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Simulations of NLC formation using a microphysical model driven by three-dimensional dynamics

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Noctilucent clouds (NLCs) represent an optical phenomenon occurring in the polar summer mesopause region. These clouds have been known since the late 19th century. Current physical understanding of NLCs is based on numerous observational and theoretical studies, in recent years especially observations from satellites and by lidars from ground. Theoretical studies based on numerical models that simulate NLCs with the underlying microphysical processes are uncommon. Up to date no three-dimensional numerical simulations of NLCs exist that take all relevant dynamical scales into account, i.e. from the planetary scale down to gravity waves and turbulence. Rather, modeling is usually restricted to certain flow regimes.

In this study we make a more rigorous attempt and simulate NLC formation in the environment of the general circulation of the mesopause region by explicitly including gravity waves motions. For this purpose we couple the Community Aerosol and Radiation Model for Atmosphere (CARMA) to gravity-wave resolving dynamical fields simulated beforehand with the Kuehlungsborn Mechanistic Circulation Model (KMCM). In our case, the KMCM is run with a horizontal resolution of T120 which corresponds to a minimum horizontal wavelength of 350 km. This restriction causes the resolved gravity waves to be somewhat biased to larger scales. The simulated general circulation is dynamically controlled by these waves in a self-consitent fashion and provides realistic temperatures and wind-fields for July conditions. Assuming a water vapor mixing ratio profile in agreement with current observations results in reasonable supersaturations of up to 100.

In a first step, CARMA is applied to a horizontal section covering the Northern hemisphere. The vertical resolution is 120 levels ranging from 72 to 101 km. In this paper we will present initial results of this coupled dynamical microphysical model focussing on the interaction of waves and turbulent diffusion with NLC-microphysics.