

Multi source- ash fallout hazard map in western Caldas department (Colombia)

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In order to prepare the emergency plans for management of volcanic risks for the western sector of Caldas department (Colombia), a regional scale evaluation of the ash fallout hazard was intended for Corpocaldas (department environmental agency). The regional and local stakeholders were interested in a unique scenario related to the co-existence of three different sources of ash, from north to south: Cerro Bravo, Nevado del Ruiz and Santa Isabel volcanoes, which are located at the Central Cordillera in middle Colombia, and they are part of the most northern volcanic complex of the Northern Volcanic Zone in South America.

The background definition of the ash fallout hazard is quite variable for the different sources, the Cerro Bravo and Nevado del Ruiz volcanoes have geology-based hazard maps with variable age constraining of their events; and Santa Isabel volcano has only an UNDRO indicative hazard map without any age data. Actually, the Nevado del Ruiz Volcano is the only active of these three volcanoes since 1984.

The recent 2012 activity of Nevado del Ruiz volcano showed a different dispersion of the ash fall from its former hazard map, due to the changes of wind direction by the restricted plume heights during the VEI 1 to 2 activities in 2012 the dispersion changed dramatically to N-NW and W directions affecting mainly the western zone of the Caldas department.

The methodology employed to evaluate the ash fall hazard was based on Bonasia et al., 2011 at the Colima volcano, where they run Hazmap creating a statistical analysis with different wind profiles obtaining as a result ash concentration maps for each month during a year.

Hazmap simulations were run for the Cerro Bravo volcano, we used the averaged mass reported from the main eruptions: 2.8×10^{11} kg and a average column height of 25 km that represent a VEI 4 eruption, with particles density of 900 kg/m³ (pumice) and 1000 kg/m³ (lithics). For the Nevado del Ruiz and Santa Isabel volcanoes we use a mass of 2×10^9 kg and a column height of 6,300 m.a.s.l. for VEI 1 eruptions and 2×10^{11} kg and 13,300 m.a.s.l. for VEI 2 eruptions, with particles density of 2750 kg/m³ (lithic) and 900 - 1726 kg/m³ (pumice) in both cases. The wind profiles necessary to set the speed and direction of wind dispersal, were extracted from the NOAA home page, taking a wind profile per month for a year.

We obtained for Cerro Bravo volcano a SW trend for most of the months, NW in February, SE in June, July and August and NE in November. In comparison, the isopach lines obtained by Lescinsky, 1990 show over-estimated thicknesses, and only W-SW trend dispersion axes.

In a similar way, Hazmap was run for the Nevado del Ruiz and Santa Isabel volcanoes related to VEI 1 to 2 eruptions, with E-W and NW-SE trends in the dispersion of ash respectively. Finally, a Multi-Ash Fallout Hazard map for the surveyed area was built using ArcGIS, combining the dispersion axes from each one of the volcanoes.