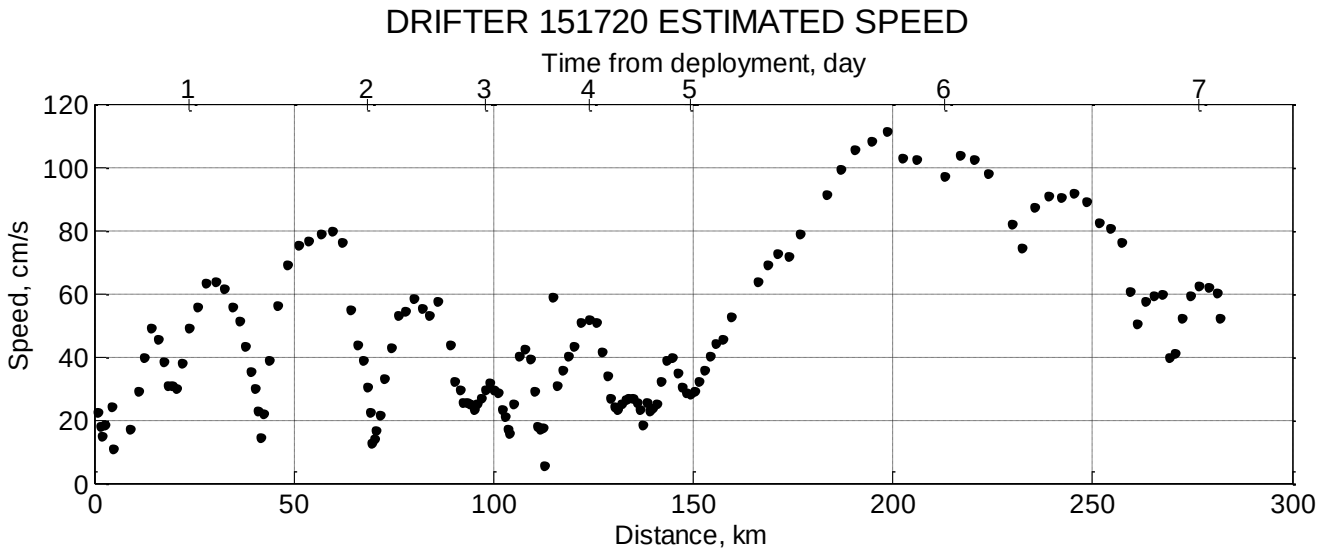

Figure 9. Drifter estimated speed.

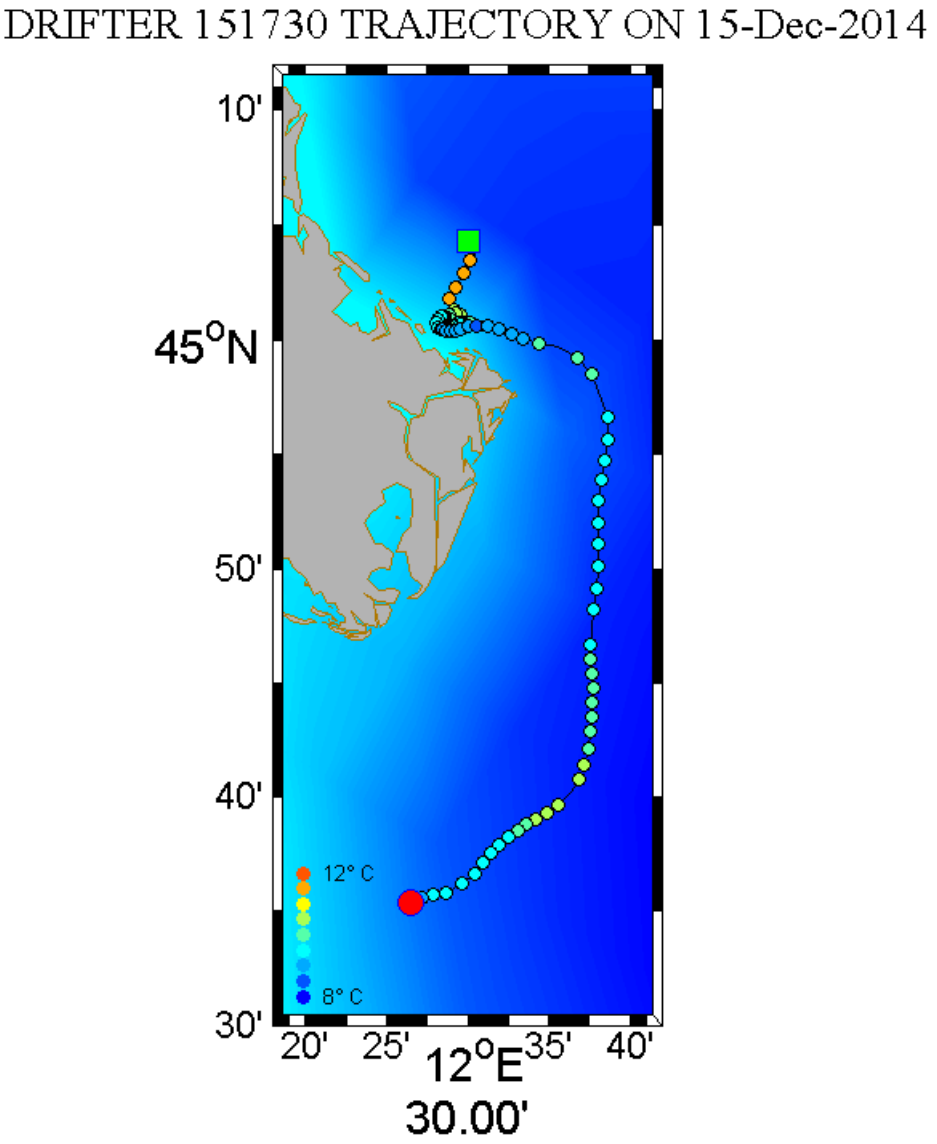

Figure 10. Drifter trajectory and sea surface temperature (color coded).

