Community for the numerical modeling of the global, regional and coastal ocean

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Brinkman volume penalization for bathymetry in three-dimensional ocean models

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Accurate and stable implementation of bathymetry boundary conditions remains a challenging problem. The dynamics of ocean flow often depend sensitively on satisfying bathymetry boundary conditions and correctly representing their complex geometry. Generalized (e.g. σ) terrain-following coordinates are often used in ocean models, but they require smoothing the bathymetry to reduce pressure gradient errors (Mellor et al., 1994). Geopotential z-coordinates are a common alternative that avoid pressure gradient and numerical diapycnal diffusion errors, but they generate spurious flow due to their "staircase"geometry. We introduce a new Brinkman volume penalization to approximate the no-slip boundary condition and complex geometry of bathymetry in ocean models. This approach corrects the staircase effect of z-coordinates, does not introduce any new stability constraints on the geometry of the bathymetry and is easy to implement in an existing ocean model. The porosity parameter allows modelling subgrid scale details of the geometry. We illustrate the penalization and confirm its accuracy by applying it to three standard test flows: upwelling over a sloping bottom, resting state over a seamount and internal tides over highly peaked bathymetry features. Preliminary results of realistic simulations of the Guf Stream detachment will also be discussed.

Do you need an official invitation letter?

No

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