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# Level set methods for meteorological multi scale problems

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Reasonable modeling of shallow cumuliform and stratocumulus convection is important to both weather and climate forecast. Indeed recent work suggests that shallow cumulus convection is the major point of departure among climate-model representations of climate sensitivity, and a principal means by which the atmospheric aerosol imprints itself on larger-scale circulations. Unfortunately our understanding of these clouds is limited, in part, by our ability to simulate them with great confidence or fidelity. A standard tool for understanding both the dry and the moist boundary layer behavior is Large Eddy Simulation (LES), but fundamental issues emerge in quantities of interest (e.g. exact boundary layer heights or Albedo). A reason for this is that current LES cannot resolve the interface physics due to insufficient grid resolution. Even elaborate physically based subgrid models are numerically smeared out, so that a distinction between numerical (e.g. discretization errors) and physical effects (e.g. entrainment) is impossible. Here, we focus on the numerical effects and explain a heterogeneous multi scale concept for the modeling of Stratocumulus clouds that has been successfully used in combustion science. The cloud top interface which is driven by large scale motions is explicitly followed (tracked) using a level set ansatz. In parallel we solve the underlying flow equations in a finite volume sense. The level set and the flow solutions are coupled via an approach called in-cell-reconstruction. The approach keeps an option to include small scale processes like e.g. entrainment via (super-) parameterizations in a modular fashion.