# Physical parameters analysis of volcanic ash particles measured by 2D-Video Disdrometer

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Weather radar is one of powerful instruments for measuring volcanic ash columns and ash clouds. However, we need fundamental physical properties on ash particles for the quantitative analysis of weather radar data of volcanic ash: necessary information are terminal velocity, axis ratio, and canting angle including density and dielectric constant of target to detect volcanic ash column correctly. In the present study, the basic features of volcanic ash particles are analyzed to develop quantitative ash fall estimations (QAEs).

The data were collected by a number of automatic tephrometers at Sakurajima volcano, Japan and reanalyzed with a 2D-video disdrometer (2DVD) in the large-scale rainfall simulator of NIED. The entire volcanic ash particles were classified as five types based on shape and orientation: Horizontal Oblate (OH), Vertical Oblate (OV), Horizontal Prolate (PH), Vertical Prolate (PV), and Sphere (Sp). Dominant particle shape was OH (71.5%) and the next was PH (17.0%). It should be noted the horizontally oriented type was 88.7% of all sampled data. The 64.4% data are concentrated on D < 0.5 mm. The number of PV and Sp particle is increased with D. The relationships of terminal velocity are dependent on particle shape types: Prolate spheroid (vertical orientation) particles were faster than those of oblate (horizontal). The distribution of $\gamma$ is from 0 to 1.5 at D < 2 mm, but these are concentrated to around 1 for D > 2 mm. The deviation of canting angle for OV (OH) is around two times larger (smaller) than raindrops. It is inferred that there would be not much rotating phenomenon.

The features of ZH and dual-pol radar variables (ZDR, KDP, and AH) were analyzed. ZH is around 4.3 dBZ smaller than that of raindrop and there is no resonance effects with radar frequency. There are large variabilities in ZDR depending on the particles shape for D < 2mm and these were close to 0 for D > 2mm. KDP and AH are variable with radar frequency but these magnitudes are almost 0 regardless of D. These results will be utilized to develop QAE methods, to detect volcanic ash column and predict its activity.