Statistical analysis of volcanic ash measured by X-band polarimetric radar

Masayuki Maki
Kagoshima University, Japan
Suzuki, Ikuko (non affiliation, Kagoshima, Japan)
Maesaka, Takeshi (NIED, Tsukuba, Japan)
Muraji, Yoshitaka (Energy Sharing, Tokyo, Japan)

E-mail: maki@rdc.kagoshima-u.ac.jp

There have been several reports of 'conventional' radar succeeding in detecting volcanic eruptions and in estimating ash amount distributions. In addition to this information, 'polarimetric' radar may have the potential to deduce the microphysical properties of volcanic ash particles such as ash particle size distribution, particle shape and postural. By analogy with past studies of hydrometeor classification in radar meteorology, polarimetric radar parameters may be used to discriminate ash particles from hydrometeors, which is a difficult task for non-polarimetric radar. The present study examines the potential use of operational polarimetric weather radar in the detection of volcanic eruptions, and for quantitative ash fall estimations (QAE).

The radar data analyzed in the present study are from eruptions of the Sakurajima volcano in Kagoshima prefecture, which is located in southern Kyushu, Japan. The data selected for analysis are based on Japan Meteorological Agency (JMA) monthly reports on volcano activity; 32 explosive eruptions of the Sakurajima volcano in 2013. The radar data from the Sakurajima eruptions were collected by the Tarumizu X-band polarimetric radar, which was located approximately 11 km south-southeast of the volcano.

Based on analysis of the eruption time period, the maximum and accumulated horizontal reflectivity factor, and the volcanic ash differential reflectivity, we reach the following conclusions:

1) Operational polarimetric weather radar has the potential ability to quantitatively estimate the amount of volcanic ash expelled during volcanic eruptions.

2) The Z-A relationship, where Z is reflectivity and A is the ash amount, are derived using ground measurements of the ash amounts.

3) Differential reflectivity over a volcano crater fluctuates in space and time, while showing significant spatiotemporal patterning in the downwind regions, which suggests the presence of an ash particle aggregation and sorting mechanism.