Ocean Circulation Modeling Using Adaptive Wavelet Collocation Method

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The adaptive wavelet collocation method is applied to basin-scale, wind-driven ocean circulation models. This method solves the governing equations on temporally and spatially varying meshes, which allows higher effective resolution to be obtained with less computational cost. The grid adaptation is achieved by using the ability of wavelet multiresolution analysis to identify and isolate localized dynamically dominant flow structures, e.g., vortices, and to track these structures on adaptive computational meshes.

In addition to studying how various ocean models behave on non-uniform, time varying grids, this work also sets out to improve the representation of continental topology and bottom bathymetry through an extension of the Brinkman penalization method. Due to the complicated geometry inherent in ocean boundaries, the stair-step representation used in the majority of current global ocean circulation models causes accuracy and stability problems. Brinkman penalization is a numerical technique used to enforce no slip boundary conditions through the addition of a term to the governing equations. When coupled with the adaptive wavelet collocation method, the flow near the boundary can be well defined. This is especially useful for simulation of boundary currents. Therefore, the Gulf stream and western boundary currents have been the focus of the work presented here.

References

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