Revision of : Hydrometeor partitioning ratios for dual-frequency space-borne and polarimetric ground-based radar observations by Velibor Pejcic, Kamil Mroz, Kai Mühlbauer, and Silke Trömel

Response to reviewer RC1

Dear reviewer,

We are very grateful for all your suggestions to further improve the manuscript. Both reviewers suggested reducing the number of abbreviations to improve readability. We agree trying to improve the readability and reduce the number of abbreviations in the manuscript. E.g., we decided to remove all abbreviations for the hydrometeor classes (reducing the number by 11 abbreviations). We also changed the individual abbreviations of the hydrometeor partitioning ratios for each specific hydrometeor class in the manuscript. For example, the hydrometeor partitioning ratio for light rain derived from dual-frequency measurements is no longer abbreviated as HPR_LR^DF but is now referred to as HPR_DF of light rain. This reduced the number of abbreviations by an additional 20 (11 HPR based on dual-polarisation and 9 HPR based on dual-frequency). Abbreviations for multi-scattering (MS) and drop size distributions (DSD) are removed as well as they do not appear frequently in the text. Furthermore, we simplified the complex abbreviation DFR^m_(Ku-Ka) to DFR. We also included a list of all remaining abbreviations for the reader's convenience (see Table C1 in Appendix C) and added "All abbreviations can be found in Tab. C" in line 62.

Additionally, we like to draw your attention to the fact that former Figures 8 and 9 (now Figures 7 and 8 in the revised manuscript) changed slightly. Unfortunately, an earlier version of the centroids and covariances was accidentally used for the case study run (plausibility check), i.e. not the ones presented in our manuscript (see Fig. 4) and used for training and evaluation. The small differences do not affect our overall results and conclusions. We apologize for this minor error.

