FINITE VOLUME FOR DYNAMICAL COUPLED MODELING IN COASTAL REGIONS

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A three dimensional finite volume ocean circulation model with a free surface is presented. The basic equations are transformed from differential into integral forms using the hydrostatic and anelastic approximations. The integral equations are solved for finite volumes (rather than grid points) with the flux conservation easily enforced even on arbitrarily meshes. Moreover, this model can easily incorporate the upwind scheme to increase the computational stability and the high-order combine compact schemes to enhance the accuracy. For abrupt topography, a crystal grid discretization is designed to reduce computational errors such that the four lateral boundaries of each finite volume are perpendicular to *x* and *y* axes, and the two vertical boundaries are not purely horizontal. This grid system reveals a superior feature than z- and sigma coordinate systems. The accuracy of this model was tested by the standard seamount test case. Use of the finite volume discretization leads to a conserved scheme for pressure gradient computation that has better truncation properties with high accuracy. The analytical coastal topography and seamount test cases are used to evaluate the new scheme. The accuracy of the new scheme is comparable to the sixth-order combined compact scheme (with an error reduction by a factor of 70 comparing to the second-order scheme) with mild topography and much better than the sixth-order combined compact scheme with steep topography. The computational efficiency of the new scheme is comparable to the second-order difference scheme. The two characteristics, high- accuracy and computational efficiency, make this scheme useful for the sigma coordinate ocean models (Chu and Fan, 2003, 2004).

REFERENCES

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