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Analysis of Trends at Mesospheric Heights in the Northern Hemisphere during 1961-2013

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We have performed trend studies in the mesosphere in the period 1961–2013 with Leibniz-Institute Middle Atmosphere (LIMA) model driven by European Centre for Medium-Range Weather Forecasts reanalysis (ERA-interim) below approximately 45 km. LIMA adapts temporal variations of CO_2 and O_3 according to observations, and observed daily Lyman alpha fluxes.
The simulation of the thermal state at the summer upper mesosphere allows to investigate the impact on the morphology of ice particle related phenomena such as polar mesosphere clouds (PMC). The PMC characteristics deduced from LIMA are validated with various data sets from satellite (NOAA-SBUV, AIM-SOFIE) observations. Generally good agreement is found between the modeled long-term PMC variations and that derived from SBUV observations.
We investigate the role of trends in mesospheric water vapor and temperature that mainly force PMC trends. We show that water vapor and temperatures in the stratosphere/meso- sphere/lower thermosphere vary none-uniformly with time. Especially, we analyze the contribution of varying concentrations of CO_2 and O_3 to the temperature trend in the mesosphere. It is important to distinguish between trends on pressure altitudes and geometrical altitudes, where the latter includes the effect of shrinking due to cooling at lower heights. As a highlight, we will present first results in analyzing the very first appearance of NLC in 1885 observed after the volcanic eruption of Krakatao in August 1883 that injected a tremendous mass of water vapor into the stratosphere.