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On the Dynamics of the Coupled Mixed Layer-Thermocline System and the Determination of the Oceanic Surface Density

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ABSTRACT

A simple model of the oceanic mixed layer is coupled to a model of the ventilated thermocline. The model allows a combination of advection and surface heating to determine the position of the outcrop lines of the isopycnals. The resulting isopycnal outcrops determine the circulation in the ventilated thermocline as in the 1983 study by Luyten, Pedlosky and Stommel (LPS). The isopycnal outcrop line is affected by both Ekman wind drift and the surface geostrophic flow. Hence, the outcrop position and the thermocline circulation are coupled.

The mixed layer and the thermocline models are extremely simple. Each is modeled by layers of constant density. The mixed layer, in which the isopycnals are vertical, is distinguished by the ability of fluid to cross the interfaces between adjacent layers under the influence of atmospheric heating. The heating is parameterized in terms of the departure of the isopycnal line from the position it would have if the ocean were heated, but at rest.

Although in most major respects the thermocline circulation is qualitatively similar to the model of LPS, the effect of the variation of the outcrop latitude with longitude introduces the possibility of potential-vorticity minima along latitude circles.

The model also predicts cooling of the most southern portion of the subtropical gyre under the influence of

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