Abstract View

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On the Numerical Implementation of Advection Schemes for Use in Conjunction with Various Mixing Parameterizations in the GFDL Ocean Model

Andrew J. Weaver and Michael Eby

School of Earth and Ocean Sciences, University of Victoria, Victoria, British Columbia, Canada

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ABSTRACT

The results from ocean model experiments conducted with isopycnal and isopycnal thickness diffusion parameterizations for subgrid-scale mixing associated with mesoscale eddies are examined from a numerical standpoint. It is shown that when the mixing tensor is rotated, so that mixing is primarily along isopycnals, numerical problems may occur and non-monotonic solutions, which violate the second law of thermodynamics, may arise when standard centered difference advection algorithms are used. These numerical problems can be reduced or eliminated if sufficient explicit (unphysical) background horizontal diffusion is added to the mixing scheme. A more appropriate solution is the use of more sophisticated numerical advection algorithms, such as the flux- corrected transport algorithm. This choice of advection scheme adds additional mixing only where it is needed to preserve monotonicty and so retains the physically desirable aspects of the isopycnal and isopycnal thickness diffusion parameterizations, while removing the undesirable numerical noise. The price for this improvement is a computational increase.