

Atmos. Meas. Tech. Discuss., referee comment RC1  
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## Comment on amt-2022-28

Anonymous Referee #1

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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-RC1>, 2022

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The paper describes an effort of using the Mie theory to model lidar backscattering and depolarization of Polar Stratospheric Clouds. Two empirical parameters are introduced to describe depolarization (X) and depression factor of solid particle backscattering (C). The input to the Mie code include in-situ measured size distributions, while the refractive index is assumed from the literature. The authors found that they can match the backscattering pretty well but failed to reproduce the depolarization factor. They claim the novelty of this paper is to test the range of Mie theory in modeling lidar data.

I cannot support the publication of this paper because the optical models lacks the basic physics consideration of light scattering. Light scattering by aspherical particles is essentially different from spherical particles. The most prominent difference is the depolarization property. The Mie (spherical) particles cannot depolarize lidar signal, if we ignore multiple scattering. It makes no sense to the reviewer that using an empirical factor X to model depolarization of spherical particles (see Eqs. 12 and 13). In addition, they use an empirical factor C to adjust the backscattering of spherical particles to aspherical particles, though it is more tolerable than the depolarization but still undesirable because of its empirical nature. There are two main causes of lidar depolarizations, nonsphericity and multipole scattering, neither is considered by this optical model so it is no surprise that you cannot mimic the behavior of depolarizations.

I encourage the author to examine their work under the light of assuming true nonspherical particle contribution instead of just trying to fit the data with some arbitrary empirical parameters. In the end the empirical parameters does not help the community gain any knowledge about the microphysical and optical properties of PSC.