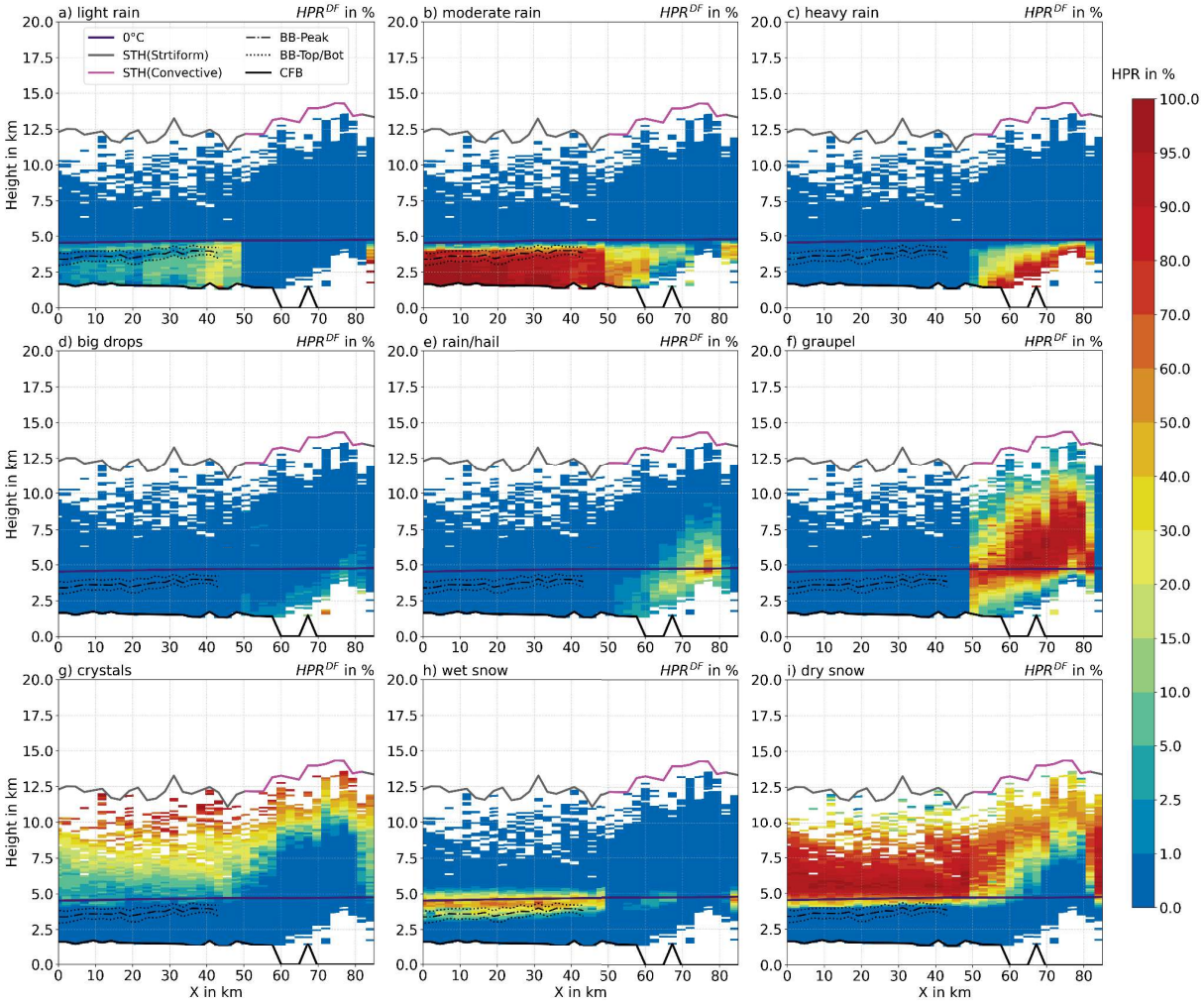

Figure 7. Estimated HPR^DF_k for different hydrometeor classes applying HMC_P to SR observations shown in Fig. 6. The black line indicates the clutter free bottom, the indigo line the freezing level height (DPR), and the STH for convective (magenta) and for stratiform (gray) SR-based RT. The dashed lines represent the bright band top and bottom. The bright band peak is illustrated as dash-dotted line

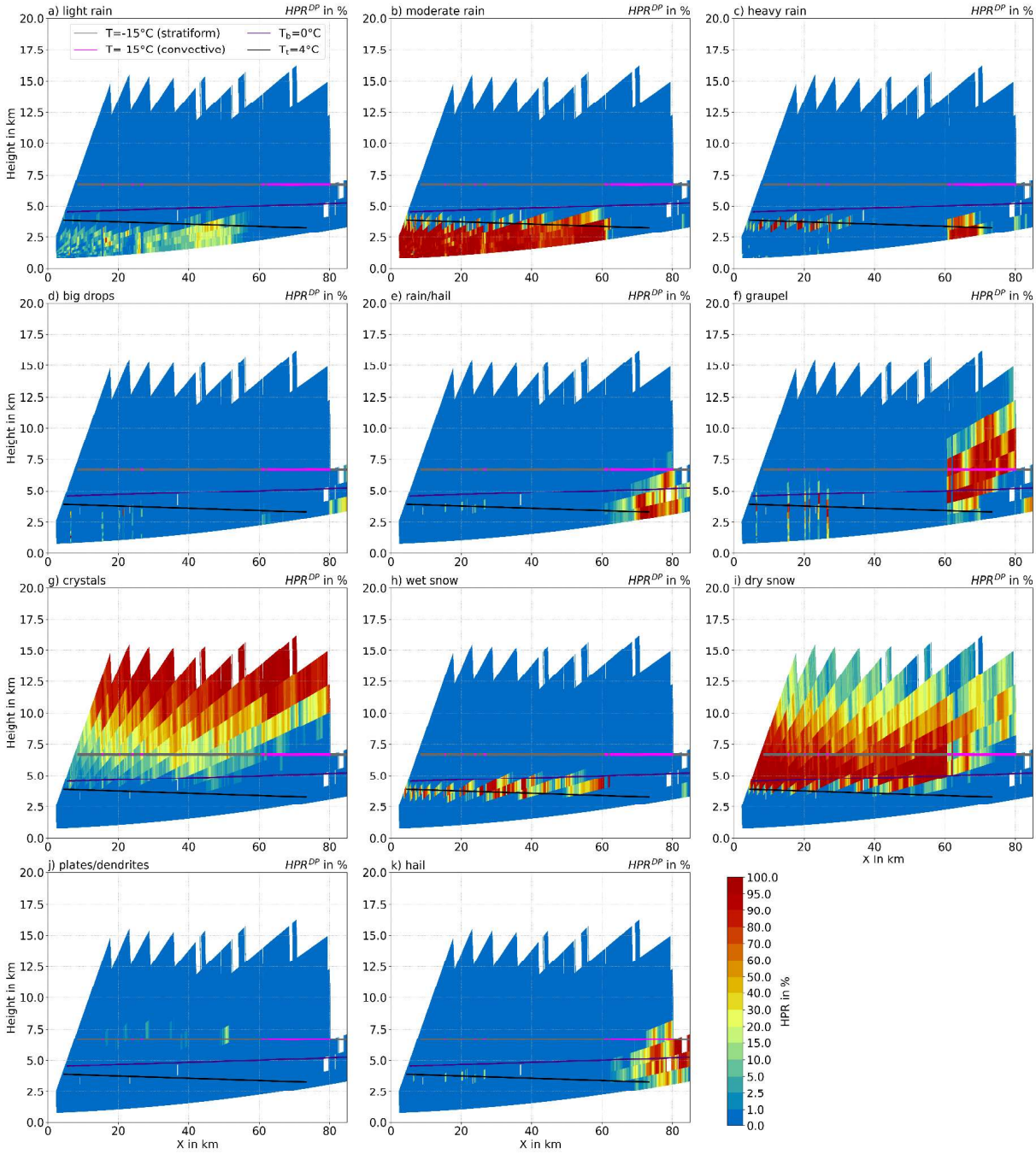

Figure 8. Estimated HPR^DP_k for different hydrometeor classes with HMC_P with GR observations shown in Fig. 6 The black lines indicate the Tt = 4°C and the indigo lines the Tb = 0°C isotherms. The Tc = −15°C is indicated in gray/magenta for the GR-based stratiform/-convective RT.

