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An Apparent Surface Buoyancy Flux Associated with the Nonlinearity of the Equation of State

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ABSTRACT

The temperature dependence of the expansion coefficient of seawater can lead to a nonzero annual-average surface buoyancy flux even if the annual-average heat flux is zero. In the Mediterranean Sea, for example, this effect apparently gives the same buoyancy flux into the sea as a heat flux of 6 W m^{-2} . This does not, however, lead to an increase in the surface layer buoyancy over the course of a year; compensating cabbelling occurs mainly in the winter and spring when there is intensive mixing. The magnitude of the apparent buoyancy flux is proportional to the area inside the hysteresis loop of the seasonal cycle of the sea surface temperature versus the total heat content of the ocean. The output of a simple mixed layer model, however, shows only a weak sensitivity of mixed layer properties, such as depth, to inclusion of the nonlinearity in the equation of state.

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