An experimental forecasting technique for the ash hazard from Sakurajima volcano, Japan

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Introduction

The long-lasting activity from Sakurajima volcano introduces hazardous amounts of volcanic ash into the atmosphere, adversely affecting the surrounding areas (e.g. Biass *et al.* (2017), Poulidis *et al.*, (2018)), making accurate localized forecasts a necessity. Here, we present initial results from an experimental forecasting methodology carried out by the Sakurajima Volcanological Observatory (SVO), Kyoto University, focusing on three points: *(i)* high resolution (333m mesh), *(ii)* use of Eruption Source Parameters (ESPs) that are derived from geophysical signals (Iguchi, 2016) and allow for a proactive forecasting approach, and *(iii)* use of dedicated models in order to properly represent the plume structure.

Forecast Methodology

A combined modelling approach is presented: Japan Meteorological Agency (JMA) forecast data are dynamically downscaled to 333m using the Weather Research and Forecasting (WRF) model (Skamarock and Klemp, 2008), while the FALL3D volcanic ash transport and deposition (VATD) model (Folch *et al.*, 2009) is used for the introduction of the plume and dispersal modelling. A quasi-online coupling approach is used here, with WRF data output every 10mins so that the resolved variablity in the wind fields is well-represented in the ash dispersal simulations. In order to study the sensitivity of results to the timing relative to eruption, a total of 5 pseudo-forecast simulations were carried out using data up to 13 hours before the eruption.

June 16, 2018 Eruption

Sakurajima erupted at 0719 JST (JST=UTC+9), June 16 2018, with a reported plume height of 4700 m above the vent. Deposition occurred west and southwest of the volcano, reaching the southern coast of the Satsuma peninsula. Ashfall locations were reported by the JMA, while the SVO carried out a post-eruption survey to collect samples. A comparison of disdrometer observations (which measure airborne ash size) and ground deposits suggest the presence of large aggregates (e.g. Bagheri *et al.*, (2016)), a fact that needs to be accounted for in order to have successful simulations.

Forecast Simulation Results and Conclusions

Initially, a control simulation was carried out using the final mass discharge rate output. Although qualitatively similar to the JMA ash forecast, it offered two key improvements: *(i)* ash deposition over the volcano occured along a narrow path, correctly reproducing the observed pattern, and *(ii)* the observed area of maximum ashfall (>1 mm deposit thickness) was reproduced correctly at a distance from the vent, over the southwestern shore of the volcano.

Forecast time sensitivity simulations showed consistent ash dispersal patterns. Simulation results using forecast data up to 10 hours before the eruption time were qualitatively similar. Up to 4 hours before the eruption, the observation to estimate ratios for the two disdrometers were constrained to factor of 4, allowing for the proposed methodology to be confidently used in forecast timescales.

References

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