DENSE WATER FORMATION IN THE SOUTHERN ADRIATIC SEA ASSOCIATED WITH VARIATIONS OF THE THERMOHALINE CIRCULATION IN THE IONIAN SEA DURING 2001-2002

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Abstract

Hydrographic observations conducted in the southern Adriatic and Ionian Seas during 2001-2002 asses the role of the Adriatic in driving the deep/internal thermohaline circulation of the Eastern Mediterranean. The concurrent presence of key elements in the southern cyclonic gyre (i.e. strong atmospheric forcing and the exposure of highly saline waters at surface) and the arrival of dense waters from the northern shelf caused the deep ventilation of the bottom layer. The mixing between the pre-existent 'older' deep waters and the new discharged one has been estimated, along with the salt contents and some biochemical elements budgets, following the transient event.

Keywords: Adriatic Sea, deep convection, thermohaline circulation

Introduction

The factors controlling the dense water formation in the Adriatic Sea have been largely studied using field observations and modelling simulations [1]. Dense water formation events occur in the southern Adriatic Sea by open-ocean deep convection because of winter outbreaks of northerly cold air masses and of highly saline waters from the Eastern Mediterranean that regularly intrude into the Adriatic Sea at the intermediate layer. Dynamic topography maps based on individual hydrographic cruises have shown consistently a topographically controlled baroclinic cyclonic circulation and periodical exposures at surface of highly saline waters [1], often associated with vigorous air-sea interactions during the winter. However, the deep ventilation of the bottom layer has not been observed during the last two decades. The overall objective of this work is to assess the regained role of the Adriatic Sea as site of dense water formation for the Eastern Mediterranean, which was temporarily reduced during the ascendant and the mature phase of the Eastern Mediterranean Transient (EMT).

Results and Discussion

The data used for this study were collected during late winter in March-April 2002 in the Adriatic-Ionian region within the SINAPSI (Seasonal, INterannual and decAdal variability of the atmosPhere, oceanS and related marIne ecosystems) national programme. The field investigations have indicated a prevailing increase of the salinity in the Southern Adriatic Sea according to the spreading of the highly saline Cretan Intermediate Water [2], which intruded into the Adriatic Sea. In the Southern Adriatic gyre, the deep ventilation of the bottom layer (1200 m) have been observed along with a density-driven bottom current transporting less saline, cold and highly ventilated dense water into the deep Ionian basin.

Figure 1 shows the vertical water-mass structure in the Southern Adriatic gyre, exemplified by the salinity, oxygen and beam attenuation coefficients measured by means of transmissometer. These observations indicate: (i) the presence of highly saline water masses at surface (S>38.80), consistent with changes in the Eastern Mediterranean circulation; (ii) the deep convection in the centre of the cyclonic gyre exemplified by the deep ventilation down to 800-1000 m (O_2 > 5.35 ml/l); and (iii) the presence of a highly ventilated water mass (O_2 > 5.40 ml/l) in the bottom layer, presumably cascading from the shelf/slope. This interpretation is further confirmed by an increase of suspended material in the bottom layer because of the re-suspension of the sediment as the water mass is cascading along the shelf/slope.

In synthesis, in 2002 the dense waters that reside in the deep southern Adriatic reservoir were renewed. However, the deep convection did not reach the bottom layer, allowing us to conclude that the signal of the ventilation of the bottom waters is associated with a large contribution from the northern shelf region. As concluding remark we can say that it took almost one decade from the maximum manifestation of the EMT for the Adriatic Sea to resume the leading role for the dense waters production of the Eastern Mediterranean.

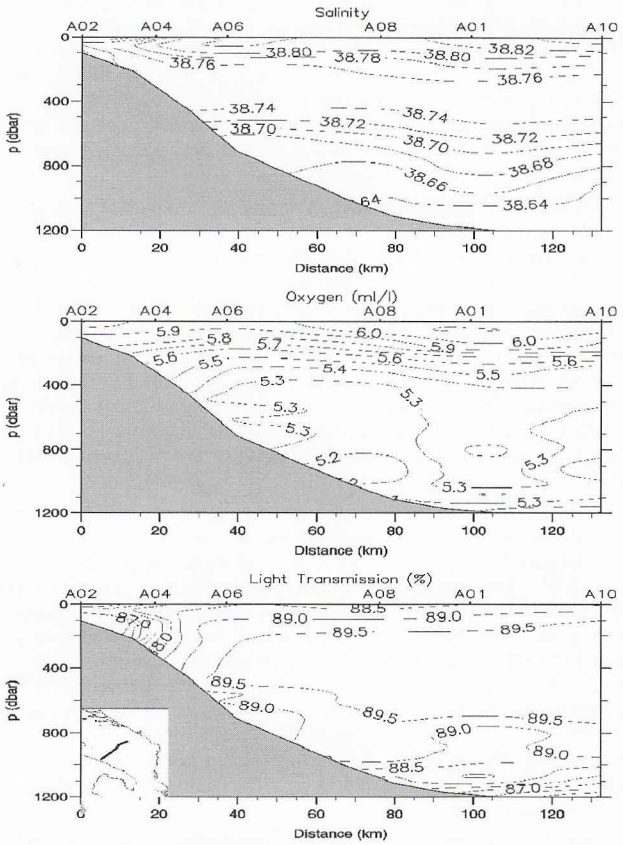

Fig. 1. Vertical distribution of Salinity, Dissolved Oxygen (ml/l) and Light Transmission (%) along the section in the southern Adriatic Sea (see inset map) in early April, 2002.

References

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