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Trajectory modelling of mesospheric ice particles

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Using the LIMA/ICE Lagrangian model for PMC simulation, ice particles within a given NLC event are traced during their lifetime. Specifically, NLCs in certain latitude bands of interest are scanned for large ice particles (e.g., radius > 20 nm), which are then traced back to their nucleation time and forward until evaporation. From these trajectories, we calculate characteristic properties of ice particles like lifetime and growth rates, as well as the geographical origin of the ice particles. Conclusions are drawn where and when the nucleation processes of the NLC particles occurred and under which atmospheric conditions (temperature, supersaturation). Most NLC particles detectable by LIDAR (i.e. maximum radius > 20 nm) nucleate near the mesopause, grow very slowly initially, then start to grow at an increasing rate and finally sediment and evaporate quickly. Nucleation itself generally occurs in short "bursts" whenever ambient conditions allow it. At other times small ice particles stagnate in size or even partially evaporate again. The time it takes for PMC particles to grow to visible size and sediment is dependent on latitude. The results indicate that NLC particles observed at higher latitudes have a longer lifetime ($\sim$ 2d) compared to lower latitudes (< 1d). This implies that ice particles which nucleate near the polar mesopause spend a lot more time in supersaturated conditions than those nucleated further south. Also, the evaporation time is generally very short in relation to total lifetime, typically 2-6 h. Using LIMA/ICE, we also investigate the latitude dependence of trends in NLC occurrence rates as well as trends in their area and southernmost extent during the season.