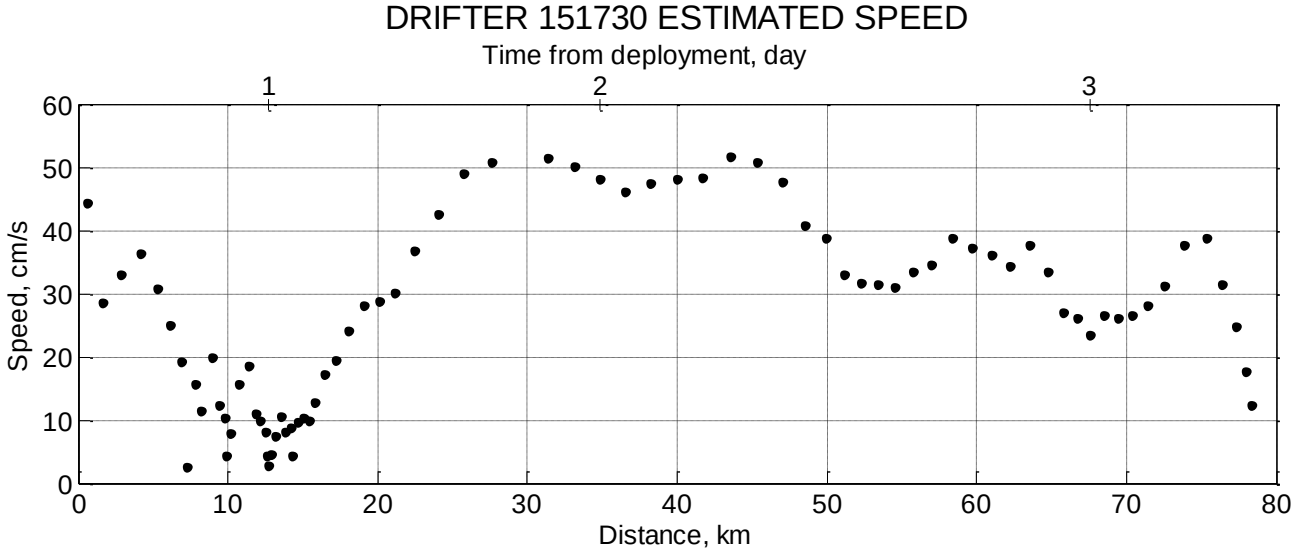

Figure 11. Drifter estimated speed.

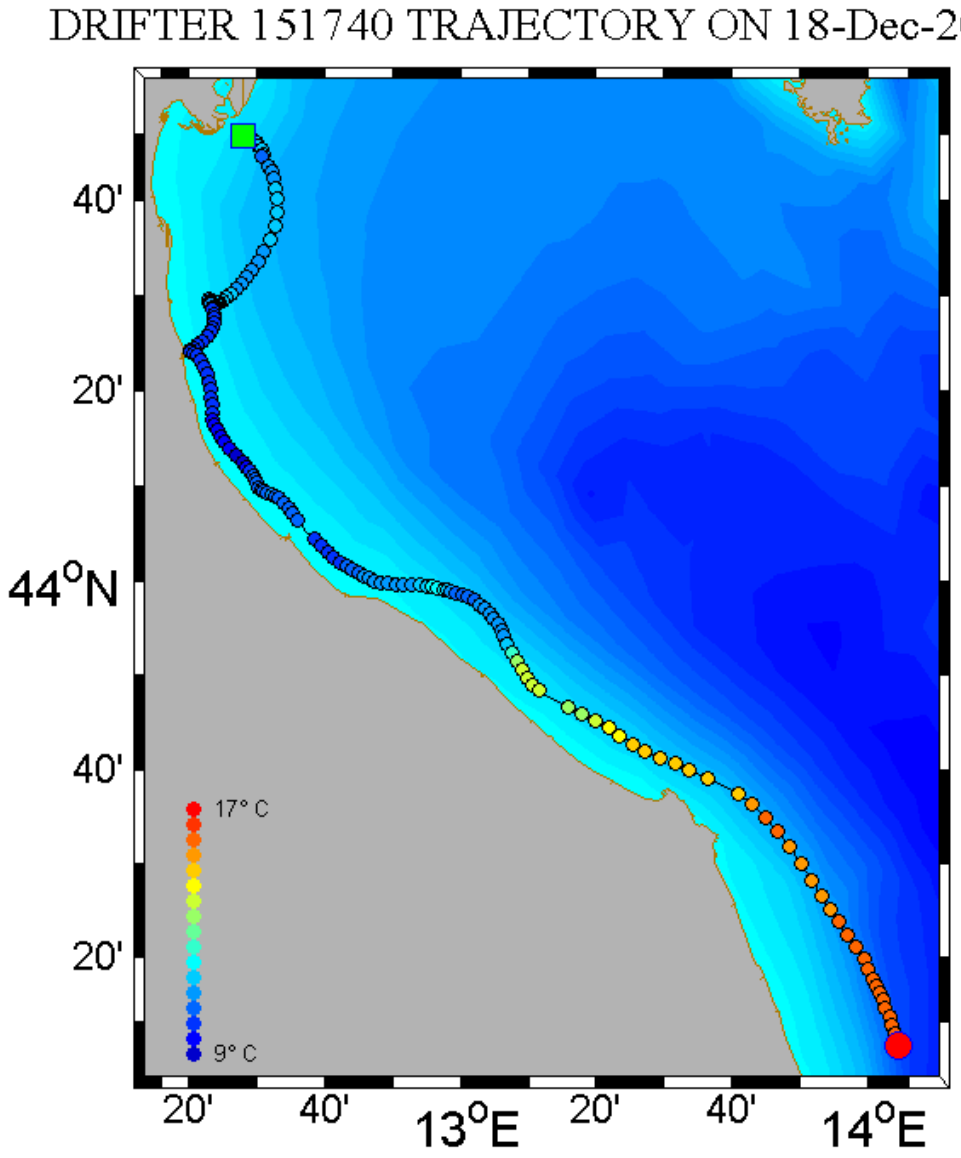

Figure 12. Drifter trajectory and sea surface temperature (color coded).

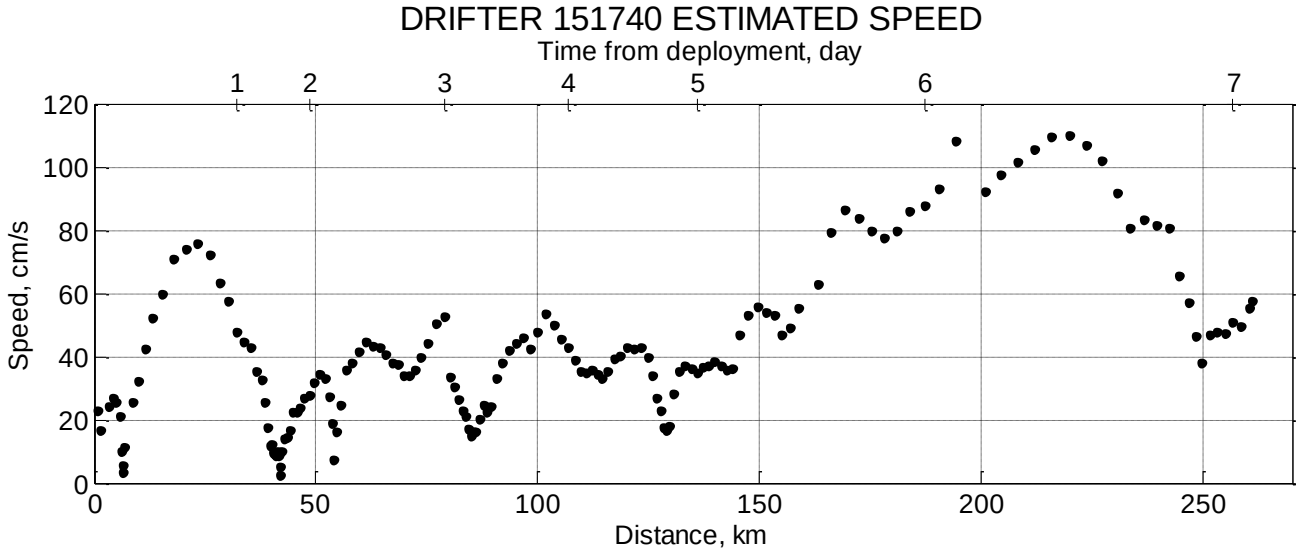

Figure 13. Drifter estimated speed.

