Geophysical Research Abstracts,
Vol. 11, EGU2009-5268, 2009
EGU General Assembly 2009

Eulerian velocity reconstruction in ideal atmospheric dynamics using potential vorticity and potential temperature

R. Blender
University of Hamburg, Meteorological Institute, Hamburg, Germany (Richard.Blender@zmaw.de)

An approach for the reconstruction of atmospheric flow is presented which uses space- and time-dependent fields of density ρ, potential vorticity Q and potential temperature θ [J. Phys. A, 38, 6419 (2005)]. The method is based on the fundamental equations without approximation. The basic idea is to consider the time-dependent continuity equation as a condition for zero divergence of momentum in four dimensions (time and space, with unit velocity in time). This continuity equation is solved by an ansatz for the four-dimensional momentum using three conserved stream functions, the potential vorticity, potential temperature and a third field, denoted as χ-potential. In zonal flows, the χ-potential identifies the initial longitude of particles, whereas potential vorticity and potential temperature identify mainly meridional and vertical positions. Since the Lagrangian tracers Q, θ, and χ determine the Eulerian velocity field, the reconstruction combines the Eulerian and the Lagrangian view of hydrodynamics. In stationary flows, the χ-potential is related to the Bernoulli function. The approach requires that the gradients of the potential vorticity and potential temperature do not vanish when the velocity remains finite. This behavior indicates a possible interrelation with stability conditions. Examples with analytical solutions are presented for a Rossby wave and zonal and rotational shear flows.