Furthermore we updated the doi of the citation “A new aggregation and riming discrimination algorithm based on polarimetric weather radars” and we introduced the missing rain type RT in line 99.

Our response is highlighted in blue below. The revised manuscript with tracked changes is also provided for better transparency.

Response to reviewer 1:

This is a study of precipitation particle type classification and presents useful results. However, it is difficult to read due to too many abbreviations.

Line 3 It is unclear what the P in HMC^DP_P means.

HMC_P describes the more sophisticated hydrometeor classifications HMCs capable of deriving even hydrometeor partitioning ratios (HPRs). The subscript P points to the author's name “Pejcic” who advanced and evaluated these newer algorithms in this publication. We do not explain the association with the author’s name in the abstract, but explain it later in line 50:

In the revised manuscript, the formulation in the abstract is changed to "Conventional radar-based hydrometeor classification algorithms identify the dominant hydrometeor type within a resolved radar volume, while newer techniques estimate the proportions of individual hydrometeor classes (hydrometeor partitioning ratios, HPRs) within a mixture. These newer algorithms (HMCDP) are based on dual-polarization measurements from ground-based radars (GR), while to date no comparable algorithms for space-borne radars (SR) with dual-frequency capabilities exist."

Later in Line 50 we clarify: “In this study, the HMC scheme from Trömel et al. (2023) (HMCP; introduced by Pejcic et al., 2021),...”

Line 6-7 It is unclear what the k in HPR^DF_k and HPR^DP_k refers to.

Subscript k stands for the k different hydrometeor classes considered in HMC_P. However, we can introduce this subscript later and avoid it in the abstract. We rewrote in the abstract: "This study (1) further improves HPR estimates based on GR dual-polarization measurements, (2) exploits the combination of dual-frequency SR and dual-polarization GR to introduce HPRs based on dual-frequency observations only, and (3) evaluates GR- and SR-based HPR retrievals. " (Line 5)

Line 9 What does "these" refer to? there are no DP measurements in GPM/DPR.

It refers to the three objectives. We clarified and changed it in Line 7 to "To achieve these objectives...".

Line 37 The u and a in Ku-band and Ka-band are not subscripts.

Yes, thanks for pointing us to this mistake. It is now corrected throughout the manuscript.

Figure 2 Why are NEXRAD radar sites concentrated in the eastern half of the country?

The quality-controlled GR observations are provided by NASA's GPM Ground Validation program (GPM-GV), which only takes the shown radar sites into account. For more information we refer to Pippitt et al. (2013) listed in our manuscript. We added in Line 108: "Only quality-controlled observations provided by NASA's GPM Ground Validation program (GPM-GV) are used. The eastern GR sites of the NEXRAD network are predominantly used in the GPM-GV.". Furthermore, we edited line 109- "Quality-controlled GR observations are provided by NASA's GPM Ground Validation program (GPM-GV). The quality control includes non-precipitating echos removal with different thresholds and phase unfolding" is reformulated as follows: "GPM-GVs quality control includes the removal of non-precipitating echoes with different thresholds and phase unfolding." We also changed the caption of Figure 1: "Overview of the NEXRAD weather radar (WSR-88D) sites used in this study." to "NEXRAD weather radar (WSR-88D) sites provided and quality controlled by the GPM-GV and exploited in this study."

Line 64 The u and a in KuPR and KaPR are not subscripts.

Changed.

Line 66 November 2024 -> Novermber 2023

Changed.

Line 95 It is unclear what MS indicates.

MS indicated "multiple scattering" but to reduce the amount of abbreviations in the manuscript it is no longer used in the revised version.

Line 149 Please explain what kind of particles are big drops (BD)

The hydrometeor class big drops originates from Park et al. (2009) and is now explained in the Appendix B where all hydrometeor classes are detailed. We added: "The big drops hydrometeor class originates from Park et al. (2009) and represents rain with a skewed drop size distribution towards larger raindrops, indicating the presence of raindrops with a diameter greater than 3 mm and a lack of smaller raindrops."

Line 171 training dataset -> test dataset

Changed.

Figure 4 A legend should be attached to each subfigure.

The legends in panels b) and c) are valid for all panels, but we agree that this is irritating. Instead, we suggest a superordinate legend for all plots instead of repeating the same legend in all panels.

Line 263 “an” overestimation

Changed.