

Interactive comment on “The microwave properties of simulated melting precipitation particles: sensitivity to initial melting” by B. T. Johnson et al.

Anonymous Referee #2

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While there have recently been several studies published on how aggregate snowflakes interact with radiation in the microwave region, very few (if any) have tackled the challenge of studying how partially melted aggregates influence scattering in the microwave region. This particular work is a good first step in an attempt to answer this question. Knowing how radiation interacts with partially melted hydrometeors can ultimately lead to better retrieval algorithms.

I found the paper very easy to read and straightforward. Also, I found the Single Particle Melting Model (SPMM) to be a very well-thought out approach to the problem of how to simulate melted hydrometeors. I do believe this article will benefit from a little more

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discussion in a key area to clear up confusion that readers may have. Depending on the results of this discussion and how it matches up to previous research, I believe that only some minor revisions need to be made in order for this to be published.

Area for further discussion:

How do these snowflakes compare to the traditional mass-dimension relationship of $m = a D^b$? It is stated in the paper (Fig. 5 is what I am thinking of specifically) that an increase of 50 times the effective radius leads to a mass increase of 125,000. This, however, is effective radius and not the maximum dimension as I believe this is what the mass-dimension relationship above uses. Has the value of b in these snowflakes been examined? If so, what is it and how does it fit into previous field study relationships? I believe this discussion would strengthen the article.

Minor revisions:

Page 5617

Line 7 - 9: “The onset of melting is generally believed. . .”.

This sentence does make logical sense, but citation of literature here would make the argument stronger.

Line 27: “Recently radar properties..”

I believe there should be a comma after “Recently” as it is modifying the rest of the sentence and not a specific verb, but this point might be debatable.

Page 5618

Line 13: “. . .sensors, such as CloudSat (Stephens et al., 2002) and the recently launched. . .”

As three things are listed in this sentence (CloudSat, GPM and aircraft sensors), I would replace the “and” after Stephens and replace it with a comma. For example, “. . .sensors, such as CloudSat (Stephens et al., 2002), the recently launched. . .”.

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Page 5619

Line 5: “Previous studies has examined...” should be “Previous studies have examined...”

Line 11: “. . .we will do not explicitly consider these effects. . .” should be “. . .we do not explicitly consider these effects. . .”.

Line 18-20: Perhaps this is not the best location for this discussion in the paper, but I think a few lines describing how the aggregates were created/generated would be useful.

Page 5620

Line 9: I would like to see a little more discussion on the stochastic control factor, mainly how it controls the rate of melting.

Lines 19 – 20: Perhaps I am misreading this sentence, but I do not see how breakup is being simulated as all melted points seek the center-of-mass and no ice and/or water points are broken off.

Page 5621

Lines 1 – 2: I would like to see a range of number of dipoles vs. time to melt the entire flake. Is it a linear relation? Exponential?

Lines 23 – 24: “. . .dipoles representing the shapes, minimizing the dipole spacing d. . .” should be “. . .dipoles representing the shapes and minimizing the dipole spacing d. . .”

Lines 24 – 25: For clarity, I would like to see a brief discussion on how $|m|$ changes with increasing amounts of water present in the hydrometeor to illustrate why d must also be changed to satisfy the $|m|kd < 0.5$ criterion.

Page 5622

Line 21: “. . .implentation. . .” to “. . .implementation. . .”

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Page 5623

Line 2: “. . .two-frequency groups. . .” should be “. . .two frequency groups. . .”

Page 5624

Lines 17 – 19: I think this is an interesting “accidental” finding. I would like to see more on this topic in the future.

Line 24: The reader is referred to “Sect. 4” (same on line 10 on pg. 5625) for further discussion whereas on pg. 5623 line 23, the reader is referred to “section IV”. One of these should be changed so that references to other sections are consistent throughout the article.

Page 5627

Line 11: $K_w = (m_w^2+1)/(m_w^2+1)$ should be $K_w = (m_w^2+1)/(m_w^2+2)$.

Line 13: $K_w = 0.93$ is typically used for water at 263K for low frequencies, but might not apply to higher frequencies. For example, Liao et al., 2010 (doi:10.1109/TGRS.2008.916079) states $K_w = 0.93$ typically applies to frequencies lower than 10 GHz and they use a value of 0.698 for 94 GHz (other literature is somewhat different).

Page 5628

Line 23: “The most apparent features are. . .” should be “The most apparent feature is. . .”

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