Abstract View

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The Buoyancy and Wind-Driven Ventilated Thermocline

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ABSTRACT

An analytical study of the combined wind-driven and buoyancy-driven thermocline problem is presented. The analysis is an extension of the ventilated thermocline model of Luyten et al.

An exact solution for the ventilated region of the subtropical gyre is found under the condition that the *ratio* of the buoyancy flux to Ekman pumping is a function of latitude alone. It demonstrates the general westward shift of streamlines when the subtropical gyre is heated and the enlargement of the eastern shadow zone.

The flow in the shadow zone is described, in most instances, for the case of relatively small buoyancy flux. It is shown that the shadow zone, now in motion due to buoyancy forcing, splits into two zones. There is a broad eastward zone in which the deep flow is northeastward and a narrow zone between this branch and the ventilated fluid in which the shadow zone flow is returned in a relatively swift current nearly preserving potential vorticity. For buoyancy/Ekman flux ratios which are nearly independent of position, the eastern branch of the shadow zone circulation lacks a beta spiral and the meridional transport can be simply calculated as a direct response to the heating.

For sufficiently large heating the model predicts pinch-off of the cold water layer along a latitude circle in the ventilated zone, south of which the solution loses validity.