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A Stratified Model of the Inertial Recirculation

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ABSTRACT

An inertial gyre with characteristics very similar to the recirculation observed in eddy-resolving general circulation models is obtained with a simple, analytically tractable, two-layer model. The recirculating gyre is contained in a box of simple geometry, which isolates it from the sverdrup interior. The gyre is forced by prescribing anomalous values of potential vorticity northward in the subtropical gyre or can be though of as a rough parametrization of diabatic forcing. In both cases the forcing is confined to the water above the thermocline, which is represented by the upper layer and is transmitted to the abyssal ocean through interfacial friction.

The condition for the abyssal water to be set in motion, is derived and for oceanic values the recirculation goes all the way to the bottom. When this occurs the center of the gyre is dominated by a barotropic flow, while the baroclinic flow is confined to the edges of the gyre. The width and strength of the gyre can be easily calculated in the limit of long, narrow gyres. The meridional scale of the gyre is directly proportional to the vorticity anomaly injected at the northern boundary, and the barotropic part of the transport is proportional to the cube of the abyssal gyre width, in close analogy with the results found by Cessi, Ierley and Young in a one layer model.

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