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Massively parallel parcel-based simulation of moist convection

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We discuss recent progress on an essentially Lagrangian model of moist convection. In this Moist-Parcel-In-Cell (MPIC) model, parcels represent both the thermodynamic and the dynamical properties of the flow. The parcels have a finite volume and carry part of the circulation and thermodynamic attributes (liquid water potential temperature and total water content). The representation of parcel properties is fully Lagrangian, but an efficient grid-based solver calculates parcel advection velocities.

The Lagrangian approach of MPIC has a number of advantages: thermodynamic properties and their correlations are naturally conserved, and the amount of mixing between parcels can be explicitly controlled. MPIC also lends itself well to parallelisation, because most of the communication required between processors is local, and an efficient solver is available where global communication is required.

A massively parallel version of MPIC which uses the framework of the Met Office NERC Cloud (MONC) model has recently been developed. This version will make it possible to simulate realistic clouds in a fully Lagrangian framework. Here, we present the adaptations we have made to MPIC, and in particular its dynamical core, to facilitate such simulations, and discuss the steps we are taking to include microphysics. We also show scaling results of the new code for up to 50,000 compute cores.