Geophysical Research Abstracts
Vol. 19, EGU2017-13868, 2017
EGU General Assembly 2017

Efficient simulation of moist processes in the atmosphere using a fully Lagrangian method

Steven Böing (1), David Dritschel (2), Douglas Parker (1), Alan Blyth (1,3)

(1) ICAS, University of Leeds, United Kingdom (earsboe@leeds.ac.uk), (2) School of Mathematics and Statistics, University of St Andrews, United Kingdom, (3) National Centre for Atmospheric Science, United Kingdom

Large-eddy models and high resolution cloud-permitting models are increasingly used to study the detailed dynamics of moist convection and rainfall formation on large domains. However, the turbulence statistics and liquid water content in high-resolution simulations are highly sensitive to the grid resolution as well as the choice of numerical method. For example, the maximum liquid water content (which is important for rain formation) in a cloud can be sensitive to numerical mixing, which is hard to control.

We are developing a potentially revolutionary approach to this problem, namely to model both dynamics and processes explicitly using Lagrangian parcels. These parcels have a finite volume and carry part of the circulation, as well as thermodynamic attributes such as total water content and liquid water potential temperature. The dynamics are fully Lagrangian, but an efficient grid-based solver is used to determine parcel advection velocities. We have explored the potential of this approach in a framework using simplified moist dynamics. Our first results compare the fully Lagrangian model to a pseudo-spectral model and the Met Office Nerc Cloud model (MONC) in the same framework. We show that the fully Lagrangian model provides an alternative for the simulation of moist physics and dynamics that compares well to MONC, but is likely to be significantly cheaper for a given effective resolution. At the same time, the method offers a step change in the ability to control Lagrangian conservation of parcel properties. We also discuss how we can represent stretching and mixing at the parcel level in our approach.