SIMULATED LAGRANGIAN MOTION IN THE TYRRHENIAN SEA

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We present the results of a set of numerical experiments aimed at simulating typical seasonal patterns of Lagrangian motion in the Tyrrhenian Sea. A sub-basin of the Western Mediterranean, the Tyrrhenian Sea, is enclosed by very densely populated regions. The knowledge of its Lagrangian circulation is, therefore, valuable for its possible ecological significance. The main exchanges between the Tyrrhenian and the surrounding basins occur in the North through the relatively narrow and shallow Corsica Channel and in the South through the wide opening between Sardinia and Sicily, which is dominated by recirculations of incoming and outgoing flow. Rather than by a net and stable stream flux, the circulation of the basin is dominated by a system of sub-basin scale gyres, characterized by typical length scales of the order of 150-200 km; the baroclinic Rossby radius of deformation in this area is 10-12 km. Its dynamics, and in particular the dynamics of the cyclonic gyre just East of Bonifacio Straits, have been the focus of the TEMPO experiment carried out in 1989, collecting a wide range of *in situ* and remotely measured meteorological and oceanographical parameters (see TEMPO Group, 1991).

Significant seasonal variability of this gyre circulation pattern has been shown by the results of several hydrographic surveys. In order to shed some light on the fraction of the Tyrrhenian dynamics induced by wind forcing, the surface circulation of the basin recently has been investigated by means of a simple barotropic model (ARTALE *et al.*, 1994). The model solves the barotropic equation for the vorticity conservation in the Stommel form (i.e. where dissipation is represented by a bottom friction term).

The circulation is forced by wind stress in the interior of the basin and by water mass exchange between the Tyrrhenian Sea and adjacent basins north and south of it. The four typical cases considered, one for each season of the year, are characterized by climatological mean wind stress patterns and water mass in-/outflows at the boundaries. Correspondingly, four steady-state streamfunction fields are obtained, displaying strong seasonal variations, in which three main gyres can be discerned. In the seasonal steady-state output velocity fields, simulated Lagrangian surface drifters are deployed. The Lagrangian velocity field is the combination of two factors: the mean flow, which is represented by the model output velocity field; and the turbulent part of the velocity, determined by a random flight model, which assumes it to behave as a Markovian process in time. The parameters characterizing the turbulent part of the motion are drawn from drifter data gathered in the framework of the TEMPO experiment (RUPOLO *et al.*, 1994), using techniques of parametrical estimation introduced very recently (GRIFFA *et al.*, 1994).

The resulting simulated seasonal Lagrangian patterns are presented and discussed, as well as compared with available Lagrangian data for the area.

REFERENCES

ARTALE V., ASTRALDI M., BUFFONI G., GASPARINI G.P., 1994. Seasonal Variability of the Gyre-Scale Circulation in the Northern Tyrrhenian Sea. *J. Geophys. Res.*, 99, C7 : 14127-14137.
GRIFFA A., OWENS K., PITERBARG L., ROZOVSKY B., 1994. Estimates of Turbulence Parameters from Lagrangian Data Using a Stochastic Particle Model. *J. Marine Res.*, in press.
RUPOLO V., ARTALE V., GASPARINI G.P., PROVENZALE A., 1994. A Study of Lagrangian Diffusion in the Tyrrhenian Sea. *J. Marine Res.*, submitted for publication.
TEMPO Group, 1991. Tyrrhenian Eddy Multi-Platform Observations 1989 Experiment: Inventory of the Measurements and Preliminary Results. IFA-CNR Tech. Rep., 1, pp. 69.

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INVASION OF POMO PITS (MIDDLE ADRIATIC SEA) BY A COLD WATER MASS DURING SPRING 1993

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In the framework of the C.N.R. project "Study of the dynamical process and circulation of the Italian Seas" (PASCHINI *et al.*, 1993), two cruises were carried out in the Middle Adriatic Sea (fig. 1) from 10 May to 7 June 1993 (Spring period). In the first cruise, an area of 42 x 36 nautical miles were covered in about 2.5 days, with 149 stations every 2 miles, alternatively with 77 CTD casts and 74 XBT launches, distributed on 7 transects. In the second cruise, in about 3 days the same area of the first cruise with one more transect to the South was covered with 87 CTD casts and 99 XBT launches.

