

Interactive comment on “Microphysical Properties of Frozen Particles Inferred from Global Precipitation Measurement (GPM) Microwave Imager (GMI) Polarimetric Measurements” by Jie Gong and Dong L. Wu

Anonymous Referee #2

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This study investigates the relation between V-H polarimetric difference (PD) and brightness temperature (TB) in high-frequency microwave channels (in particular, 89 and 166 GHz). An important discovery of this study is a universal bell-curve for the correlation between PD and TB. This bell-curve feature may be potentially useful for inferring the radiative and microphysical properties of frozen particles in the atmosphere. Furthermore, a heuristic model is designed to explore the physical mechanism of the aforementioned bell-curve.

Overall, the manuscript is well organized and clearly written. The radiative transfer

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simulations and data analyses are convincing. No major technical errors are found in this manuscript. However, some revisions are suggested for the authors' consideration.

Specific comments:

1. Line 6 on page 12: the term “the aspect ratio (AR) factor” defined in this manuscript is not appropriate. Normally, the “aspect ratio” is used to indicate an ratio between two geometric dimensions along two different directions. However, in this manuscript, “the aspect ratio factor” is a quantity to quantify the difference of radiative properties associated with two polarization states. Thus, this factor should be referred to as “the dichroism factor” to indicate the difference due to different polarization states. Please see the following references:

Mishchenko MI. Extinction and polarization of transmitted light by partially aligned non-spherical grains. *Astrophys J* 1991; 367: 561-74.

Mishchenko MI, Travis LD, Lacis AA. *Scattering, Absorption, and Emission of Light by Small Particles*. Cambridge, UK: Cambridge University Press; 2002.

Parker, S. P., *McGraw-Hill Dictionary of Scientific and Technical Terms*, (5th Edition), McGraw-Hill, Inc., New York, 1993.

Yang, P., M. Wendisch, L. Bi, G. Kattawar, M. Mishchenko, and Y. Hu, 2011: Dependence of extinction cross-section on incident polarization state and particle orientation. *J. Quant. Spectrosc. Radiat. Transfer*, 112, 2035-2039.

2. This study suggests “horizontally oriented nonspherical frozen particles are thought to produce the observed PD because of different ice scattering properties in the V and H polarizations.” However, previous studies based on observations in the visible channels (Noel and Chepfer 2010, Zhou et al 2012, 2013) suggest that the percentage of horizontally oriented ice crystals is quite small. Apparently, further investigations are necessary to validate this claim.

3. Line 11 on page 1 “It is the first study on global . . . that uses . . .”: would it be better

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to say “It is the first study of frozen particle microphysical properties on a global scale with the use of dual-frequency . . .”

4. Line 13-14 on page 1: “the scatterings of frozen particles are”: would it be better to say “the scattering by frozen particles is”

5. Line 16 on page 14 (and throughout the manuscript): “particle habitat” should be “particle habit”

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