P77 A vertical semi-lagrangian large-time step method to improve the efficiency of the WRF model for CAM grids.

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Current convective allowing model (CAM) grids often use horizontal and vertical grid spacing having large aspect ratios (e.g. $\Delta x/\Delta z \sim 10$). In regions where strong updrafts occur this often severely limits the time step that remains stable for the vertical advection. Moreover, the number of grid points where this constraint applies is only a small fraction of the total grid.

An algorithm is devised that replaces the normally used Runge-Kutta vertical advection time stepping with a semi-lagrangian large time step method similar to that proposed by Leonard (1993) using the "5c" Bott scheme proposed Costa and Sampaio (1997). Using this method, the vertical courant number can now be as much larger than 1, and is now limited by the local 2D or 3D deformation in the flow. The solutions from locally switching to the upwind scheme remain similar. In simple tests with strong deformational flows, the CAM model's time step can be increased by up to 20-30%.