Geophysical Research Abstracts, Vol. 9, 09902, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-09902

Hamiltonian-based numerical methods for forced-dissipative climate prediction

B. Peeters (1)

(1) University of Twente (b.w.i.peeters@utwente.nl)

Although our climate is ultimately driven by (nonuniform) solar heating, many aspects of the flow can be understood qualitatively from forcing-free and frictionless dynamics. In the limit of zero forcing and dissipation, our weather system falls under the realm of *Hamiltonian fluid dynamics* and the flow preserves several conservation laws such as the conservation of energy and phase space structure. One would like to have a numerical forecasting scheme that can reproduce the correct flow structure for the limit of zero forcing and dissipation, as does the exact system. Many present long-term weather forecast models fail at this point. But the question remains, however: **Is it advantageous to use numerical schemes with a Hamiltonian core for realistic climate modeling?**

As a first step, the hydrostatic dynamics for a forcing-free and frictionless atmosphere are formulated within the framework of Hamiltonian fluid dynamics using isentropical coordinates. A Hamiltonian system is completely specified by the *Hamiltonian* and its so-called *Poisson bracket*. A relative easy way of deriving this Hamiltonian and Poisson bracket for the isentropic atmosphere will be presented, cf. the method of Bokhove & Oliver (2006).
As a second step, the Hamiltonian Particle Method is used to discretize the equations of motion, cf. Frank et al. (2002). The method is partially Lagrangian and partially Eulerian. Conserved are mass, energy, circulation and potential vorticity. The method includes a time integrator that preserves the Hamiltonian phase space structure. The algorithm, when applied to our isentropic atmosphere, will be discussed. Preliminary numerical results will be presented. Finally, several future developments will be discussed, including a parameterization of unresolved gravity waves, adequate damping of small scale nonlinear structures and the overturning of isentropes (static instability).