EGU22-3019, updated on 19 Aug 2022
https://doi.org/10.5194/egusphere-egu22-3019
EGU General Assembly 2022

Will future noctilucent clouds affect Earth's albedo?

Franz-Josef Lübken, Gerd Baumgarten, Mykhaylo Grygalashvyly, and Ashique Vellalassery
Leibniz Institute of Atmospheric Physics, Kühlungsborn, Germany (luebken@iap-kborn.de)

Noctilucent clouds (NLC) are often cited as potential indicators of climate change in the middle atmosphere. They owe their existence to the very cold summer mesopause region (~130K) at mid and high latitudes. We analyze trends derived from the Leibniz-Institute Middle Atmosphere Model (LIMA) and the MIMAS ice particle model (Mesospheric Ice Microphysics And tranSport model). We first concentrate on the years 1871-2008 and on middle, high and arctic latitudes, respectively. Model runs with and without an increase of carbon dioxide and water vapor (from methane oxidation) concentration are performed. Trends are most prominent after ~1960 when the increase of both carbon dioxide and water vapor accelerates. Negative trends of (geometric) NLC altitudes are primarily due to cooling below NLC altitudes caused by carbon dioxide increase. Increases of ice particle radii and NLC brightness with time are mainly caused by an enhancement of water vapor caused by the oxidation of methane. Several ice layer and background parameter trends are similar at high and arctic latitudes but are substantially smaller at middle latitudes. Ice particles are present nearly all the time at high and arctic latitudes, but are much less common at middle latitudes. Ice water content and maximum backscatter are highly correlated, where the slope depends on latitude. This allows to combine data sets from satellites and lidars. Furthermore, IWC and the concentration of water vapor at the altitude of maximum backscatter are also strongly correlated. Results from LIMA/MIMAS are consistent with observations. More recently, we have expanded our model runs into the future, namely up to the 2060s. We have used IPCC scenarios regarding future concentrations of carbon dioxide and methane. We find that all NLC parameters, such as occurrence rates and backscatter coefficients increase substantially in this time period. Furthermore, we have studied the extinction of solar radiation by NLC. We will present details regarding the (wavelength-dependent) extinction and the temporal and spatial distribution of this extinction. We will also present new results on the impact of solar cycle induced radiation variability on NLC.