Geophysical Research Abstracts
Vol. 14, EGU2012-10587-1, 2012
EGU General Assembly 2012
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The human health impact of Nyiragongo and Nyamulagira eruptions on Goma city and its surrounding area

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Located in the east of the Democratic Republic of Congo (DRC), Nyiragongo and Nyamulagira are two of the most active volcanoes in Africa. Nyiragongo last erupted in January 2002 and Nyamulagira in November 2011. Even if only a small number of victims resulted directly from these eruptions (notably because they both happened in the day-time), the town of Goma (approx. 700 000 inhabitants) is directly threatened by the fluid lava flows, of which the speed can reach several tens of km/h. But this is not the only menace. Indeed, Nyiragongo hosts a permanent lava lake that produces a plume of gases rich in sulphur (SO_2), carbon (CO_2), and halogen compounds (HCl, HF). As for Nyamulagira, it makes a major contribution to these emissions during its frequent and regular periods of eruptive activity (approx. every two years). Although the region under study is densely populated (up to 250 inh/km^2), and basic volcanic hazard mapping exists, an updated and long-term evaluation of the specific impact of Nyiragongo and Nyamulagira semi-permanent volcanic plumes on the population health has not been done to date. It is the objective of this study.

Michigan Technological University (MTU, USA) provides satellite data retrievals of volcanogenic SO_2 gas columns. These remote sensing data provide insights about the spatial distribution of Nyiragongo and Nyamulagira plumes, which are used to select the sampling areas for studying the human health impact of volcanic emissions. Based on the Congolese Health Information System (HIS) data provided by the CEMUBAC, our study is focused on the 1999-2010 time period. Scientific studies carried out on other active volcanoes suggest that certain pathologies could be linked to a high concentration of SO_2 in the atmosphere. These include Acute Respiratory Infections (ARI), conjunctivitis, skin diseases, and ear-nose-throat infections. Using Poisson regression analysis, we determine a Relative Risk Index (IRR) that allows us to identify the years of higher health risk for the population living under the plume. Additionally, time series analysis helps us to disregard any seasonal effect of certain pathologies and to derive a 12-year risk trend. For 2004-2010, our results are compared to SO_2 gas emission rates and plume location data measured by using Differential Optical Absorption Spectroscopic (DOAS) sensors located around Nyiragongo volcano. Finally, the areas identified as more hazardous are highlighted through a geographical approach (using GIS tools), to generate maps and other relevant information that can be of direct use for risk assessment authorities.

Our preliminary analysis suggests that the impact of SO_2 emissions doesn't seem to be severe, being its most important effect an increase of ARI in the area surrounding the volcanoes (up to 50km). Our on-going study will help us to better determine the magnitude and geographical extent of the impact of volcanic plumes on the health of the population, as well as locate the areas that are most affected. This will contribute to provide the appropriate sanitation recommendations (water treatment, early warning system, etc.) and lead to a more effective volcanic impact reduction on human health.