

Answer of Referee #1

Major comments:

1. The appeal of the originality of this study against former studies is inadequate. You should describe clearly and precisely about originality and position of this study (what is problems of former studies and how does this study solve the problems, for example) in abstract, introduction, and summary. This is most important point to correct your manuscript

Author's answer: Thank for the referee's comment. It can be found the previous references focused on the aerodynamic characteristics of volcanic ash particles, especially the terminal velocity (e.g., Bagheri et al., 2016; Dioguardi et al., 2017; Freret-Lorgeril et al., 2019). However, they considered the inefficient falling distance ($\sim 1.13\text{m}$) and the number of samples ($< 10^4$) which would be hard to meet the condition of natural falling ash particles. Therefore, we added a sentence as follows:

Added sentence [line 80-83]:

However, the falling distance ($\sim 1.13\text{m}$) and the number of sample ($< 10^4$) would be hard to meet the condition of natural falling ash particles. Del Bello et al. (2017) analyzed the effect of particle volume fraction on VT through free fall experiment but it also considered the aforementioned experiment condition (5.1m falling distance).

2. There are no description about lithological and petrographical characteristics of volcanic ash samples used in the experiment. As your manuscript show that the ranges of shapes of volcanic ash particle are wide, the contents of volcanic ash particles derived from Sakurajima Volcano are variable. For example, the tephra derived from the recent eruption of Sakurajima Volcano contains particles with various degrees of roundness, and sometimes contains tabular shaped glassy particles as co-ignimbrite ash derived from caldera forming eruption. In addition, shapes of essential glassy particles have wide variation, such as blocky and vesicular particles. Therefore, you should described classification and proportion of volcanic ash particles in the text.

Author's answer: The authors agreed with the referee's comments. However, unfortunately, the petrological characteristics of Sakurajima volcanic ash were not analyzed. Therefore we cited the recently references describing it (Oguchi et al., 2009; Takahashi et al., 2013)

Added sentence [line 256]:

\sim tephra is approximately 60–66 % SiO_2 Peléan-type (Oguchi et al., 2009; Takahashi et al., 2013)

3. The introduction about characteristics of Sakurajima Volcano is insufficient in chapter 2-d. Especially, you should described about volcanic history and characteristics of eruption type of recent eruptions from 2006 at Showa and Minamidake summit craters. The purpose is to clarify the characteristics of the volcanic ash sample used in the experiment as pointed out in above. The sampled date are described in Table 2, but there are no description about the characteristics of eruptions

Author's answer: We appreciated the referee's comments. We added the following paragraph to 2.d Sakurajima.

Added sentence [line 258-265]:

Sakurajima is an andesitic volcano with two peaks (Kita-dake and Minami-dake). Volcanic activity at Kita-dake ended around 4,900 years ago then it changed to Minami-dake. Activity has centred on Showa crater from 2006 (Iguchi, 2013). Showa crater is located on the eastern flank approximately 500 m east of Minami-dake (Southern Peak) of Sakurajima volcano. It was appeared in 1939 after one month of eruptions that year (Yokoo and Ishihara, 2007). The Minami-dake summit crater was the only active center of Sakurajima volcano until the recommencement of Showa crater from 1948 to 2006 then eruptive activity of Showa crater was resumed in June 2006 and vulcanian eruptions gradually increased in the autumn of 2009 (Hotta et al., 2016).

4. You should indicate clearly in summary about the advantage of your result and possibility about future works. The summary of first manuscript is just only description of data.

Author's answer: Thank you for the comments. A discussion section has been added to emphasize the advantage of our results.

5. Several other comments are shown in the manuscript (made by Adobe Reader).

Please also note the supplement to this comment:

<https://www.atmos-meas-tech-discuss.net/amt-2019-88/amt-2019-88-RC1-supplement.pdf>

Line 1 : "Laboratory analysis" is not most important keyword. How about "Free-fall experiment", for example.

Author's answer: 'Free-fall experiments' would be great. We will change the title.

Line 305 : Show reference.

Author's answer: This is a JMA report but, recent papers (Oguchi et al., 2009; Takahashi et al., 2013) describing the petrological characteristics of Sakurajima volcanic ash would be better for the manuscript. So, we changed the sentence.

Added sentence [line 256]:

~ tephra is approximately 60–66 % SiO₂ Peléan-type (Oguchi et al., 2009; Takahashi et al., 2013)

Line 305 : "eruptive events in historic age"

Author's answer: Thank you. We changed it.

Line 306 : Add Showa eruption and recent eruption from 2006 both at showa and Minamidake-summit craters. Furthermore, show the eruptive types of each event, and specify when the sample used in this study was taken.

Author's answer: It is judged that it is same comment for Major comment No.3.

Line 329 : "the"

Author's answer: Thank you. We changed it.

Line 612 : Specify the expected result.

Author's answer: This is future work. There are some limitations in describing the expected outcome. In addition, this study is a result obtained by 2DVD, not weather radar. Therefore, it was the authors' purpose to explain the direction of detailed research.