Contribution ID: **49** Type: **Poster**

Issues with the retrieval of particle size information of noctilucent clouds from optical remote sensing measurements

Noctilucent clouds (NLCs) are optically thin ice clouds occurring near the polar mesopause in the summer hemisphere. Our understanding of the particle size of NLCs is to a large extent based on optical measurements in different observation geometries and optical NLC particle size retrievals are always based on a priori assumptions on the shape of the particle size distribution. The actual shape of the particle size distribution is generally not well known and can be assumed to be highly variable. In addition, the scattering cross section of NLC particles depends strongly on particle size. This leads to effects that have until now not been considered properly in the literature, i.e. if the assumed shape of the particle size distribution differs from the actual one, NLC size retrievals based on different measurement techniques will be associated with different biases. These differences can be quite substantial, for the retrieved particle number density in particular. In this study we carry out NLC particle size retrievals based on simplified synthetic forward simulations for the following observation techniques: satellite occultation, satellite limb-scatter, ground-based lidar and satellite nadir measurements. For the forward simulations we assume a bi-modal particle size distribution, while for the size retrieval a mono-modal distribution is assumed - which is typically the case in the literature. We assume both normal and log-normal particle size distributions, but the main results of this study are independent of the specific assumption on the shape of particle size distribution. We find that even for small deviations from the assumed shape of the particle size distribution, relatively large differences in retrieved size estimates occur between the different observation geometries considered. The retrieved median radii can differ by up to a factor of 2, while retrieved particle number densities can differ by more than a factor of 10 between the different observation geometries. These results need to be considered when comparing NLC size retrievals from different optical techniques.

Topic

Aerosols and clouds

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