Geophysical Research Abstracts
Vol. 15, EGU2013-12355, 2013
EGU General Assembly 2013

Large-eddy simulations of stratocumulus to cumulus transition

Dorota Jarecka (1), Marcin J. Kurowski (2), Hanna Pawlowska (3), and Wojciech W. Grabowski (4)

(1) University of Warsaw, Institute of Geophysics, Faculty of Physics, Warsaw, Poland (dorota@igf.fuw.edu.pl), (2) Institute of Meterology and Water Management, Warsaw, Poland (kurowski@ucar.edu), (3) Institute of Geophysics, Faculty of Physics, University of Warsaw, Warsaw, Poland (hanna.pawlowska@igf.fuw.edu.pl), (4) Mesoscale and Microscale Meteorology Division, NCAR, Boulder, Colorado, USA (grabow@ucar.edu)

In this study, the stratocumulus to cumulus transition is investigated by means of large-eddy simulation. The anelastic nonhydrostatic model EULAG is setup to simulate transition cases designed in the framework of the EUCLIPSE project (European Union Cloud Intercomparison, Process Study and Evaluation Project, EU FP7). The first case is based on the Atlantic Stratocumulus to Cumulus Transition Experiment (ASTEX) field campaign. Three other "composite" cases are also based on field observations but represent more idealized framework for model evaluation of transition processes that differ in terms of the prescribed forcing amplitude or timescale. Model simulations represent evolution of the boundary layer that initially features solid stratocumulus layer and transitions into a field of shallow cumulus clouds later in the simulations. The initially thick stratocumulus deck undergoes systematic changes in response to a gradual increase of the sea surface temperature, decrease of the large-scale subsidence, and the diurnal cycle of radiative forcing, with the dominant role of the cloud-top longwave radiative cooling. Combined with a quasi-steady entrainment of warm dry air from above the inversion, these processes lead to the increase of the boundary layer depth, decoupling, and eventual transition to broken cumulus regime. The focus of the analysis is on the sensitivity of the boundary-layer evolution to the representation of cloud microphysical parameterizations. Representation of cloud microphysics affects the entrainment rate, drizzle formation, and to some extent radiative transfer. The key result is cloud microphysics has a significant impact on the evolution of boundary-layer characteristics and strongly affects the transition.