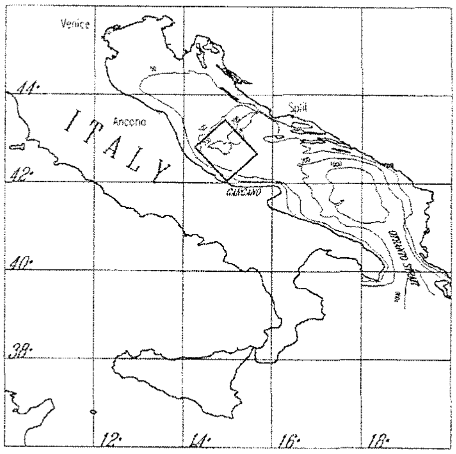

Fig. 1. Area of investigation.

A Sea Bird SBE 9/11 CTD (Conductivity, Temperature and Depth) coupled with twelve bottles GO Rosette sampler were used. The CTD was outfitted with additional sensors measuring oxygen, fluorescence and height above the bottom. In every CTD stations samples were taken at different depths for the oxygen content determination with the Winkler method; every two CTD stations water samples were taken at different depths also for the nutrients (nitrite, nitrate, phosphate and silicate) determination. In this communication only the data collected with the CTD casts are examined.

An evident evolution was registered in almost all the parameters going from the first to second cruise. The surface layer is warmer and much more less saline in the second cruise with a more pronounced thermocline; at the contrary the bottom layer of the Pomo Pit is colder than in the first survey.

In the second cruise, at around 50 m depth, is present a well pronounced salinity maximum (S > 38.6 PSU) characteristic of the MLIW (Modified Intermediate Levantine Water) (ARTEGIANI *et al.*,1994). The average fluorescence maximum depth is about the same (60 m) during the two surveys, but the maximum values, in the second cruise, is about the double than in the first one.

The dense and cold North Adriatic bottom water, still evident along Italian continental shelf in the first cruise, occupied, during the second cruise, the Pomo depression from the South side, following the isobath of about 150 m with a cyclonic path. This is particularly evident from figures 2a and 2b showing the bottom (only 2-4 meters from the sea bottom) temperature distribution during the two cruises.

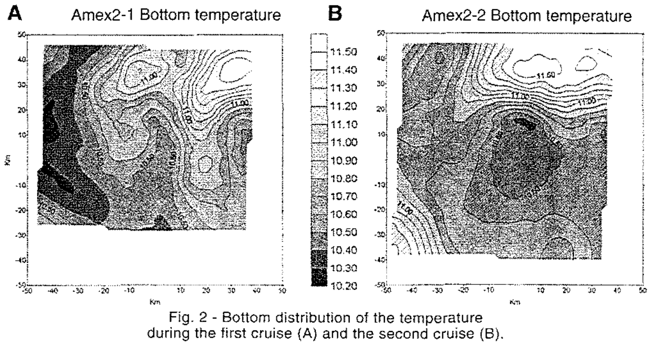

Fig. 2 - Bottom distribution of the temperature during the first cruise (A) and the second cruise (B).

REFERENCES

ARTEGIANI A., D. BREGANT, E. PASCHINI, N. PINARDI, F. RAICICH and A. RUSSO, 1994. The Adriatic Sea General Circulation Part I: air-sea interactions and water mass structure, submitted to *Journal of Physical Oceanography*.
PASCHINI E., ARTEGIANI A. and PINARDI N., 1993. The mesoscale eddy field of the Middle Adriatic Sea during fall 1988. *Deep Sea Research*, I, Vol. 40, No 7, pp. 1365-1377.