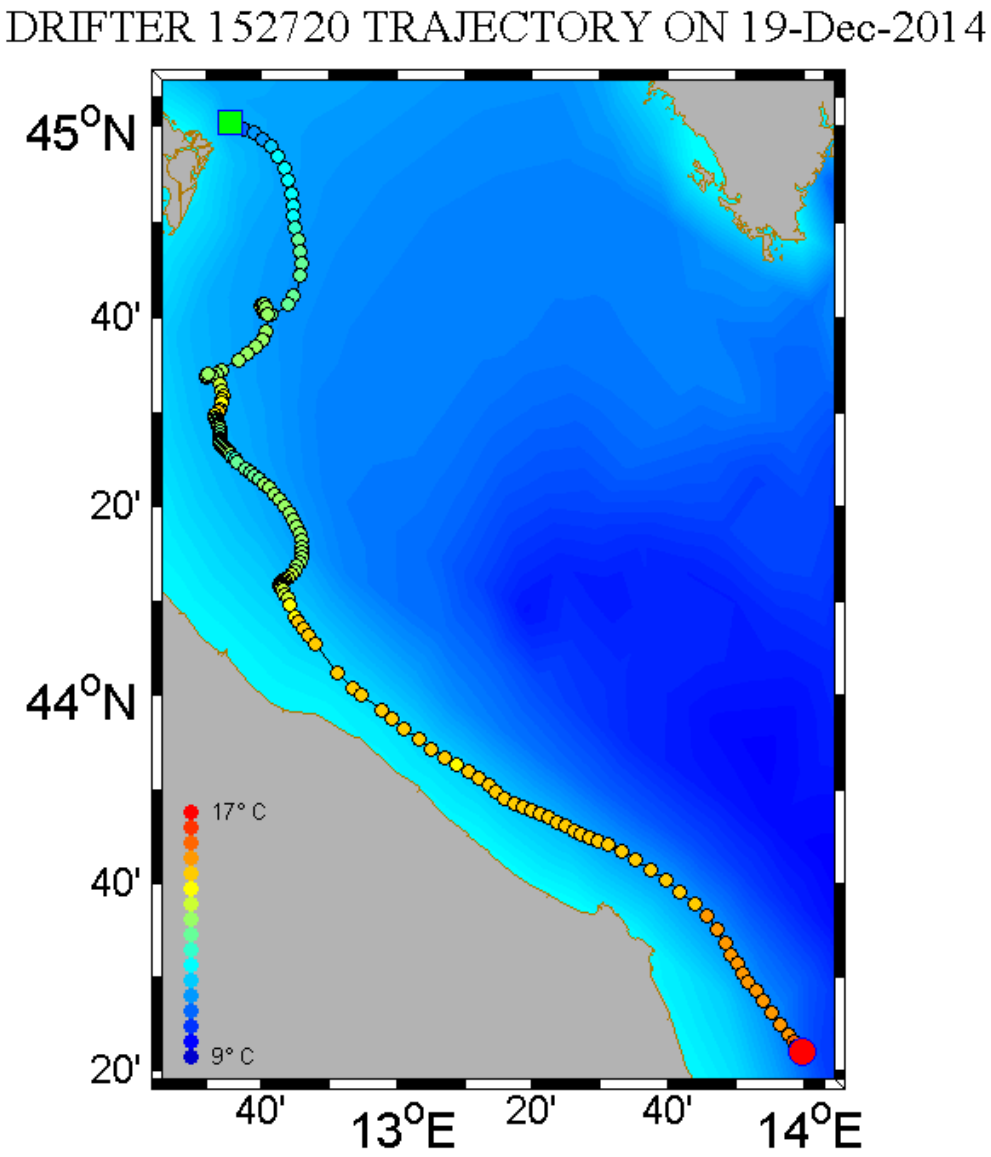

Figure 14. Drifter trajectory and sea surface temperature (color coded).

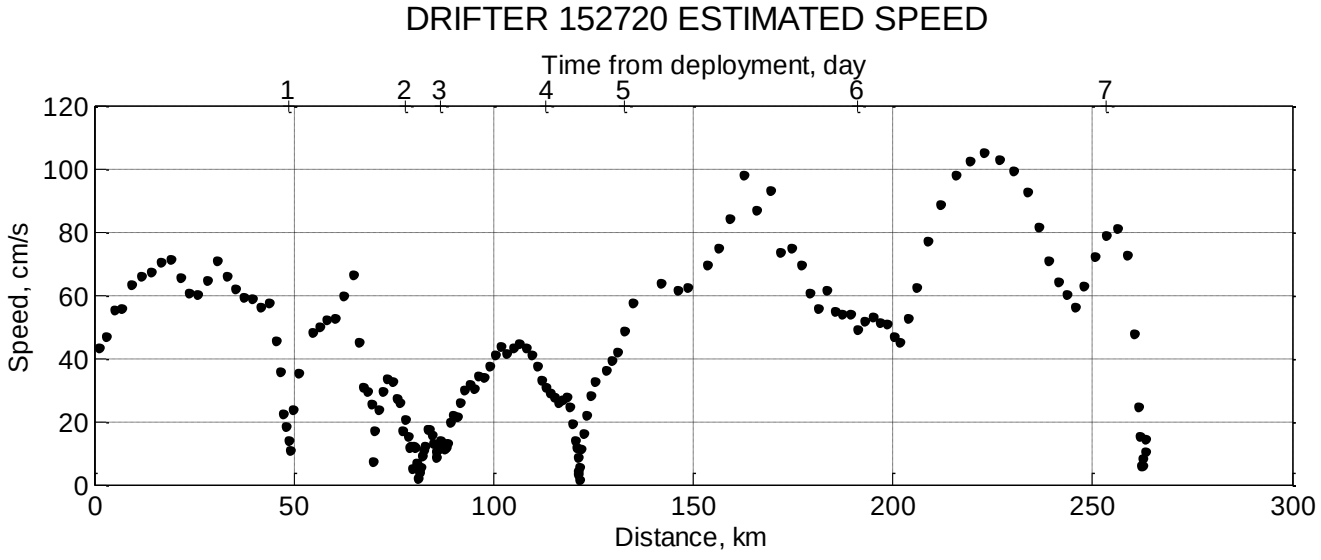

Figure 15. Drifter estimated speed.

