

Three-Dimensional Radar Data Analysis Tools of Volcanic Ash Clouds

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Weather radar data analysis tools have been developed to investigate the internal structures of volcanic ash clouds. The analysis tools calculate statistical parameters, three-dimensional distributions of polarimetric radar parameters that can be used to retrieve the inner structures of ash columns and ash clouds, echo top heights, ash amounts, and the ascent or descent speeds of pyroclastic material. The analysis tools were applied to 31 explosive eruptions of the Sakurajima volcano that occurred in 2013, which eruptions were selected with the condition that their ash column heights were greater than 3000m from the crater. The radar data were collected by operational X-band polarimetric radar, which was located approximately 10 km south-southeast of the volcano. Analysis of the temporal change of the histogram of the radar parameters in the ash clouds shows interesting results; while both reflectivity and differential reflectivity had no peak just after the eruption, they began to exhibit a normal distribution with time. While the reflectivity peak value decreases, depending on time, the differential reflectivity peak value increases. This is probably due to the size sorting mechanism and the uniformity of the shape of the falling ash particles. The specific differential phase was less than 1 deg/km. Doppler velocity measured above the crater can be used to estimate the speed of the pyroclastic materials, which determines the scale of eruption and ash column height.

Keywords: Weather radar, volcanic ash column, volcanic ash clouds, volcanic ash smokes, statistic, size sorting