NUTRIENT DISTRIBUTIONS AND FLUX ESTIMATES IN THE WESTERN MEDITERRANEAN SEA

K. Schröder [1] *, M. Borghini [1], G. Cerrati [2], V. Difesca [2], R. Delfanti [2], G.P. Gasparini [1], A. Vetrano [1]

[1] CNR - ISMAR / Sezione di La Spezia, Forte Santa Teresa, 19036 Pozzuolo di Lerici, Italy,[2.] ENEA - CRAM Forte Santa Teresa, 19036 Pozzuolo di Lerici, Italy - katrin.schroder@santateresa.enea.it

[2] ENEA - CRAM Forte Santa Teresa, 19036 Pozzuolo di Lerici, Italy

Abstract

In spring 2005 an oceanographic survey was carried out in the central part of the western Mediterranean basin. Hydrological data and nutrient distributions were analyzed along eight transects. The distribution of physical properties evidenced the peculiarity of winter 2004/2005, which was characterized by the formation of a significant amount of new WMDW. The geostrophic transports across each transect were estimated with an inverse box model, allowing the assessment of the exchanges between sub-basins. Mass transport estimations permitted the computation of the biogeochemical fluxes between sub-basins. Finally, nutrient mass balances enabled us to estimate new production in the inner basins.

Keywords : Circulation Models, Hydrology, Inverse Methods, Western Mediterranean.

In spring 2005 the central part of the Western Mediterranean Sea has been investigated, in order to better define the pathway, the physical and the biochemical properties of the water masses involved in the circulation of this basin. Hydrological data and nutrient distributions were analyzed along eight transects.

The aim of this study was the assessment of the nutrient distribution in key regions of the Western Mediterranean Sea (WMED) and the estimation of the biogeochemical fluxes between sub-basins, by means of an inverse box model. This should be a first attempt to quantify the nutrient budgets in different sub-basins of the WMED.

The distribution of physical properties (temperature, salinity and density) evidenced the peculiarity of winter 2004/2005, which was characterized by the formation of a significant amount of new Western Mediterranean Deep Water (WMDW) [1]. The biogeochemical features appear strongly associated with the hydrodynamical patterns, with a close relationship between chemical parameters and water mass distribution.

Two typical nutrients vertical profiles were found in the investigated area (see figure 1). The first profile refers to the southern part of the WMED, where the *new* WMDW has not been found: concentrations, very low in the surface layer, increase with depth, reaching a maximum in the intermediate layer, occupied by the oldest water mass found in this region, the LIW. In the deep layer nutrient concentrations are relatively high. A different situation is found in the second type, which refers to the north-western part of the WMED, where significant amounts of the *new* WMDW were found. The surface concentrations are higher and the intermediate ones lower. The reason may be the convective processes acting in this area during the dense water formation period, which may have lead to a considerable mixing between the two water masses. Further, the deep layer, which was occupied by a newly formed water mass, shows a strong decrease in nutrient concentrations. This is because the *young* water mass has not had the time to accumulate nutrients and to remineralize the whole amount of organic matter.

The geostrophic currents and mass transports across each transect were estimated with an inverse box model, imposing the conservation of mass, heat and salt in closed volumes of water (5 boxes). Mass transport estimations permitted the computation of the biogeochemical fluxes between sub-basins. If the import exceeds the export there is a nutrient sink inside the box, i.e. the nutrient amount entering the box is higher than the amount leaving it, therefore there has to be a nutrient consuming process (sink). On the other hand, if the export exceeds the import, there is a nutrient producing process inside the box, a source.

Generally there is a nutrient sink in the surface layers, to which corresponds a deep source [2]. A nutrient sink may be attributed to primary production in the euphotic zone, which consumes nutrients, or to vertical fluxes inside the box. The last term has not been quantified by the inverse model. The deep nutrient source, instead, may be attributed to remineralization of organic matter, which has been exported from the euphotic zone, to vertical fluxes of inorganic nutrients, and to horizontal import of organic matter and therefore to the export production of bordering areas.

Attributing the deep nutrient sources to the remineralization of organic matter and therefore to the previously exported production, it is possible to estimate the export production of the area [3]. In order to perform this computation we used the classical Redfield ratio (C:N:P = 106:16:1). For the whole box we found an export production of 80 - 90 mg C m^{-2} d^{-1}. These values agree with the estimated ranges of Béthoux (1989, [3], corrected by [4]) for the WMED, comprised between 68 and 123 mg C m^{-2} d^{-1}.

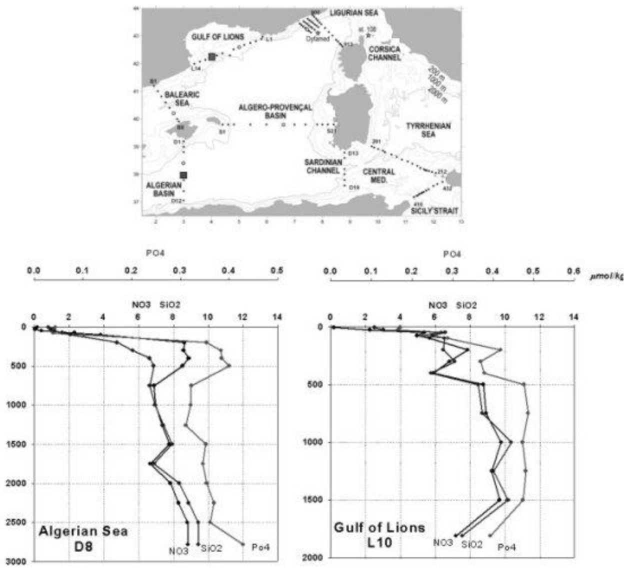

Fig. 1. Station map and two typical nutrient profiles.

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