

Semi-Lagrangian Advection without Iteration

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Abstract

The conventional semi-Lagrangian method (see Staniforth and Cote 1991 for example) used to have large time step for advection requires first guess and several iterations to locate the mid-point as well as departure point both in upwind and downwind scheme. The possible errors due to guessing and iteration trigger the motivation to search for alternative solution.

Requiring guessing and iteration method is mainly due to the consideration of the regular grid point at either arriving point in upwind scheme or departure point in downwind scheme. The alternative method proposed here is starting from mid-point as regular grid point. In this case, the advection wind and all forcing are at the regular grid point as mid-point of the semi-Lagrangian advection. Thus, there is no need to guess and perform several iterations to locate the mid-point for advection.

Starting at mid-point as regular grid point avoids the guessing and iteration, but it still requires interpolation as all semi-Lagrangian methods did. The interpolation in this proposed method requires only one in departure point and one in arrival point. Thus, the number of interpolation is much less than the usual iteration methods, which require at least three interpolations during iterations. Furthermore, the forcing is precisely at mid-point, no need to do interpolation as other conventional method. This simple and economical method will be an attractive scheme for numerical modeling. More advantages and several cases results will be presented in the meeting.

References

Staniforth, A., and J. Côté, 1991: Semi-Lagrangian schemes for atmospheric models — A review. *Mon. Wea. Rev.*, **119**, 2206–2223.