EGU2020-5298
https://doi.org/10.5194/egusphere-egu2020-5298
EGU General Assembly 2020

Extremely low frequency detection of electrical discharges at Minamidake crater (Sakurajima volcano, Japan)

Caron E.J. Vossen[1], Corrado Cimarelli[1], Alec J. Bennett[2], André Geisler[3], Damien Gaudin[1], Daisuke Miki[4], Masato Iguchi[4], and Donald B. Dingwell[1]

[1]Ludwig Maximilian University of Munich, Munich, Germany
[2]Biral Ltd, Bristol, United Kingdom
[3]University of Hamburg, Hamburg, Germany
[4]Kyoto University, Kyoto, Japan

Volcanoes are increasingly better monitored around the world. Nonetheless, the detection and monitoring of volcanic ash plumes remains difficult, especially in remote areas. Intense electrical activity and lightning in volcanic plumes suggests that electrical monitoring of active volcanoes can aid the detection of ash emissions in near real-time. Current very low frequency and wide-band thunderstorm networks have proven to be able to detect plumes of large magnitude. However, the time delay and the relatively high number of non-detected explosive episodes show that the applicability of these systems to the detection of smaller (and often more frequent) ash-rich explosive events is limited. Here we use a different type of thunderstorm detector to observe electrical discharges generated by the persistent Vulcanian activity of Minamidake crater at Sakurajima volcano in Japan. The sensors consist of two antennas that measure the induced current due to the change in electric field with time. In contrast to the current thunderstorm networks, these sensors measure within the extremely low frequency range (1-45 Hz) and can detect lightning up to 35 kilometres distance.

Two detectors were installed at a distance of 3 and 4 kilometres from Minamidake crater and recorded almost continuously since July 2018. Within this period, the ash plumes reached a maximum height of 5.5 kilometres above the crater rim. Using a volcanic lightning detection algorithm and the catalogue of volcanic explosions compiled by the Japan Meteorological Agency (JMA), the number of electrical discharges was determined for each individual explosive event. In addition, the start of electrical discharges was compared to the eruption onset estimated by the JMA.

Preliminary results show that the detector closest to the crater had the highest detection efficiency. It detected electrical discharges during 60% of the eruptions listed by the JMA. This is significantly higher than for the World Wide Lightning Location Network, which detected electrical discharges (in the very low frequency range) within 20 kilometres of Sakurajima for less than 0.005% of the eruptions. Furthermore, the results show that for 40% of the detected eruptions, electrical discharges were detected before the estimated JMA timing. Hence, electrical discharges

can mark the inception of the explosion with a higher precision and are an indication of ash emission. This demonstrates the value of the cost-effective sensors used here as a monitoring tool at active volcanoes.