

Dispersion of volcanic ash clouds in Ecuador: a 20 years perspective

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Volcanic ash clouds and their deposits represent the volcanic hazard with the furthest reach and a high potential socio-economic impact. In order to reduce its effects, real-time monitoring and numerical model-based forecasting of ash clouds are critical. Since 1983, the Instituto Geofísico de la Escuela Politécnica Nacional (IG-EPN) has been monitoring the volcanic activity in Ecuador. Since 1999, it has been assisted in this task by the Washington Volcanic Ash Advisory Center (VAAC), which is responsible for monitoring all available satellite imagery for volcanic ash plumes and issuing Volcanic Ash Advisories. In the last two decades nine volcanoes have erupted in Ecuador, five on the mainland (Guagua Pichincha, Tungurahua, Reventador, Sangay and Cotopaxi) and four in the Galápagos archipelago (Fernandina, Cerro Azul, Sierra Negra and Wolf). Accordingly, the Washington VAAC has emitted thousands of advisories, from which 3666 and 91 show ash plumes from the mainland and Galápagos volcanoes, respectively. This information is processed by the IG-EPN Seismic and Volcanic Activity Management and Monitoring System in order to extract meaningful statistics such as plume height, direction, velocity, and length. We observe that moderate (5-10 km above the crater) to high (>10 km) altitude ash clouds are produced at the onset of the mostly effusive Galápagos eruption and do not represent a major threat for the local population or wildlife. Low (<5 km) altitude ash emissions are the most typical behaviour of the mainland volcanoes, leading to months or years of atmospheric contamination that can produce chronic health issue. Moderate to high altitude ash clouds on the mainland are associated with hydromagmatic, violent strombolian, vulcanian and sub-plinian paroxysms responsible for the most damages for farming and civil aviation at a regional scale. 25 to 50% of the total number of ash plumes for each volcano are directed toward the West, with secondary directions between SW and NW. The ash plume velocities are generally below 20 m/s with rare plume velocities > 30 m/s such as the 28th May 2010 and 22nd December 2011 Tungurahua eruptions. Finally, the maximum plume lengths are 700 and 440 km for the mainland and Galápagos volcanoes, respectively. This information is further used for long-term hazard assessment, such as hazard maps, and also serves as input parameters for ash dispersion models to produce short-term forecasts. Coupled with early action plans, strengthening and continuous analysis of this database is important to reduce the impact of ash clouds in Ecuador.