Abstract View

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Two-layer Models for the Thermocline and Current Structure in Subtropical/Subpolar Gyres

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ABSTRACT

A study is made of the thermocline and current structures of a subtropical/subpolar basin. Tis paper explores the shape of the interface, and the flow patterns when the lower layer is infinitely thick. Simple frictional parameterizations are used to obtain a full solution including the structure of the boundary layers. When the amount of water in the upper layer is less than (or the wind stress is larger than) a critical value, the lower layer outcrops near the middle of the western boundary of the subpolar gyre. A dynamically consistent picture includes a strong, isolated western boundary current (i.e., bounded on one side by the wall and on the other by a streamline along which the upper layer thickness vanishes) flowing southward and an internal boundary current (i.e., a current that flows in the interior of the ocean along the outcrop, separating the two layers) flowing northeastward across the zero-wind-curl line. This interior boundary current models the Gulf Stream and the North Atlantic Current. In addition, there will be a normal western boundary layer in the subtropical ocean. When the amount of upper water is less than a second critical value, the upper layer water separates from the eastern wall and becomes a warm water pool in the southwest corner.

Our model describes the thermocline structure for a two-gyre basin. The surface temperature is determined from the dynamical balance of the entire basin. The subtropical and subpolar gyres combine to a unified pattern, which is asymmetric with the zero-wind-curl line.

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