

Atmos. Meas. Tech. Discuss., referee comment RC2  
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## Comment on amt-2022-28

Anonymous Referee #2

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Referee comment on "A study of Mie scattering modelling for mixed phase Polar Stratospheric Clouds" by Francesco Cairo et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2022-28-RC2>, 2022

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This paper describes a simplified method for calculating the optical properties of mixed-phase polar stratospheric clouds (PSCs), i.e., those composed of both spherical supercooled ternary solution (STS) droplets and non-spherical nitric acid trihydrate (NAT) or ice particles. It is assumed that the backscatter and depolarization of NAT and ice particles can be modeled by applying empirically derived factors ( $C$  = backscatter depression, and  $X$  = polarized fraction) to Mie scattering results for equivalent-size spheres. The Mie calculations are based on monomodal or bimodal lognormal fits to size distributions measured on balloon flights in the Antarctic and Arctic, with particles smaller (larger) than a threshold radius ( $R_{th}$ ) assumed to be STS (NAT or ice). Best-fit values/ranges for  $C$ ,  $X$ , and  $R_{th}$  are determined by comparing the calculations to concomitant lidar and backscatter-sonde measurements of backscatter and depolarization.

I don't think this study makes a significant contribution to the literature. The method does a very poor job of modeling the measured depolarization. The authors cite a number of prior papers supporting this negative finding, which makes it seem that this was a foregone conclusion. There is a decent match between modeled and measured particulate backscatter, but this parameter provides much less information about PSC formation and evolution than depolarization does.

In my opinion, the authors should redo the study using a different approach in which the scattering and depolarization of the presumed non-spherical particles larger than  $R_{th}$  are computed using readily available tables of T-matrix results for randomly oriented spheroids with different aspect ratios. They should attempt to determine a value/range of aspect ratios that best fit the observations, which would be a much more valuable contribution to the literature than the present paper.

I must also comment that the use of the English language could have been improved in

many spots in the paper. The paper could also have benefited from closer proofreading, e.g., 3 formulae are presented on both page 3 and page 4, but there are 4 formula numbers on each page.