Study of Levantine intermediate water formation processes, production rates and sensitivity to interannual variability with a 1-D mixed layer model

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A one dimensional modified Kraus-Turner mixed-layer model is used, to study the winter formation of the Levantine Intermediate Waters (LIW) in the Eastern Mediterranean. To force the model we use climatological heat fluxes and wind stress data (P. MAY, 1982 and 1983). The study is carried out in two stages: a) first we apply the model in the whole Levantine Basin and initialize it with climatological T and S profiles (DAVIS *et al.*, 1986). We define the LIW production zone and rate as well as its sensitivity to interannual variability of the heat fluxes. b) we then apply the model to a section of insitu POEM-2 cruise data (POEM GROUP, 1992), and identify the formation mechanism on a finer scale.

Climatological results

1.- LIW formation area and production rate.

The model is integrated for two years at each grid point of the Levantine Basin (185 grid points), and initialized with fall (November) climatological profiles. We use an exponential advection term, with a depth scale of 35m, to compensate for the non-zero heat and water budget at each location. An objective map of March mixed layer densities, produced by the model, is presented in figure 1. Densities within the range 28.85-29.10, generally accepted as typical of LIW, are concentrated in the broader area of the Northwestern Levantine during February and March. This area is occupied permanently by the Rhodes Cyclonic Gyre. The mean climatological production rate of LIW is calculated to be equal to 0.99 Sv, a value close to the 1.23 Sv suggested by OVCHINNIKOV (1983).

2.- Sensitivity study to heat fluxes interannual variability.

We simulate a severe and a mild winter by increasing and decreasing respectively the total winter heat losses by 300 W/m^2. In the first experiment the production zone of waters denser than 28.85 was significantly expanded. The LIW production rate was increased to 1.63 Sv while in the central part of the Rhodes Gyre 2.67 Sv of denser than LIW waters were produced with characteristics close to those of the deeper layers. In the second experiment no LIW was produced inside the basin. These experiments indicate a significant sensitivity of the LIW production area and rate to interannual variability.

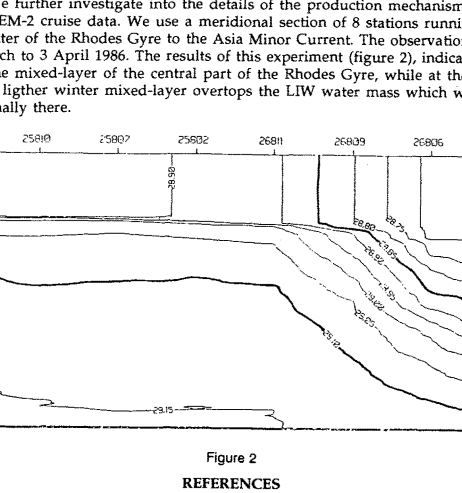

Figure 1

POEM-2 Results

The climatological study suggests LIW is produced inside the Rhodes Gyre area at the end of winter. We further investigate into the details of the production mechanism with the use of insitu POEM-2 cruise data. We use a meridional section of 8 stations running northward from the center of the Rhodes Gyre to the Asia Minor Current. The observations were taken from 27 March to 3 April 1986. The results of this experiment (figure 2), indicate that LIW is formed in the mixed-layer of the central part of the Rhodes Gyre, while at the periphery, a warmer and ligther winter mixed-layer overtops the LIW water mass which we assume has sunk isopycnally there.

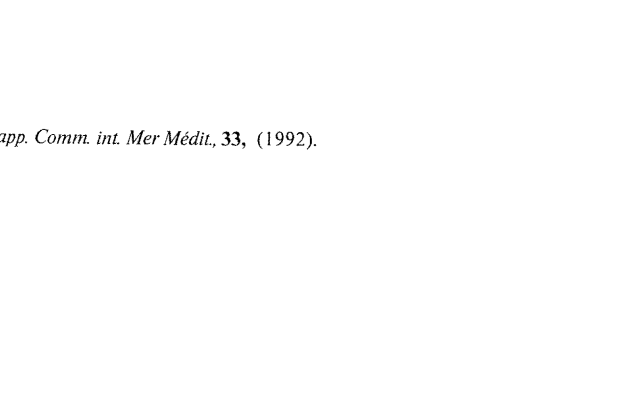

Figure 2

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