

High resolution simulations of vulcanian eruptions at Sakurajima, Japan, using WRF-LES and FALL3D

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Sakurajima is one of Japan's most active and closely monitored volcanoes; the latest ongoing eruptive phase started at 1955, with various periods of intensification (e.g. 2008) and decrease (2015). Scheduled forecasts are carried out by the Japanese Meteorological Agency (JMA) every 3 hours, however these are largely qualitative. The large population density on and around the volcano makes understanding and predicting the proximal deposition of ash a priority.

Proximal to the vent, ash fallout is known to be heavily affected by volcanological effects such as changes in the eruption dynamics and sedimentation regime, ash aggregation that can both enhance and impede the sedimentation of ash, as well as downwards propagating instabilities that arise from local differences in ash concentration. These effects act in tandem with the meteorological fields, atmospheric boundary layer effects and topography, with the final ash fallout patterns decided by the complex interplay of all these factors.

Here we study proximal deposition of ash (within ~5km from the vent) using a combined modelling approach. FALL3D is used over very high resolution atmospheric modelling carried out with WRF-LES (down to 90m horizontal resolution), for two vulcanian eruptions (plume heights between 1-2km at ground level) that occurred on the 2017.06.06 and 2017.10.01. Both days featured a heavily sheared atmosphere with winds changing from easterly (surface) to westerly (at a height of 2 and 5km respectively).

Initially a simulation was carried out for the 2017.06.06 event in order to estimate a grain size distribution based on deposition data. Simulations with a fixed grain size distribution were then carried out for the 2017.10.01 event in order to examine the sensitivity of results to volcanological (plume model, eruption duration) and technical (meteorological data input time step, horizontal and vertical resolution) parameters.

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