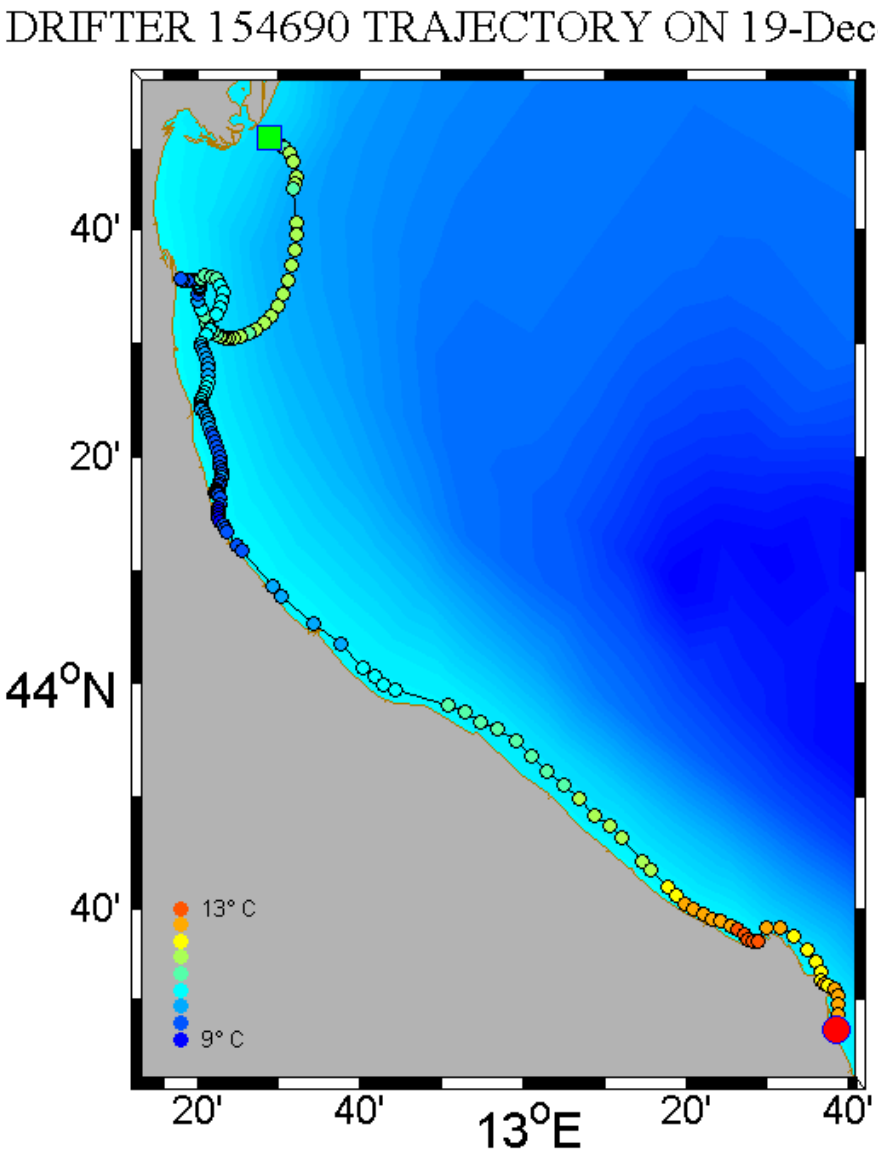

Figure 16. Drifter trajectory and sea surface temperature (color coded).

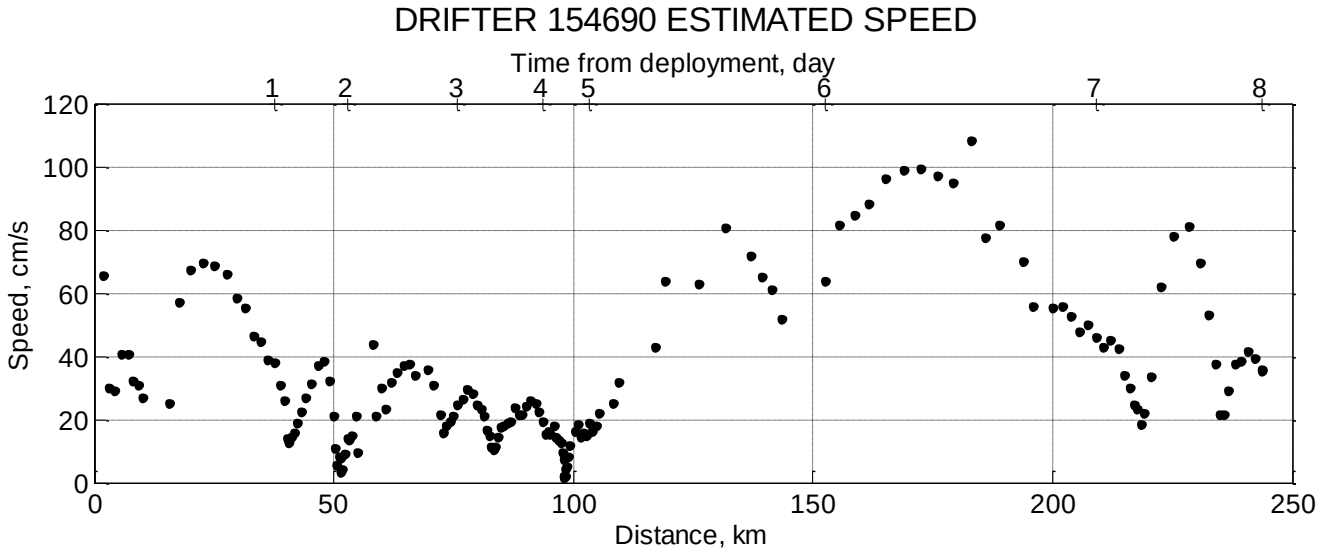

Figure 17. Drifter estimated speed.

