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Atmospheric control on ground and space based early warning system for hazard linked to ash injection into the atmosphere

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Violent volcanic eruptions are common in the Southeast Asia which is bordered by active subduction zones with hundreds of active volcanoes. The physical conditions at the eruptive vent are difficult to estimate, especially when there are only a few sensors distributed around the volcano. New methods are therefore required to tackle this problem. Among them, satellite imagery and infrasound may rapidly provide information on strong eruptions triggered at volcanoes which are not closely monitored by on-site instruments.

The deployment of an infrasonic array located at Singapore will increase the detection capability of the existing IMS network. In addition, the location of Singapore with respect to those volcanoes makes it the perfect site to identify erupting blasts based on the wavefront characteristics of the recorded signal.

There are $\sim$750 active or potentially active volcanoes within 4000 kilometers of Singapore. They have been combined into 23 volcanic zones that have clear azimuth with respect to Singapore. Each of those zones has been assessed for probabilities of eruptive styles, from moderate (Volcanic Explosivity Index of 3) to cataclysmic (VEI 8) based on remote morphologic analysis. Ash dispersal models have been run using wind velocity profiles from 2010 to 2012 and hypothetical eruption scenarios for a range of eruption explosivities. Results can be used to estimate the likelihood of volcanic ash at any location in SE Asia.

Seasonal changes in atmospheric conditions will strongly affect the potential to detect small volcanic eruptions with infrasound and clouds can hide eruption plumes from satellites. We use the average cloud cover for each zone to estimate the probability of eruption detection from space, and atmospheric models to estimate the probability of eruption detection with infrasound. Using remote sensing in conjunction with infrasound improves detection capabilities as each method is capable of detecting eruptions when the other is ‘blind’ or ‘defened’ by adverse atmospheric conditions. According to its location, each volcanic zone will be associated with a threshold value (minimum VEI detectable) depending on the seasonality of the wind velocity profile in the region and the cloud cover.