An Adaptive Grid Technique for the Vertical Structure of Hydrodynamic Models

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Abstract

The efficient resolution of the boundary layers occurring in geophysical flows has motivated the search for criteria to optimize the vertical nodal placement in three-dimensional shallow water models. This paper describes the implementation and testing of an adaptive grid technique for the internal mode of shallow water models. The technique uses an r-method in which the nodes are moved vertically based on the velocity gradients between consecutive nodes. One-dimensional tests show that the method behaves well in tidal- and wind-driven flows, both in well-mixed and stratified conditions. Average accuracy improvements of 50% were obtained relative to uniform grids, with a 15% CPU time increase.

The adaptive technique accounts accurately for the space and time variability of the flow, thus being attractive for any type of problem. Furthermore, the technique does not require an a priori knowledge of the flow conditions, thus simplifying greatly the modeling procedure.

Keywords: adaptive grid, shallow water model, three-dimensional, vertical discretization.

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