VLES MODELING OF GEOPHYSICAL FLUIDS WITH NONOSCILLATORY FORWARD-IN-TIME SCHEMES[1]

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Abstract

Atmospheres and oceans are mostly incompressible and turbulent. The experience of the meteorological community with modeling such flows is based primarily on centered in time and space (CTS) methods. Our experience applying nonoscillatory forward in time methods (NFT) to a range of flows have revealed some unexpected benefits specifically in the area of modeling geophysical turbulence; where, broad span of scales, density stratification, planetary rotation, inhomogeneity of the lower boundary, etc., make explicit modeling of subgrid-scale motions particularly challenging. It turns out, that in the absence or insufficiency of a proper subgrid-scale model, NFT methods supply their own, implicit, turbulence models that are quite
effective in assuring quality simulations of high-Reynolds number flows. Since such simulations abandon rigorous notion of the large-eddy-simulation approach, and merely aim at computing explicitly large coherent eddies resolvable on the grid, they are referred to as
very-large-eddy simulations (VLES). In this paper we will describe advantages of the NFT approach and illustrate them with an example of gravity-wave-breaking induced turbulence in a deep atmosphere. On the philosophical side, we challenge a common misconception that NFT methods are overly diffusive and therefore inadequate for high Reynolds' number flow simulations.

[1] *International Journal of Numerical Methods in Fluids*, **39**, 799-819 (2002).