Abstract View

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A Model for the Vertial Circulation of the Baltic Deep Water

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ABSTRACT

The time-dependent vertical circulation of the Baltic Proper is modeled using a horizontally integrated model of high vertical resolution. A seasonal pycnocline model computes the properties of the mixed layer. Below this an advection-vertical diffusion model computes the evolution of the salinity and temperature fields. A simple model for an entraining dense bottom current—which carries the intruding seawater and drives the vertical advection in the basin—is developed and used. In the derivation of entrainment velocity w_e it is shown that $E(=w_e/u$, where u is the speed of the bottom current) may be expressed in the well-known empirical constants m_0 and C_d.

The hypsographic features of the Baltic are accounted for in the model. The model is forced using realistic meteorological and hydrological time series. The inflow of dense seawater to the Baltic, with large fluctuations in flow rate and salinity, is realistically described and constitutes the upstream boundary condition for the bottom current.

Tht vertical diffusiivty of salt and temperature κ, applicable in the interior of the basin, i.e. outside the dense bottom current and below the mixed layer, is taken to be $\kappa = \alpha/N$, where N is the Brunt-Väisälä frequency. By comapring model results with field data it is concluded that $\alpha = 2\times10^{-7} \mp 35\%$ ($m^2\ s^{-2}$). The accompanying κ-values are generally lower than values for the Baltic reported by other investigators. The reason for this is that the present study manages to separate the mixing performed by the dense bottom current from the mixing performed in the interior of the basin.

The model produces a vertical stratification quite similr to that observed in the real Baltic, with a parennial hallocline at about 60 m depth and below this a strongly stratified deepwater. The observed intermittent exchange of the deepest deepwater is well described by the model. The model has been run also with constant volume flow and salinity of the intruding seawater. In this case the stratification below the perrennial halocline becomes only weakly stratified. This experiment clearly demonstrates that the characteristics of the inflow of seawater have a profound influence upon the resulting stratification.

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