Review comments

Overall comments

In this paper, titled "A Microwave Scattering Database of Oriented Ice and Snow Particles: Supporting Habit-Dependent Growth Models and Radar Applications (McRadar 1.0.0)," the authors presented a database of microwave scattering from ice and snow particles, which are computed using the discrete dipole approximation (DDA). The database contains scattering matrices of 2627 individual ice crystals and 450 aggregates for four microwave frequencies in C-, X-, Ka- and W-bands.

The database developed by the authors would become a new option to perform forward radar simulation with ice particles. The larger number of particle samples might be an advantage compared with past databases. However, I think the quality of the manuscript is not sufficiently high for a journal paper, and major revision would be required.

Major comments

1) Lagrangian super-particle models and habit-prediction schemes should be introduced in the introduction, probably in the fourth paragraph. These models and schemes seem to be important for the authors' motivation, according to the abstract.

2) In Section 2, the explanation of the methods is not sufficient. Particularly, explanations of the Reiter algorithm and the aggregation model are necessary. If a brief explanation is difficult, the authors can add an appendix for the explanation. References to the original papers would not be sufficient to explain the methods for the present study.

In the present manuscript, it is impossible to understand the meanings of the key parameters α, β, and γ, and thus the parameter values tell nothing.

It is also difficult to understand why the Reiter algorithm is not enough to cover the variety of habits because there is no explicit explanation of the detail and the limitation of the algorithm.

The aggregation model seems to be used for generating columnar crystals, while there is no explanation of the aggregation model in Subsection 2.2. What is the aggregation model and how did the authors use it?

3) In figures 1 and 3, it is not easy to understand the three-dimensional structure of particles only from the silhouettes. I think the authors can add the edge lines or differentiate the face color depending on the directions. Such visualization would be possible by using e.g. ParaView.

Figure 3 is not referred to in the main text. Add the reference to figure 3 in the main text or remove figure 3.

4) In figure 5, the authors copied and modified an image from Wikipedia, "Euler angles" (https://en.wikipedia.org/wiki/Euler_angles). The license of this image file is CC BY 3.0. Therefore,

the authors must give appropriate credit, provide a link to the license, and indicate if changes were made.
This image in Wikipedia explains a rotation of *z-x-z* sequence. However, in line 153, the authors wrote that they use 3 Euler rotations "that follow the commonly used zyz-conversion (Fig. 5b)." This description is not consistent with the figure 5: The rotation sequence is different, and the image of the rotation sequence is used in figure 5a.
The notations for the three rotation angles are the same as the key parameters for Reiter algorithm. The notations for different quantities should be differentiated to avoid any confusion.

5) In Section 3, there is no explanation about the discrete dipole approximation (DDA) whereas the simulation method is essentially important to consider the reliability of the simulated results. It would also be important to explain why the approximation is considered so accurate. The representation method of particle shapes and the discretization method for the dipoles should also be explained. The equations to compute Z_{ij} from S_i should also be shown to complete the explanations.

6) At line 193, it is assumed that snowflakes fall by aligning the longest axis of inertia horizontally, but this assumption would not be appropriate. In a recent letter by Bhowmick et al. (*Phys. Rev. Lett.*, 132, 034101,2024), existence of strong orientation fluctuations of nonspherical solid particles in the atmosphere is reported experimentally and theoretically. It is also stated that this orientation fluctuation occurs for typical atmospheric particles, and the fluctuation may be enhanced by turbulence.
Equation (7), below the sentence at line 193, does not consider the assumption, and then it seems that the authors consider the assumption to obtain Eq. (8). This relationship should be clarified.

7) The scattering properties are computed by the DDA for incident microwave directions (θ_0, ϕ_0) in the particle reference frame (PRF), where the azimuth angle ϕ_0 is selected from 0^o to 360^o with interval of 22.5^o. The interval 22.5^o would be too coarse for dendritic ice particles to obtain sufficient statistics of scattering for arbitrary incident direction. Since the dendritic particles have six branches, only three azimuth angles are considered in the present setting. It is necessary to show the evidence that the computation is sufficiently accurate even in the present setting, if the authors think it is sufficiently accurate.

8) For the case of spherical water droplet, the normalized scattering cross section $k^2\sigma$ is given by a function of kD, where σ is the scattering cross section, k is the microwave wavenumber, and D is the particle diameter. This is because the electric field around the sphere is determined by the ratio of the wavelength of the electric field and the particle diameter. I imagine that the same normalization would also work for ice particles, i.e., normalized scattering properties are the same for

the same value of kD_{max} with the same shape. If it is true, the results computed by the DDA is applicable to arbitrary frequency. Why do the authors need to limit the number of frequencies for the computation?

9) In figure 6, the authors plotted the radar reflectivity factor, but the number density is necessary to determine the factor if I am correct. The discussion up to Subsection 3.4 is only about single scattering properties. I think the authors should explain how they assumed the number density of particles. I have the same question also to Figure 8.

10) The verification of the authors' DDA computation should be provided. I think that Rayleigh scattering from spherical and spheroid particles would be good examples and should be compared with theoretical solutions.

11) In Section 4.1.1, the error in scattering properties caused by the regression based on the nearest-neighbor method is verified, and the authors accepted the small deviations in individual particle properties. However, there is no quantitative discussion. The authors should explain quantitatively why the error level shown in Table 1 is sufficiently small in forward radar simulations. In addition, the discussion in this section is only verification, it is not validation. The subsection title should be corrected.

12) In Subsection 5.2, the authors stated that the advantage of the present database is larger number of particle samples. As the authors state, a dense database could be better than a sparse database. However, in that subsection, the authors do not discuss the advantage of their dense database. The authors should compare the databases with different numbers of samples. I think it is possible to create such database by randomly subsampling particles from the original database.

13) The advantage of the authors' database should be clarified in comparison with that of Lu et al. (2016). The database of Lu et al. (2016) provides scattering properties across a range of orientations and includes over 1000 ice particles, ranging from single crystals to aggregates and graupel for X-, Ku-, Ka, W-bands. The difference of the present database from that of Lu et al. seems to be the number of particles and the chois of the frequencies. Is that the advantage of the present database?

14) Appendices should be referred to in the main part of the paper. The appendices should also contain main sentences that explain and discuss the figures and tables in the appendices.

Minor comments

- [l. 45] "log" in $O(nlogn)$ should not be italic.
- [l. 106] It would be better to write "Section 5.1".

- [l. 113] Probably, the citation should be written as “Leinonen and Moisseev (2015)”.
- [l. 145 and 151] Probably, “is fixed with” would be better than “is solid with”.
- [l. 156] The explanation about the angle *az* is not precise. The rotation with angle *az* does not correspond to the inverse rotation with angle α since the absolute values of *az* and α are different in general. Only the difference $(\alpha - az)$ is meaningful.
- [Eq. (2)] The variables *I*, *Q*, *U*, and *V* are not defined.
- [l. 170] The reference of Yurkin and Hoekstra (2011) is a journal paper on JQSRT, which is not the User Manual of the ADDA code. The authors should add appropriate reference information. I think the relationship of the Mueller and amplitude matrices would be found in other review papers or textbooks.
- [Subsection 4.1] There is no reference to McRadar. It seems that the authors are at least a part of the developer of McRadar, but the development of McRadar is not be the main topic of this paper. Therefore, appropriate references should be added to McRadar at least in Subsection 4.1.
- [l. 320-323] Use italic fonts for variables *c* and *a* appropriately.
- The authors must explain what the abbreviations are. For example, explanations of ZDR, DWR, and MDV are missing.
- I think the availability of the level 0 database should also be written in *Code and data availability*.