Abstract View

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A Numerical Model of the Ventilated Thermocline

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ABSTRACT

A steady state numerical solution is found for an idealized, rectangular ocean basin driven by wind and surface buoyancy flux. A three-dimensional primitive equation model is used. In agreement with recent analytical modeling, the thermocline in the numerical solution consists of three regions, quite distinct in their ventilation characteristics. Forming the greater part of the subtropical thermocline is an unventilated “pool” zone located in the core of the subtropical gyre, and a “ventilated” zone to the east. The unventilated “shadow” zone lies farther east and toward the equator. Analysis of potential vorticity on constant density surfaces is used to study the structure of the thermocline. A small but intense zone of convection located in the western boundary outflow, caused by rapid heat loss to the atmosphere, produces source water for the ventilated zone. This water of extremely low potential vorticity (mode water), is distributed widely into the subtropical thermocline. The pool forms equatorward of the convective influence, although lateral mixing in the western boundary current provides indirect ventilation within this region. Trajectory analysis is used to illustrate the effects of the individual terms in the density equation on potential vorticity.