Abstract View

Volume 15, Issue 11 (November 1985)

Journal of Physical Oceanography
Article: pp. 1392–1404 | Abstract | PDF (988K)

A Model for the Seasonal Pycnocline in Rotating Systems with Application to the Baltic Proper

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(Manuscript received October 29, 1984, in final form April 2, 1985)

DOI: 10.1175/1520-0485(1985)015<1392:AMFTSP>2.0.CO;2

ABSTRACT

A one-dimensional seasonal pycnocline model, primarily intended for use in long-term circulation models, is developed. The model is of the two-layer (integral) type with a turbulent, well mixed surface layer and a nonturbulent, stratified lower layer. The parameterization of the entrainment velocity at the pycnocline accounts for the effects of buoyancy fluxes through the sea surface upon the entrainment flow. Also the "retreat" of the pycnocline, caused by large positive buoyancy supplies through the sea surface, is allowed for in the model. Effects of the rotation of the system are included. Under stable or neutral conditions the rotation may limit the penetration of mechanically generated turbulence. Hence, for weak positive buoyancy fluxes through the sea surface the rotation will cause the "retreat" of a deep pycnocline.

The model is utilized to simulate the climatological mean annual cycles of temperature and salinity in the upper parts of the Baltic (above the perennial main halocline at about 60 m depth). The test of seasonal pycnocline models introduced by Gill and Turner is applied. Two empirical constants are determined, the well known m_0, which appears in formulas for the entrainment velocity, and $\mathcal{V}$, which determines the thickness of the Ekman layer. For the best-fit case, which is obtained for m_0=0.6 and $\mathcal{V}$=0.20, the computed annual cycles of temperature and salinity appear quite realistic.

The estuarine circulation of the Baltic is accounted for. Brackish surface water is exported to the ocean and a dense bottom current carries the import of saltier "sea" water from the mouth. The seasonal pycnocline model correctly predicts the depth of the main halocline.

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