Abstract View

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Gyres Driven by Combined Wind and Buoyancy Flux

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ABSTRACT

The combined effects of buoyancy forcing and wind in a gyre-scale steady ocean circulation are modeled using discrete layers with an interfacial flux, not necessarily vertical. The equations for vorticity conservation of the geostrophic flow in this system are fully nonlinear, involving a Jacobian for the layer thicknesses. These equations are written in a form which can be solved by the method of characteristics. The form of these equations invites the interpretation that the geostrophic baroclinic flow is driven by buoyancy and steered by the wind. Two examples are solved and discussed, a subtropical gyre with heating, and a subpolar gyre with cooling. In each case, there are distinct regimes of flow, depending upon whether the characteristics originate at the eastern or western boundaries of the model. A simple geometrical argument illustrates that the difference between these two regimes, the direct and indirect cells, depends upon the sign of the true vertical velocity relative to the interfacial flux.