Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2020-256-RC3, 2020

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Linkage among Ice Crystal Microphysics, Mesoscale Dynamics and Cloud and Precipitation Structures Revealed by Collocated Microwave Radiometer and Multi-frequency Radar Observations" *by* Jie Gong et al.

Anonymous Referee #2

Received and published: 25 May 2020

In this article, Gong et al. delve into a unique GMI measurement, the difference between Polarimetric Difference (PD) between radiances at 166 GHZ, that could be used to retrieve novel information for precipitation retrievals and satellite-based meteorological research. I believe the science of the study is incredibly valuable. PD represents a unique source of information in frozen clouds that can only be retrieved from the GMI, but interpreting radiance information on frozen precipitation has been a challenge due to the multiple explanations that could account for a similar PD signal. The authors

provide a clever combination of globally averaged observations between two satellites, simulation results, and a set of specific storm observations to winnow down the physical interpretation of PD observations. I look forward to following future developments in this research.

Unfortunately, I believe the writing quality for this article falls below the level necessary for publication. Grammatical errors are frequent (e.g. "collocation cases... are averaged separately considering they locate in different weather regimes at L228), articles/prepositions are often missing or used inappropriately, and word choices are often inappropriate, both in the sense of conventional English (e.g., "the biggest blob of power" at L304) and in terms of formal writing (e.g., "more and more" throughout). Occasionally, it was enough of an issue that I found it difficult to understand the author's message. Please make sure that this paper is proofread more carefully before the next submission, with specific attention to formal word choices.

Specific comments are below:

L40: It would be nice to have more detail here. I have never heard of Cloud Radiative Effect before, and I would like to know which microphysical properties you are referring to.

L17/87: PD is defined in two different ways (Polarimetric radiance Difference, Polarimetric Difference). I would suggest unifying these.

L163: Has the collocated GMI, DPR, and CPR dataset been used by "many" other researchers for published articles? Yin et al. (2017) was the only one I was familiar with before reading this paper.

L193: ". Compared with "high-PD" scenario, the "low-PD" one apparently has more high clouds that are thinner than those from deep convective scenes as the reflectivity magnitudes are smaller". Unsure of what you mean by "more high clouds that are thinner". According to the CloudSat CFAD, the distribution of reflectivities for clouds

above 13 km appear to extend larger at low PD than high PD, so I feel like that would make the high clouds at low-PD thicker?

L203: I don't understand how a mean could be "PDF-weighted". Consider rewording?

L203-L218: I don't agree with the interpretations of reflectivity used throughout this paragraph, and I would prefer if the authors would be more objective. Reflectivity is used to describe the "thickness" of clouds and the "presence" of clouds in the same sentence, even though these two traits are not directly comparable. Later it is used to describe the number of precipitation sized particles (less/more), even though reflectivity can also be indicative of precipitation particle size. I would prefer if the figures are discussed more literally in this section, just explaining which PD scenarios have larger average reflectivity at different altitudes, and then save the interpretation of reflectivities for the following paragraph.

Figure 3: I do not see any novel information provided by Ka band reflectivity in Figure 3b, so I think it could be removed.

On a similar note, Ka band reflectivity can be used to construct a Ku/Ka DWR. DWR can be used to provide information on ice particle size without being influenced by particle concentration, unlike the Z measurements used throughout the study. Comparison between DWR and Ku may also provide information on ice particle concentration. Considering the frequent discussion on ice particle aggregation, I think it could be valuable and relatively straightforward, to make figures similar to Figure 2 and 3 (and potentially Figure 8) with DPR-measured DWR. Keep in mind that DWR may also be influenced by liquid water attenuation, so a DWR profile should be interpreted with caution. This is more of a suggestion than a perceived requirement for publication, however.

Figure 6: I am having difficulty understanding this figure well enough to determine whether I agree with your interpretation. The combination of filled and unfilled contours worked in Figure 2, but only because the zones of reflectivity were mostly separate. I think this figure would work better if both high PD and low PD were line contour plots of

different colors, and regardless of whether that suggestion works, I would appreciate if this figure could be replotted to be more decipherable.

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