Geophysical Research Abstracts
Vol. 12, EGU2010-758, 2010
EGU General Assembly 2010


# Non-uniform adaptive vertical grids for 3D numerical ocean models

Richard Hofmeister (1), Hans Burchard (2), and Jean-Marie Beckers (3)

(1) Leibniz Institut for Baltic Sea Research, Warnemünde, Germany (richard.hofmeister@io-warnemuende.de), (2) Leibniz Institut for Baltic Sea Research, Warnemünde, Germany (hans.burchard@io-warnemuende.de), (3) MARE-GHER-AGO, University of Liege, Belgium (JM.Beckers@ulg.ac.be)

A new, adaptive strategy for the vertical gridding in terrain-following 3D ocean models is presented here, which is designed for reducing discretisation errors in ocean models. The vertical grid adaptivity is partially given by a vertical diffusion equation for the vertical layer positions, with diffusivities being proportional to shear, stratification and distance from the boundaries. In the horizontal, the grid can be smoothed with respect to $z$-levels, grid layer slope and density. Lagrangian tendency of the grid movement is supported. The adaptive terrain-following grid can be set to be an Eulerian-Lagrangian grid, a hybrid $\sigma$-$\rho$ or $\sigma$-$z$ grid and combinations of these with great flexibility. With this, internal flow structures such as pycnoclines can be well resolved and followed by the grid. The grid adaption strategy is easy to implement in various types of terrain-following ocean models. A set of idealised examples is presented, which show that the introduced adaptive grid strategy reduces pressure gradient errors and numerical mixing significantly. The idealised examples give evidence that the adaptive grids can improve realistic, long-term simulations of stratified seas while keeping the advantages of terrain-following coordinates. Additionally to the idealised examples, a first assessment of the performance of the adaptive vertical coordinates in a realistic application, the Baltic Sea, is provided. The numerical mixing is compared directly to the physically induced mixing for fixed and adaptive vertical grids in the experiments. This shows, that due to the reduced numerical mixing and an optimised resolution of the vertical gradients, the performance of the turbulent mixing calculation in the model can be enhanced when using adaptive vertical grids.