

Computational Tests of Advection Equation: Finite Difference on a Staggered Grid

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Abstract

There are many problems in atmospheric science where a central concern is the manner in which scalars (e.g. trace constituent, potential vorticity and water vapor) is transported by moving fluid. It is important to find a suitable finite difference algorithm on a staggered grid for this problem. In this paper, we use a simple one-dimensional linear advection equation to study the advective processes on the staggered grid. It is illustrated that caution must be taken in defining flux on the staggered C-grid. It is shown that accuracy can be lost in the fourth-order centered differencing if flux is defined improperly. A consistent way of defining flux with the fourth-order finite differencing is presented. To avoid the appearance of negative value, positive definite schemes are also tested.

Key words : positive definite scheme, finite difference, advection equation, staggered grid

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