



Forward-backward Scheme modified to suppress Lattice Separation, and Impact of the Order of Integration

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A rich history of the use of the forward-backward scheme in atmospheric models is reviewed. Modified to suppress lattice separation problem of the B/E grid, it has been used in the Eta model and its predecessor models for several decades. It has been and is used also in other models and/or experiments. It appears that in spite of this widespread use and a number of papers published on the scheme, it was nowhere stated if the order of integrations affects the solution. It is pointed out that while the formal properties of the scheme, cast for pure linearized gravity waves or even in its “divergence modified” form for gravity-inertia waves, are identical, the solutions will nevertheless be different. This is because the analog of the wave equation is a three time level scheme, so that the initial condition alone does not determine the solution; values at the first two time levels do.

This being realized, the question arises which equation should better be integrated first, momentum or the continuity equation. Heuristic arguments suggest that in atmospheric models with forcing integrating the momentum equation first should be advantageous. An experiment with the Eta model however reveals only a very minor impact. An experiment with a shallow water global version of the Eta however does confirm the benefit of integrating the momentum equation first. Additional experiments are planned to be done and reported upon at the actual presentation of the paper.