WHAT DOES INDUCE TEMPERATURE AND SALINITY CHANGES IN THE WMED ALONG THE SECOND HALF OF THE 20TH CENTURY?

Patricia Zunino [1]*, Manuel Vargas-Yañez [1], M. Carmen García-Martinez [1] and Francina Moya [1]
[1] Instituto Español de Oceanografía. Centro Oceanográfico de Málaga, Fuengirola, Spain - pzunino@ma.ieo.es

Abstract
Temperature and salinity evolution in the Western Mediterranean have always been studied on isobaric surfaces. But TS changes on pressure levels can be affected by changes on isopycnal surfaces and due to the vertical displacement of isopycnals (referred to as heaving). Temperature changes induce salinity changes and vice versa. The main objective of this work is to quantify which process dominates TS changes along the second half of the 20th century.
Keywords: Western Mediterranean, Global Change, Time Series

In most of the works carried out in the Western Mediterranean (WMED), temperature and salinity trends have been estimated on isobaric surfaces. It is well known that Western Mediterranean Deep Water has warmed and increased its salinity during the second half of the 20th century [1]. Concerning temperature trend in the intermediate layer, different figures have been provided by different authors, lots of them statistically non significant, even some of them are contradictories [1]. A possible explanation to the previous is that changes on isobaric surfaces have two effect added: changes on material surfaces (related to water mass changes) and those caused by the vertical displacement of isopycnals (related to wind stress curl and formation rate of deep water) [2]. These authors proposed the methodology to evaluate how former effects affect to changes on each pressure level. This methodology has recently been applied for the first time in the WMED [3]. Usually, temperature changes in water mass induce salinity changes and vice versa. Depending whether temperature or salinity induces the change, two different processes have been defined: pure-warming or pure-freshening [2]. Besides, when temperature or salinity changes on pressure levels are produced by the vertical displacement of isopycnals, the process is named pure-heaving [2].

The objective of the present work is to indentify what process dominates different sub periods along the 20th century as an extension of the previous work [3].

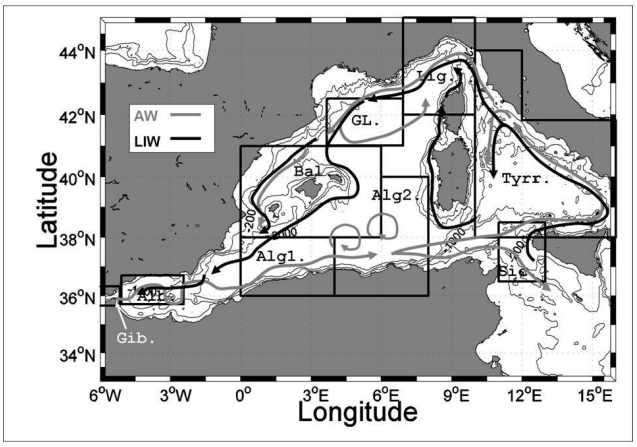

Fig. 1. Map for the Western Mediterranean. Rectangles identify the areas for which MEDAR Group´s [2002] data have been obtained. The final data set is made of averages for the whole WMED. These averages are weighted by the box areas

Salinity and temperature data were extracted from MEDAR database, from 1943 to 2000, and from different selected regions of the WMED (squares in fig. 1). The final data set was made of averages for the whole WMED. Temperature, salinity and density reference profiles were obtained averaging data from 1960 to 1990. We have estimated TS changes on isobaric surfaces and its two different contributions, isopycnal changes and heaving, following the methodology explained in [3]. And finally, the relative strength of each process (pure-warming, pure-freshening and pure-heaving), in terms of percentage variance explained can be estimated solving equations (17) proposed in [2].

Preliminary results show that more than one process coincide explaining the same percentage of variance in a same pressure level and sub period (fig. 2). This is because the equation system has been solved considering that only a single process induces the property change. But, matching processes at each pressure level are not always the same, and this is related to the temperature and salinity vertical gradients and to the magnitude of the TS changes in the different layers of the water column. Indeed, the dominating process in each sub period is related to abrupt temperature and/or salinity changes documented in previous works as well as to intense events of deep water formation.

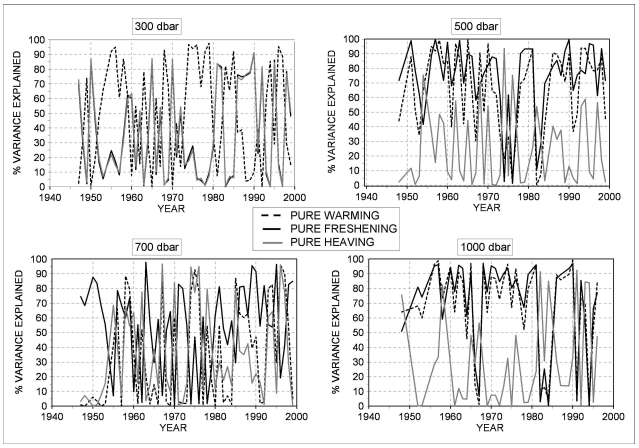

Fig. 2. Percentage variance explained by pure warming (dashed black line), pure freshening (black line) and pure heaving (grey line) for four different pressure levels (300, 500, 700 and 1000 dbar).

References
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