Nyiragongo SO_2 flux and ground deformation data, using sentinel mission data.

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Introduction

Nyiragongo is in the Democratic Republic of Congo near the border with Rwanda with a height of 3470 m. Several cities are located around the volcano, which makes it a geological hazard and a risk for the surrounding populations. The last recorded eruption was in 2002, when the lava flowed into the city, causing hundreds of fatalities. The remote location and the geopolitical situation of the region make this volcano a perfect target for monitoring by remote sensing instruments.

The volcano has a persistent lava lake that causes continuous SO_2 emission into the atmosphere.

On 22 May 2021, an eruption started with the opening of a fissure on the volcano's flank.

Here we use daily SO_2 TROPOMI data to analyze the changes in the degassing behavior. We also applied Sentinel-1 SAR data to look for deformation patterns on the the volcano and the surrounding areas.

Fig 1. Photo showing the lava lake on the top of the Volcano

Methods

SO_2 flux

We use the PlumeTraj toolkit {1}, which combines TROPOMI data with back trajectory analysis using the HYSPLIT model, to produce individual pixel injection altitude, injection time and measurement altitude.

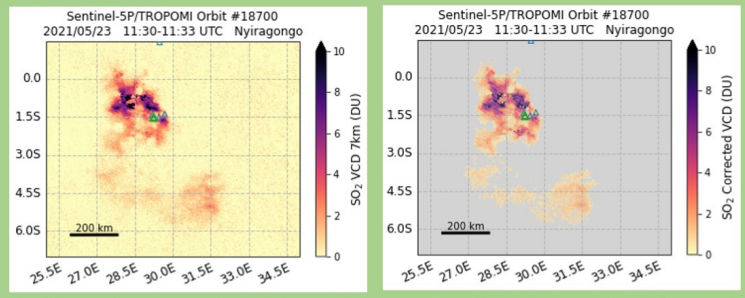

Fig 2. On the left raw data from TROPOMI showing the detected vertical column density (VCD) from the eruption day. On the right the interpreted VCD.

Ground deformation

We use Sentinel-1 data to create the interferograms by using the LiCSAR {2}, processor for both orbits, ascending and descending. The re-visit time for the ascending orbit is of 6 days , while for the descending orbit is usually 12 days. We aim to create a time series of the deformation using STAMPS or LiCSBAS.

Preliminary Results

The eruption began without any clear precursor in the SO_2 flux or the ground deformation and caused the lava lake to drain. Lava flowed from the fissure and stopped just at the entrance of the city. The SO_2 flux time series show a slight increase in degassing the days before the eruption; however, the variability was within the bounds of that seen during the previous months. The pre-eruption interferograms show no deformation on the volcano edifice or in the surrounding areas. However, deformation is visible on the first interferogram post-eruption. The deformation was first seen on the ascending track (3 days after eruption) and then corroborated by the descending track (5 days after eruption). The deformation patterns suggest the emplacement of a dike on the area of Goma.

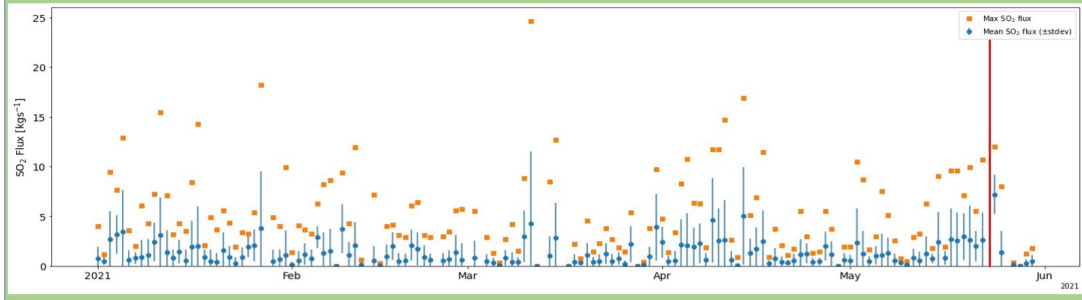

Fig 3.SO_2 time series from January 1st to May 30th, 2021. The red line indicates the date of the eruption.

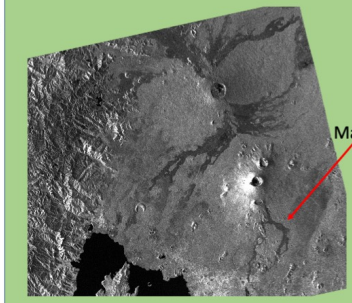

Fig 4. Amplitude images of May 25th , showing the lava flow.

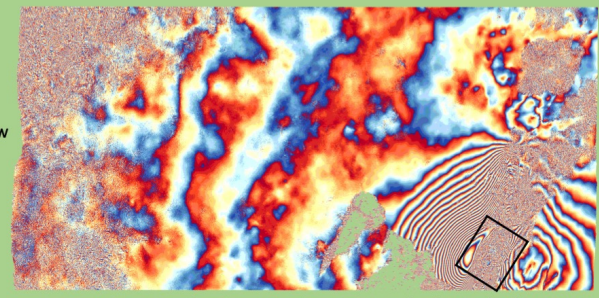

Fig 5. Interferogram for the ascending orbit 19/05/21-25/05/2021. One full cycle = 2.5 cm of deformation. Deformation could indicate dike emplacement. Black square marks the approx. location of the dike.

Conclusions

- Not precursory degassing or deformation data indicated an eruption.
- The lack of precursory information results in a bigger hazard for the surrounding population since it doesn't allow time for evacuation.
- Collaboration and data sharing with the local observatory could help to better understand the volcano's behavior.

References

{1} Burton, M., Hayer, C., Miller, C., & Christenson, B. (2021). Insights into the 9 December 2019eruption of Whakaari/White Island from analysis of TROPOMI SO_2imagery.Science Advances,7(25), eabg1218. https://doi.org/10.1126/sciadv.abg1218
{2} Lazecký, M. Spaans, K. González, P.J. Maghsoudi, Y. Morishita, Y. Albino, F. Elliott, J. Greenall, N. Hatton, E.L. Hooper, A. Juncu, D. McDougall, A. Walters, R.J. Watson, C. Weiss, J.R. and Wright, T. 2020. LiCSAR: An Automatic InSAR Tool for Measuring and Monitoring Tectonic and Volcanic Activity. Remote. Sens.