ON THE FORMATION OF LEVANTINE INTERMEDIATE WATERS

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A theory of LIW water formation has been developed and is being tested out by appropriate numerical experiments. It ascribes an important role to baroclinic eddies which form around the periphery of the formation site and flux in water and bouyancy from the side keeping the convection shallow. The eddies also carry the LIW away.

Previous open ocean convection studies (JONES and MARSHALL, 1993) have shown that the rim current at the periphery of the cooling patch, becomes unstable and baroclinic eddies develop. These eddies advect heat laterally towards the cooling region. Under continuous atmospheric cooling, a final steady state is reached in which the heat brought in by the eddies balances the heat lost to the atmosphere. At this stage convection is 'switched off' and the mixed layer stops from deepening. The time needed for this equilibrium to be reached is (VISBECK and MARSHALL, 1994) Tfinal=9*(r**2/B)**(1/3), where r is the radius of the cooling patch and B the bouyancy loss.

In areas of cyclonic circulation such as the Rhodes Gyre the typical preconditionned stratification can be thought of as a stratified layer of depth H and constant N overlying a homogeneous deep layer. The time needed for convection to break the stratification and penetrate the deep layer (thus producing deep waters) is Tbreak_through=(NH)**2/2B.

We argue that if Tbreak_through is longer than Tfinal then the eddies will take control of the convection process before the chimney penetrates deep. In such a case intermediate, not deep, waters will be produced.

In a series of numerical experiments we show that such a mechanism could be responsible for the production of intermediate waters (LIW) in the Rhodes Gyre area under normal climatological forcing. On the other hand we show that this equilibrium is quite sensitive and that under severe winter forcing Tbreak_through can be smaller than Tfinal, in which case deep waters are expected to be produced.

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