Answer of Referee #2

Major comments

1. As noted in the introductory part my largest issue with the manuscript is the lack of a good discussion section to put the findings into perspective. I believe there are a number of key issues concerning ash dispersal that the results are relevant to (see other points 3 and 4) and I would like to see at least some of the discussed in more detail in a larger discussion section. This doesn't have to necessarily be a separate section from the conclusions (although it would be preferred), but at least a more complete version of what was included in the first iteration. Parts of the introduction feel overly long and repetitive so I would suggest tidying up the introduction and using the space for a more comprehensive discussion section.

Author's answer: Thank for referee's comment. We have added a discussion session (section 4) to discuss in detail the future direction of research that can be expected from the results of this study. Also, we removed the sentences section that were deemed unnecessary in the introduction.

2. Speaking about the introduction, at the end it is stated that one of the two goals of the paper is to "develop QAE methods for accurate detection of ash clouds by cloud radar" (ln158-161). Although I understand that this is one of the aim of the larger study presented it is not really addressed again in the paper aside from the concluding section (ln 610-615). I feel that at this point this is future work and mainly makes sense in the conclusions; usually the last paragraph of the introduction is reserved for topics that are actually addressed in the paper.

Author's answer: The quantitative ash fall estimation (QAE) is the motivation and purpose of the present study. The authors concluded that the reasons why these variables were analyzed should be explained. The author agreed referee's comment. Therefore, all sentences related to QAE in the manuscript have been moved to the discussion section to suggest the possibility of QAE method.

3. How would ash aggregation affect the results in real conditions? Aggregation changes the new particle density and size and thus affects vertical velocity (for example see Bagheri et al 2016 Timing and nature of volcanic particle clusters based on field and numerical investigations, J. Volcanol. Geotherm. Res.). What would the effect of that be in radar observations?

Author's answer: The effects of aggregation on radar observations are outside the scope of the present study though it is important. Due to the changes in particle diameter and axial ratio through aggregation, the variation in differential reflectivity (Z_{DR}) which is a function of and the particle axial ratio and the horizontal reflectivity (Z_H) which is proportional to the sixth power of the particle diameter can be expected.

4. What would the results suggest for ash hazard simulations? How can this new knowledge be expected to impact results from volcanic ash simulations considering that volcanic ash is commonly represented as a single category with common geometry? I think that this represent an interesting point that could be touched upon to show the significance of the work.

Author's answer: The particle density and its shapes are the main factors that determine the terminal velocity. Since the particles of the oblate spheroids have a lower terminal velocity than that of the sphere. The terminal velocity of ash particle, thus, traveling distance of particles. Therefore, the higher performance of diffusion simulation results can be expected if a model considers the results of the present study.

5. Some of the paragraphs, especially in the introduction, are overly long and complicated. One paragraph should only discuss one idea, expressed by the first sentenced and expanded in the following sentences. Ideally, a reader should be able to have a good idea about what is written in the paper just by reading the first sentence of each paragraph. Overly long and complicated paragraphs can be very tiring to go through.

Author's answer: Thank for the referee's comments and authors agreed the advice. Therefore, we minimized the introduction section and focused on the free-fall experiment of ash particles.

Minor and technical comments

See manuscript for minor (blue) and technical/language (green) comments. These don't have to be addressed in the response, unless the authors would like to refute them

Please also note the supplement to this comment:

https://www.atmos-meas-tech-discuss.net/amt-2019-88/amt-2019-88-RC2-supplement.pdf

Line 40 : I can't understand the meaning

Author's answer: Thank for the comments. We modified the sentence as follows:

Added sentence [line 40-42]:

It is interesting the terminal velocities for OH decreased rapidly in the range 0.5 < D < 1 mm corresponding to the decrease in axis ratio (i.e., smaller the particle, the flatter the shape).

Line 42 : I would replaced with "ranged"

Author's answer: Thank for the comments. We modified the word

Line 54 : Bonadonna et al. (2011)

Author's answer: Thank you.

Line 94 : Marazano

Author's answer: Thank you.

Line 96 : > ?

Author's answer: Thank you for the comments. This is not a typo so we modified it to 'Lapilli (D > 0.53 mm)' based on Marzano et al. (2013).

Line 99 : can be

Author's answer: Thank you.

Line 111 : Example/reference?

Author's answer: Thank for the comments. This is information from Marzano et al. (2006). However, we removed this sentence to minimize the introduction.

Line 130 : In

Author's answer: Thank you. We removed this sentence to minimize the introduction.

Line 148 : Volcanic ash dispersal simulations?

Author's answer: This is a T-matrix scattering simulation, not a numerical model. It is described in the following paragraphs and this sentence moved to the discussion section.

Line 159 : This is future work?

Author's answer: Right. This study is the fundamental research for the development of a quantitative ash fall estimation (QAE) method based on weather radar.

Line 206 : I would rewrite to "The difference in angle between ... is defined as beta"

Author's answer: Thank you. We revised the sentence what you suggested.

Line 323 : remove the word 'by a manager'

Author's answer: Thank you.

Line 324 : This is a bit vague

Author's answer: This was cited by Maki et al. (2016) but we fully agreed to the referee's comments. Therefore, it was deleted.

Line 324 : Something seems to be missing here

Author's answer: Thank for the referee's advice. We modified 'the former data set (A, B)' to 'Type 1' to avoid confusing.

Line 331 : 2?

Author's answer: It's not a typo. The results are shown in Figure 3 of Bonadonna et al. (2011).

Line 362 : I would refer to Freret-Lorgeril et al. 2019 (J. Volcanol. Geotherm. Res.) to show a case where disdrometers were succesfully used in the field to observe ashfall

Author's answer: Thank for the referee's guidance.

Line 429 : Results are summarized..

Author's answer: Thank you.

Line 448 : This should either be expressed in log(Re) to reflect the figure axis or a line should be added in the figure to indicate Re=70.
Author's answer: Thank for your comment. We added 'Log (Re) ~ 1.845' in line 394.

Line 546 : I feel that this section should either come after or be merged with Section b. Fig. 15 could also be added as a second panel to Fig. 9 as:

New Fig 9:
9a. Old Fig. 9
9b. Old Fig. 15

Author's answer: Thanks for the question. The authors have been concerned about the simplification of the manuscript same as the referee's opinion. We agreed the referee's advice so we removed the section 3.f and merged the figure with Fig. 9.

Line 565 : I agree with this written here but not written as a direct aim of the paper in the introduction as its future work.

Author's answer: Thank you for the comment and we agreed the referee's comment. The sentence was removed.

Fig. 8 : Number? I think this would be better expressed as a fraction.

Author's answer: Thank you. We modified as 'Fraction'.