Geophysical Research Abstracts, Vol. 9, 01210, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-01210

The diabatic contour-advective semi-Lagrangian algorithms for the shallow water equations on the sphere

A. R. Mohebalhojeh (1), D. G. Dritschel (2)

(1) School of Mthematics, University of St. Andrews, UK and Institute of Geophysics, University of Tehran, Iran (arm@mcs.st-and.ac.uk), (2) School of Mathematics, University of St. Andrews, UK (dgd@mcs.st-and.ac.uk)

The extension of contour-advective semi-Lagrangian (CASL) algorithms to include diabatic forcing is discussed for the shallow water equations on the sphere. The CASL algorithms solve for potential vorticity (PV) by advecting particles in a contour representation, more precisely a piece-wise uniform, discontinuous representation. Such representation removes any need for differentiation/interpolation to advect PV and thus makes it possible to capture near-discontinuous distributions of PV generated by nonlinear advection. The CASL algorithms involve two novel transforms: (i) a contour-to-grid transform to find an Eulerian representation for the Lagrangian representation available in contours dividing piece-wise uniform regions of PV; (ii) a grid-to-contour transform to find a Lagrangian representation in the form of a set of piece-wise uniform regions of PV divided discontinuously by contours for the available Eulerian representation.

The diabatic CASL partitions the PV fields Q to an adiabatic part $Q_{\rm a}$ and a diabatic part $Q_{\rm d}$. The adiabatic part $Q_{\rm a}$ is evolved in time by contour advection as in adiabatic CASL. No source/sink comes into the advection of $Q_{\rm a}$, except a *regularisation* procedure called contour surgery. Having an Eulerian, grid representation only, the diabatic part $Q_{\rm d}$ is advected by a semi-Lagrangian advection scheme incorporating source/sink effects on PV. At certain time intervals, the $Q_{\rm a}$ and $Q_{\rm d}$ are merged on an Eulerian fine/ultra-fine grid and *recontoured* to reconstruct the Lagrangian representation. The recontouring is nothing but the realisation of the grid-to-contour transform. Ideally, we would like the merger process to be complete, i.e. reset $Q_{\rm d}$ to zero after recon-

touring. But in general the grid-to-contour transform leaves a non-zero *residual*. The treatment of residual and further developments on diabatic CASL algorithms, including a fully-Lagrangian description of PV dispensing with semi-Lagrangian advection, are discussed in detail.