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Comparison of LES and DNS results for a two-dimensional evaporatively driven cloud-top mixing layer

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Reasonable modeling of shallow cumuliform and stratocumulus convection is important to both weather and climate forecast. Unfortunately, our understanding of certain physical processes in clouds is very limited. Recent results from direct numerical simulations (DNS) of evaporative cooling by isobaric mixing in a temporally evolving cloud-top mixing layer help to understand parts of the physical complexity, especially the importance of molecular effects. Here we analyze the performance of large eddy simulation (LES) for the DNS case by successively refining the numerical grid. Molecular effects are included in the LES and the turbulence subgrid-scale model is switched off. Convergence to the DNS results is achieved for four times the DNS grid resolution. For the coarsest grid order one errors are observable in some statistics of relevance, like the vertical displacement of the inversion. Typical resolutions for fine-scale LES in stratocumulus simulations are of order of meters which is even much coarser than the resolutions investigated in this work.