Abstract View

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A Simulation of Bomb Tritium Entry into the Atlantic Ocean

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ABSTRACT

Tritium is used in a model calibration study that is aimed at developing three-dimensional ocean circulation and mixing models for climate and geochemical simulations. The North Atlantic tritium distribution is modeled using a three-dimensional advective field predicted by a primitive equation ocean circulation model. The effect of wintertime convection is parameterized by homogenizing the tracer to the observed March mixed-layer depth. Mixing is parameterized by horizontal and vertical Fickian diffusivities of 5×10^{-6} cm^2 s^{-1} and 0.5 cm^2 s^{-1}, respectively.

The spreading of tritium in the model is dominated by advection in the horizontal, and by wintertime convection and advection in the vertical. The horizontal and vertical mixing provided by the model have negligible effect. A comparison of the model tracer fields with observations shows that most of the basic patterns of the tritium field are reproduced. The model's mean vertical penetration of 543 m in 1972 is comparable to the 592 m penetration obtained from the data. The major discrepancy between model and data is an inadequate penetration into deeper portions of the northwestern subtropical gyre main thermocline. Some of the problems that may contribute to this are identified.

A tritium simulation with a smoothed input gives a penetration depth of only 395 m. The smoothing puts a high fraction of the tritium into low-latitude, low-penetration regions such as the equator. This suggests that great care needs to be exercised in using simplified models of tritium observations to predict the behavior of tracers with different input functions, like fossil fuel CO_2.

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