Near-Surface Dispersion and Circulation in the Marmara Sea
(MARMARA)

Pierre-Marie Poulain
Istituto Nazionale di Oceanografia e di Geofisica Sperimentale
Borgo Grotta Gigante, 42/c
34010 Sgonico (Trieste), Italy
Phone: +39 040 2140322 Fax: +39 040 2140266 Email: ppoulain@ogs.trieste.it
Award #: N000140810943
http://poseidon.ogs.trieste.it/sire/drifter/marmara_main.html

LONG-TERM GOALS

To investigate the dynamics of semi-enclosed seas dominated by buoyancy input and wind forcing, and influenced by complex topography. To improve the understanding of coastal marine environmental evolution, with particular emphasis on eddy dynamics.

OBJECTIVES

The main objective of the MARMARA project is to study the near-surface dispersion and circulation in the Marmara Sea, a small (70 x 250 km) basin connecting the Mediterranean Sea (through the Dardanelles Strait) to the Black Sea (via the Bosphorus Strait). It is planned to study the surface circulation dynamics of the Marmara Sea at scales from inertial/tidal to seasonal using drifter observations and ancillary satellite data (SST and ocean color) over about a year (from summer 2008 to spring 2009), in conjunction with other observational programs and numerical simulation exercises conducted by colleagues in the Turkish Straits System.

APPROACH

Surface drifters will be deployed in two main episodes (in late summer 2008 and late winter 2009) at key locations to maximize the geographical coverage in the Marmara Sea and to construct maps of mean circulation and eddy variability, in terms of seasons and major wind regimes (Eulerian statistics). The deployments will mostly be in small (1 nm) clusters of three drifters in order to assess the horizontal dispersion of the surface waters (Lagrangian dispersion statistics). The drifter data will also be used in concert with satellite images (sea surface temperature and ocean color) to describe qualitatively the surface dynamics.

WORK COMPLETED

Drifters of CODE design with Argos telemetry and GPS positioning (Fig. 1) were acquired from Technocean (Cape Coral, Florida, USA). The Technocean CODE drifters have been shown to follow the water within 2-3 cm/s even in strong wind/wave conditions.
1. REPORT DATE  
30 SEP 2008

2. REPORT TYPE  
Annual

3. DATES COVERED  
00-00-2008 to 00-00-2008

4. TITLE AND SUBTITLE  
Near-Surface Dispersion And Circulation In The Marmara Sea (MARMARA)

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

6. AUTHOR(S)  
National Institute of Oceanography and Experimental Geophysics, Borgo Grotta Gigante, 42/c, 34010 Sgonico (Trieste), Italy,

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)  
National Institute of Oceanography and Experimental Geophysics, Borgo Grotta Gigante, 42/c, 34010 Sgonico (Trieste), Italy,

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)  

10. SPONSOR/MONITOR’S ACRONYM(S)

11. SPONSOR/MONITOR’S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT  
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES  
code 1 only

14. ABSTRACT  
To investigate the dynamics of semi-enclosed seas dominated by buoyancy input and wind forcing, and influenced by complex topography. To improve the understanding of coastal marine environmental evolution, with particular emphasis on eddy dynamics.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:  
a. REPORT  
unclassified

b. ABSTRACT  
unclassified

c. THIS PAGE  
unclassified

17. LIMITATION OF ABSTRACT  
Same as Report (SAR)

18. NUMBER OF PAGES  
4

19a. NAME OF RESPONSIBLE PERSON

Standard Form 298 (Rev. 8-98)  
Prescribed by ANSI Std Z39-18
RESULTS

Out of 12 drifters, two units failed to transmit right after deployment (see Fig. 2). Given the relatively small size of the Marmara Sea and the high probability of pick-up by seafarers, the operating lifes of the drifters are rather short. For example, five drifters provided data for 3-4 days before stranding or being picked-up. In less than a month, 7 drifters ended up on the southern coast. One lucky unit (Argos number 85198) is still drifting with the currents as of 29 September, that is about a month after deployment. Its trajectory shows intricate loop motions in addition to a basin-wide anticyclonic circulation (yellow trajectory in Fig. 3).

As expected, the drifters reveal a general surface flow to the southwest in the Marmara Sea, connecting the Bosphorus to the Dardanelles (see trajectories in Fig. 3). Contrasting this mean circulation picture, two drifters (85198 and 85203) followed a basin-wide anticyclonic flow pattern with eastward currents prevailing to the north. Smaller meandering and looping drifter trajectory segments indicate the existence of mesoscale circulation features and inertial oscillation motions throughout the basin.
Fig. 2. Timelines of the CODE drifters deployed in the Marmara Sea on 30/31 August 2008, updated as of 29 September 2008. Black lines indicate stranded drifters.

Fig. 3. Trajectories of the CODE drifters deployed in the Marmara Sea on 30/31 August 2008. Deployment locations are depicted with star symbols whereas open circles indicated the last fixes (stranded or still active in water on 29 September 2008).

IMPACT/APPLICATION

The scientific impact of this project is to increase our understanding of the Marmara Sea dynamics and of its major forcing mechanisms. Future application could be the validation of diagnostic numerical models and the assimilation of the drifter data into prognostic numerical models in the framework of operational oceanography projects.
RELATED PROJECTS

The MARMARA project is strongly related to, and fully integrated in, projects carried by the Naval Research Laboratory (NRL), NURC and the University of Miami in the Turkish Strait System (Northeastern Aegean, Marmara and Southwestern Black seas).

These programs include:

- The TSS08 project conducted by NURC (P.I. Dr. S. Besiktepe)
  (http://geos2.nurc.nato.int/tss08/html/home.html).

- The NRL Exchange Processes in Ocean Straits (EPOS) project to improve our understanding on the significance of synoptic variability to exchange dynamics in ocean straits (P.I.s: Drs. J. Book and E. Jarosz).

- Development of a multi-scale coupled ocean model system for the Turkish Strait System by NRL (P.I.: Dr. C. A. Blain).

- Coastal and shelf modeling activities carried out at the Rosenstiel School of Marine and Atmospheric Science (University of Miami) (P.I. Dr. V. Kourafalou).
  (http://coastalmodeling.rsmas.miami.edu/Models/View/AEGEAN_SEA)