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First steps towards a fully Lagrangian General Circulation Model: a Shallow Water Model based on the Finite Mass Method

G. Erhardt, V. Grewe and R. Sausen

Institut für Physik der Atmosphaere, Deutsches Zentrum fuer Luft- und Raumfahrt e.V. (DLR), D-82234 Wessling, Germany (gabriele.erhardt@dlr.de / Phone: + 49 8159 28 2596)

Gerneral circulation models (GCMs) are used to simulate atmospheric behavior and are based on the primitive equations describing the fundamental laws. These equations are solved by either using spherical grids or spherical harmonics. Meteorological quantities and concentrations of species are described as functions or calculated at every gridpoint and time step (Eulerian scheme). The big disadvantage of this method is the numerical diffusion. To better reproduce reality it is worth to consider trajectories of single air parcels (Lagrangian scheme). Therefore,the Lagrangian transport scheme ATTILA has been developed at DLR (Reithmeier and Sausen, 2002). Our goal is now to create a new kernel for a GCM which is completely based on the Lagrangian approach. For the numerical implementation, we use the "Finite Mass Method" described in Yserentant(1997) and Gauger et al.(2000). There we divide the mass into small packets of mass and calculate the evolution of the distribution of those mass packets. The advantage of this method is the implicit conservation of mass, energy, momentum, angular momentum and vorticity. As a first approach, we apply the method to solve the shallow water equations. A detailed description of the method itself and applied to the shallow water model will be given. First results will be discussed and compared to an eulerian model.