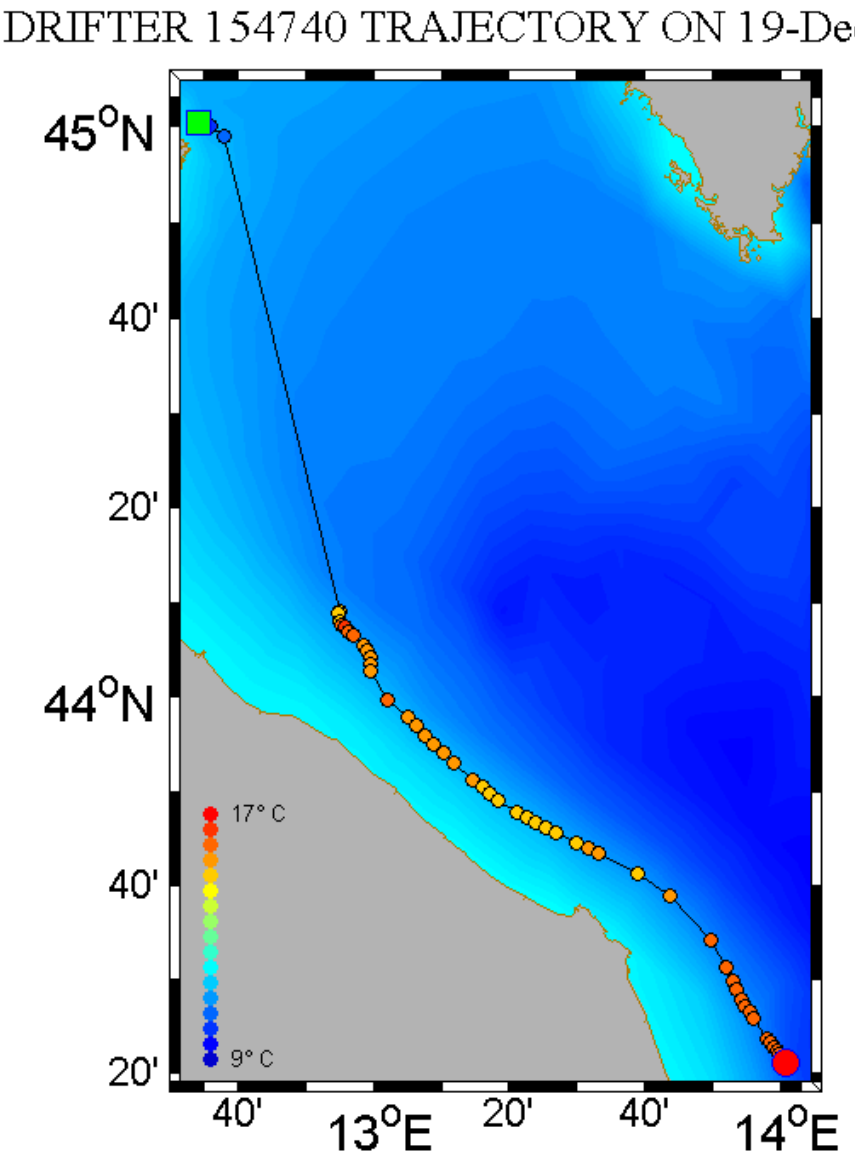

Figure 18. Drifter trajectory and sea surface temperature (color coded).

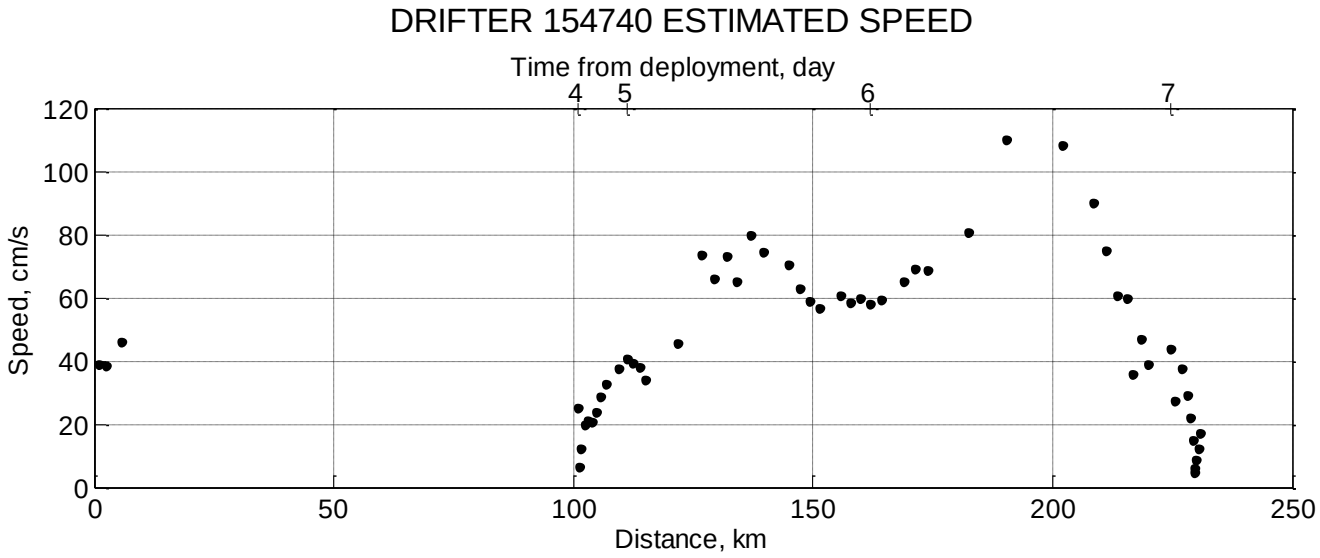

Figure 19. Drifter estimated speed.

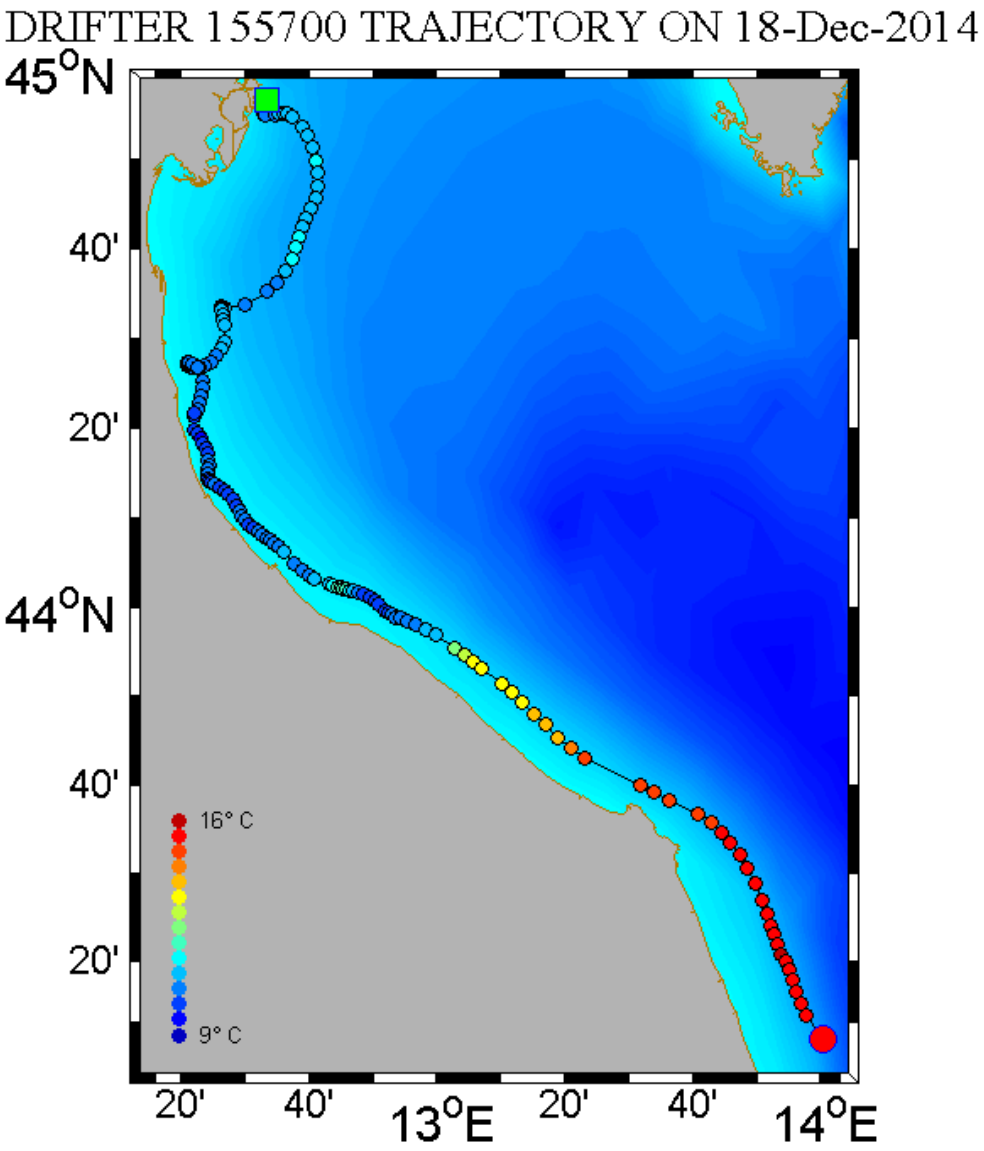

Figure 20. Drifter trajectory and sea surface temperature (color coded).

