EGU21-13871
https://doi.org/10.5194/egusphere-egu21-13871
EGU General Assembly 2021

Forecasting the dispersion and fallout of volcanic ash during a crisis: Assessment of the September 20, 2020 eruption at Sangay volcano in Ecuador

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Sangay volcano (2.00°S, 78.34°W, 5326 m asl), located at the southern end of the Northern Volcanic Zone of the Andes (Morona Santiago province, Ecuador), has frequently been referred as one of the most active volcanoes in the world. Its most recent eruptive period began on May 7, 2019 and is still ongoing. It is characterized by a semi-continuous viscous lava flow emission accompanied by frequent low magnitude explosions (Vasconez et al., this meeting). This eruptive episode is the first in more than two decades to produce significant impacts both locally and regionally, and reached its paroxysm on September 20, 2020 without clear precursory signals. The eruption started at 9:20 (UTC) and lasted about one and a half hours. The eruptive column rapidly split into a high-altitude (15 km asl) gas-rich cloud, drifting eastward at 5-8 m/s and a lower (12 km asl) ash-rich cloud, drifting westward at 10-14 m/s. The ash began to fall at 11:00 (UTC) in the communities near the volcano and reached the city of Guayaquil, the second largest city in Ecuador, at 13:00 (UTC), forcing the closure of the international airport.

In this work, we evaluate the ash dispersion simulations performed by the IG-EPN using the Ash3D model before, during and after the eruption using different eruptive source parameters (ESP), by comparison with the available satellite images (GOES-16). The simulated ash fallout for each set of ESP is compared to reports from the community and volcanic observers, as well as with a fallout map obtained from a four-days field trip initiated immediately after the eruption to ensure good quality of samples and measurements (September 20-23). Ash fallout was estimated using thickness measurements where possible and area density at 40 sites located between 30 and 180 km from the volcano. The grain size distribution of 35 samples was obtained by laser diffraction.

Our results show that the general westward direction and speed of the ash cloud in the simulations is coherent with the satellite images, except for the high-altitude, gas-rich cloud. However, large discrepancies were found when comparing the simulated and measured ash fallout. Field data shows that the first simulation using ESP based on the previous activity at Sangay, underestimated the eruption size, while the second simulation using the eruption column height estimated in near-real time overestimated it. As expected, the simulation carried out immediately after the eruption, based on the first field results shows the best correlation with field data, although there are still some second-order discrepancies. In particular, the plume axis was

shifted about 12° northward in the simulation, which is attributed to the atmospheric model. We also noted that the deposition pattern was slightly different between the field data and the simulation. Grain size analysis reveals uni- to multimodal distributions, associated with complex eruptive dynamics and aggregation that probably influenced the sedimentation process. Further research is needed to better understand the eruptive dynamics at Sangay in order to improve forecasts.