

EGU23-251, updated on 17 Nov 2023

<https://doi.org/10.5194/egusphere-egu23-251>

EGU General Assembly 2023

© Author(s) 2023. This work is distributed under the Creative Commons Attribution 4.0 License.



Numerical modelling of the volcanic plume dispersion from La Soufrière de Guadeloupe

Yuly Paola Rave Bonilla¹, David Jessop^{1,2}, and Séverine Moune^{1,2}

¹Université Clermont Auvergne, CNRS, IRD, OPGC, Laboratoire Magmas et Volcans, F-63000 Clermont-Ferrand, France

²CNRS, Institut de Physique du Globe de Paris, Université de Paris, Paris, France

Passive volcanic degassing often occurs at active but not actively erupting volcanoes. Gases are emitted by fumaroles and through diffuse soil degassing. This results in the emission of toxic gases such as H₂S at quasi-steady rates over long periods of time (months to years). Whilst less apparent than gas emissions during more vigorous and violent paroxysms, the long duration of emission and the fact that such gases are dispersed at low altitude (i.e. along the flanks of the volcano, often at human height) means that even the typically low concentrations (e.g. tens of ppb H₂S) pose a significant hazard to human health in nearby habitations.

La Soufrière de Guadeloupe has been undergoing an unrest phase since 1992 and it has one of the highest gas emission rates of any volcano in the Lesser Antilles. Gas emissions here are principally from three fumarolic sites at the summit though the typically high winds and low gas temperatures result in a laterally dispersed plume within a few metres of the ground. In this study, gas dispersion from the volcano over the period 2016–2021 was modelled using a numerical code that takes into account wind direction and strength, atmospheric stability, local topography and gas flux measurements; we used information from local meteorological stations, ECMWF Climate Reanalysis data and the gas flux dataset acquired by MultiGas measurements during the mentioned period. We ran c.100 individual simulations of the most frequently observed wind and gas flux conditions using a Monte-Carlo scheme. From the ensemble of results, we calculated the mean (i.e. most probable gas concentration values at any given location) and found that the most exposed zones are the hamlet of Matouba and the upper parts of St. Claude. We also simulated particular dates with strong H₂S odours reported by local inhabitants via online surveys and we compared the model results with the Gwad'air agency's air quality station located at St Claude, the closest town to the volcano. This allowed us to establish the prevalence of gases coming from La Soufrière in nearby cities and the accuracy of our models. The resulting maps of the areas potentially long-term (>8 years) exposed by gas emissions can be used to evaluate health risks for all people living around the volcano. In these locations, our results suggest that there is a 20% and 5% probability, respectively, for these areas of exceeding H₂S guidelines for long-term gas exposure (70 ppb).