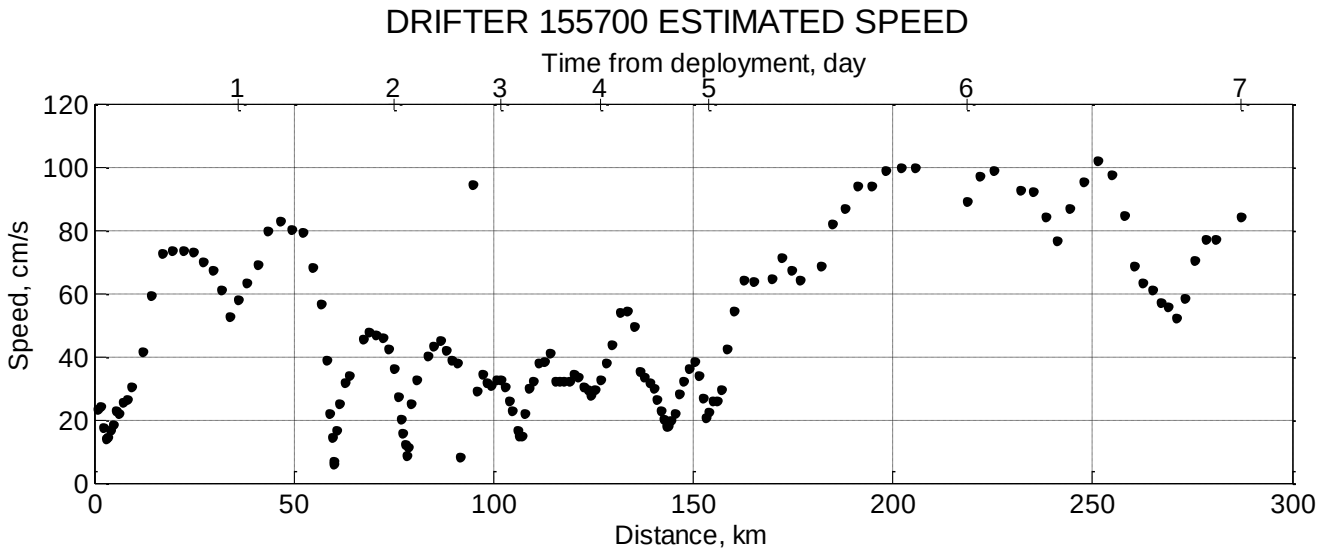

Figure 21. Drifter estimated speed.

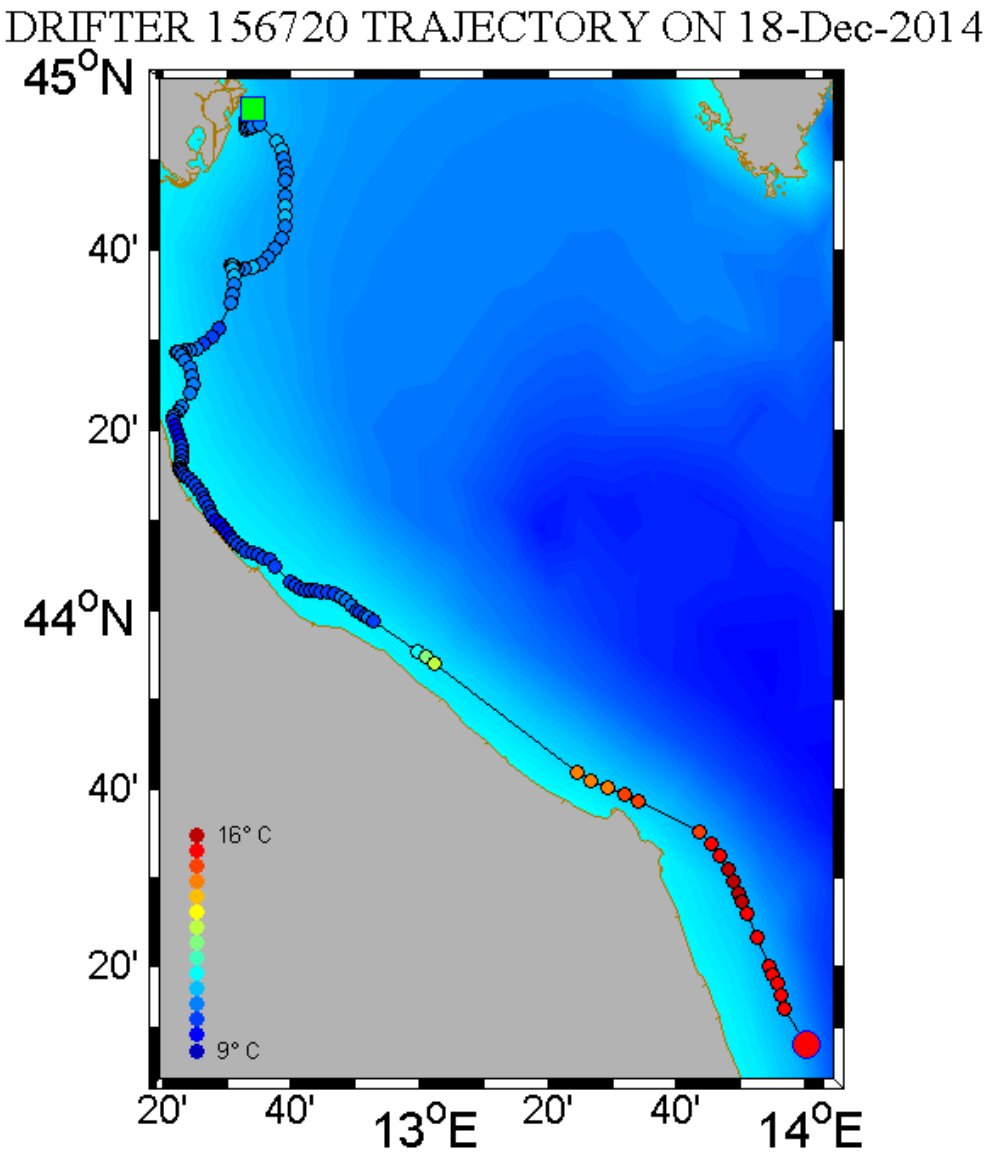

Figure 22. Drifter trajectory and sea surface temperature (color coded).

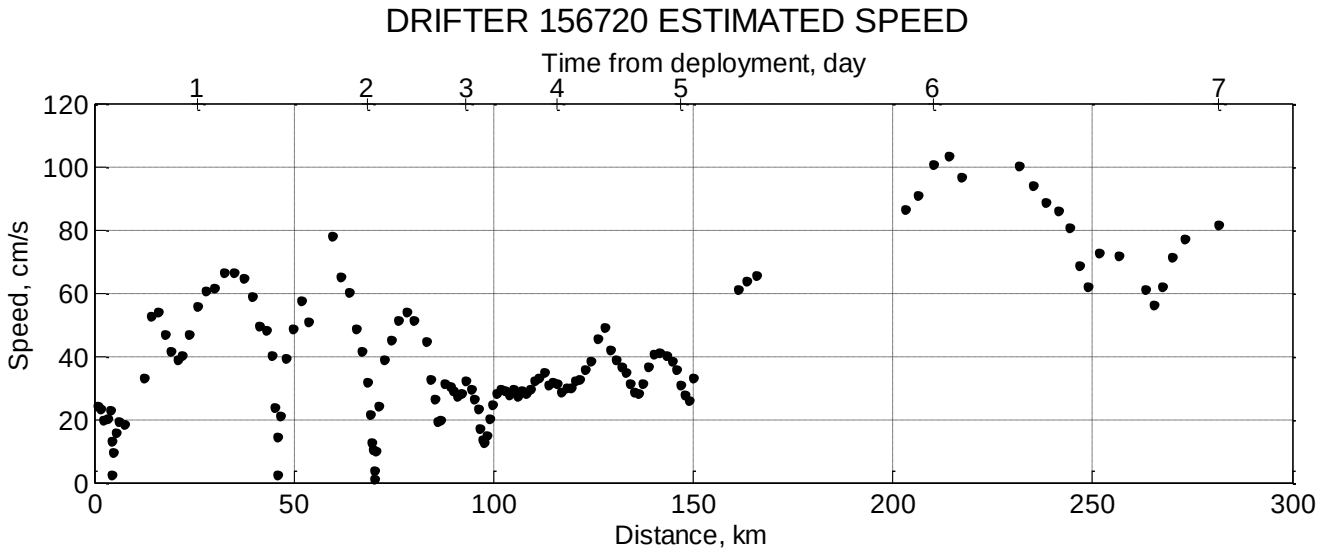

Figure 23. Drifter estimated speed.

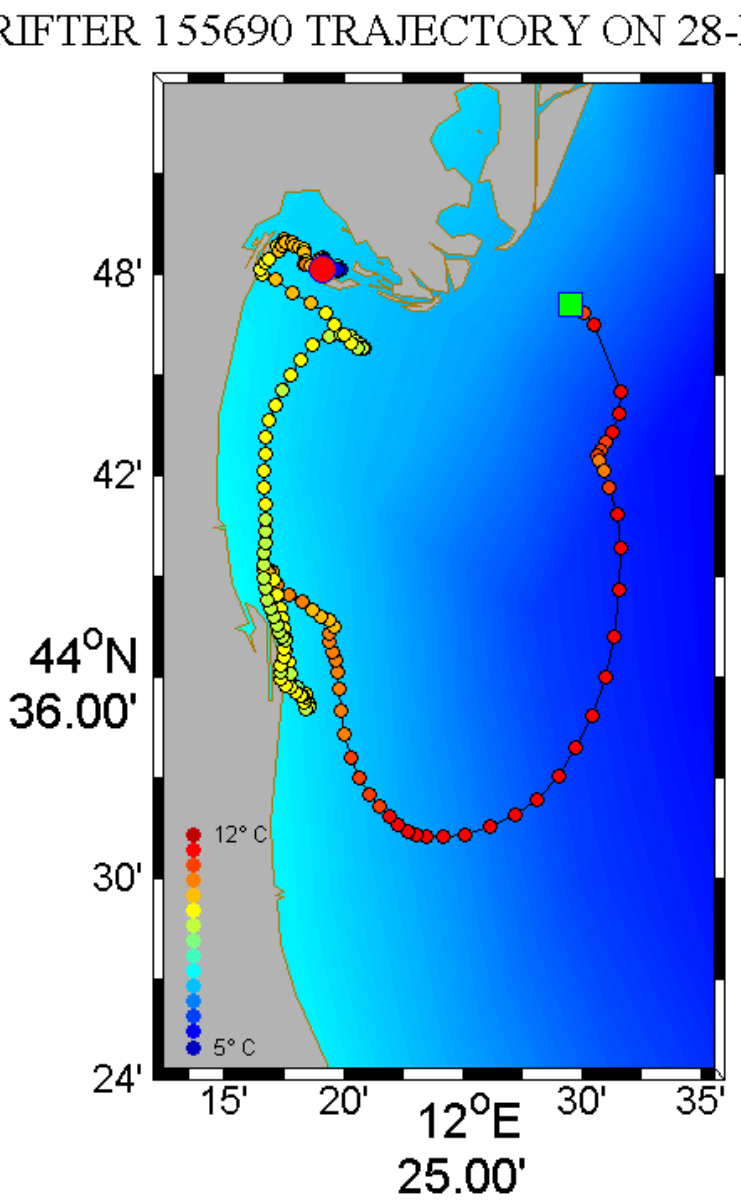

Figure 24. Drifter trajectory and sea surface temperature (color coded).

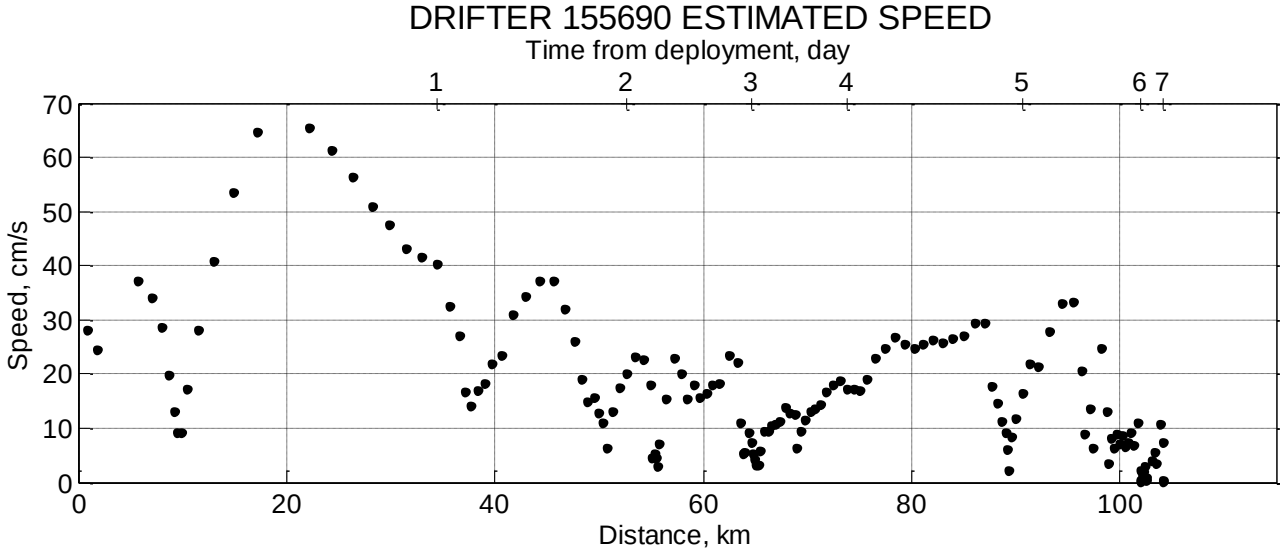

Figure 25. Drifter estimated speed.

3.1 Drifter 155680: communication lost on 16/01/15

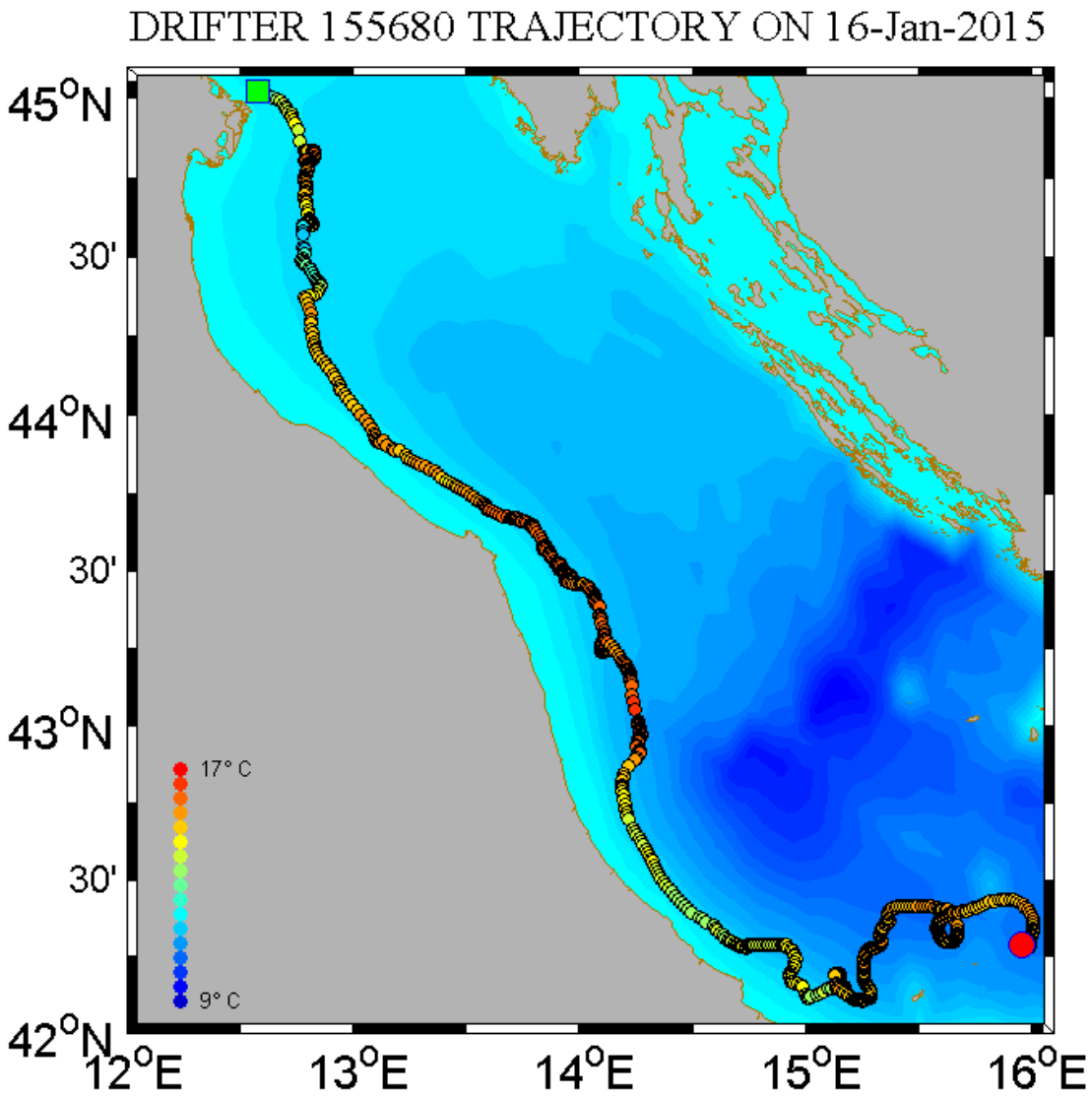

Figure 26. Drifter trajectory and sea surface temperature (color coded).

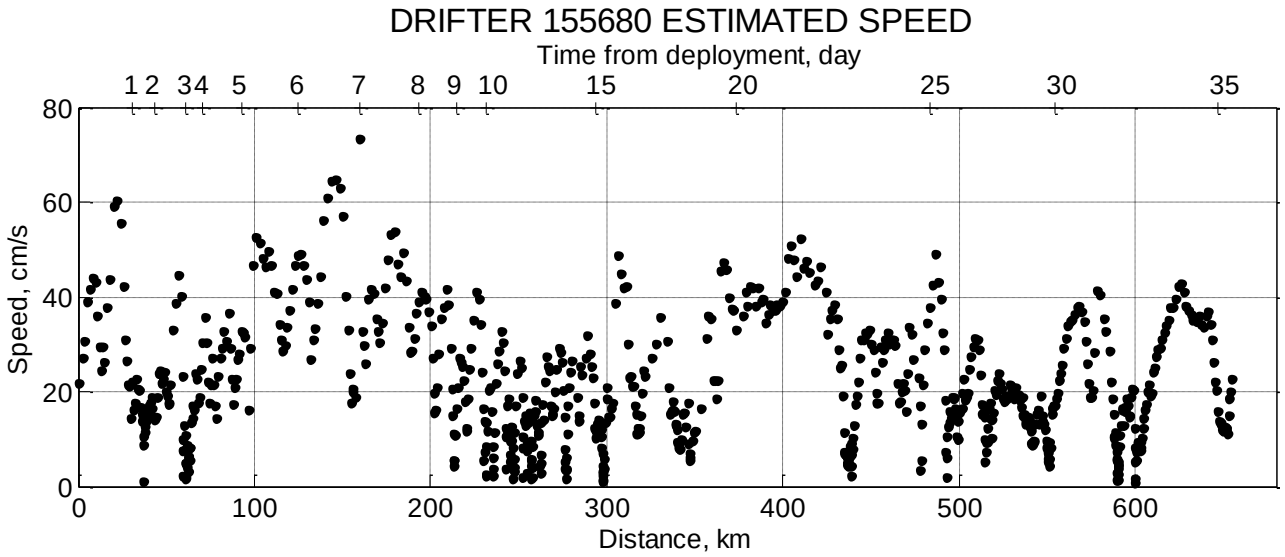

Figure 27. Drifter estimated speed.

5. Conclusions

This experiment allowed to observe and quantify the surface currents in front of the Po delta area for a period of about 8 days and after a moderate plume event. All the instruments worked fine and were fully recovered excepting one that reached the south Adriatic Sea. The trajectories revealed an averaged current along the Italian coast, towards south, that ranged between 20-50 cm/s with strong variability. The instruments were essentially trapped by the Western Adriatic Current (WAC). Many speed graphs revealed that the trajectories were affected by inertial or tidal motions; the averaged covered distance was about 270 km.

6. Acknowledgments

The authors would like to thank Christian Ferrarin and Debora Bellafiore from CNR-ISMAR Venezia for the help with the forecasting of surface currents useful for the drifter recoveries. Special thanks also go to the crew of R/V G. Dallaporta.

7. References

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