EUROVOLC

European Network of Observatories and Research Infrastructure for Volcanology

Deliverable Report

D25.1 Report on WP25 VA service during the project

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Work Package leader:	*Mike Burton*	
Task (Activity) name:		
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Contents

Summary

This is the report for the VA service SO_2 flux, in WP25 of EURVOLC. The daily Etna SO_2 flux website continues to function http://dailyetna.eps.manchester.ac.uk/and we have been able to extend and improve the service beyond that originally planned through new research project activity. Disruption from COVID has meant that some user access counting functionality of the website is not functioning, and the IT priority in UMAN is on teaching delivery, so this is yet to be rectified. We have completed the development of a major upgrade to the original algorithm used to quantify SO_2 flux time series from TROPOMI data, some example figures are shown below. We will deploy this new algorithm for the VA in March 2021.

Introduction

This VA consists of an anonymous access through a web interface to (i) a database of SO_2 flux time series and plume heights from previously collected satellite images of SO_2 plumes and (ii) a real-time updates of SO_2 flux time series and plume heights from newly collected satellite images of SO_2 plumes. By providing an easy-to-use access portal these data open up these data to scientific communities who are not equipped to work on SO_2 imagery, but who are interested in volcanic eruptions and processes. This will greatly enhance the scientific output arising from the satellite imagery and allow the focus to move from technical challenges to volcanic process questions.

Activity and main results

The daily Etna website continues to function http://dailyetna.eps.manchester.ac.uk/and we have been able to extend and improve the service beyond that originally planned through new research project activity. Disruption from COVID has meant that some user access counting functionality of the website is not functioning, and the IT priority in UMAN is on teaching delivery, so this is yet to be rectified. We have completed the development of a major upgrade to the original algorithm used to quantify SO2 flux time series from TROPOMI data, some example figures are shown below. We will deploy this new algorithm for the VA in March 2021.

INGV-OE has been using outputs from WP25 to compare measured SO_2 fluxes with seismic tremor, as shown in figure 1. This shows some interesting potential relationships between the two signals. This highlights a major potential research direction arising from the automated SO_2 service.

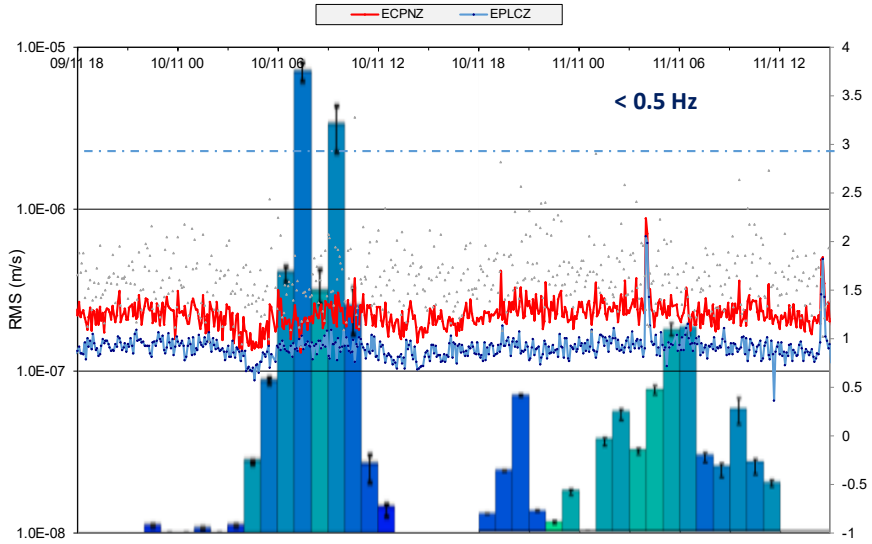

Figure 1: Comparison of INGV-OE seismic tremor and gas emission rate produced by WP25 on 10-11 November 2020. There appears to be an increase in tremor associated with the peak in SO_2 flux observed in 10/11/21

The core functionality of the VA is reported in these papers, Pardini et al., 2015; Pardini et al., 2017; Pardini et al., 2019; Pardini, 2018; Queisser et al., 2019.

A major conceptual advance has been made, which builds complementarity between our VA and observatory SO2 flux measurements worldwide. The concept is that the main uncertainty in ground-based network measurements of SO2 flux are the plume height, plume direction and plume speed. All of these can be provided by our analysis of TROPOMI data. This offers the possibility of producing a hybrid product, taking advantage of the strengths of both ground-based and satellite data to produce an improved SO2 flux time series, which is higher quality than either of the initial separate datasets. We will be working closely with INGV Catania in the coming months to test this new approach. We will also be steadily deploying more volcanoes on the VA as well as retrospectively analysing data from 2018 when data became available. This will build an essential resource for gas flux monitoring. Examples of the new algorithm are shown below, applied to a recent lava fountain event from Mt Etna.

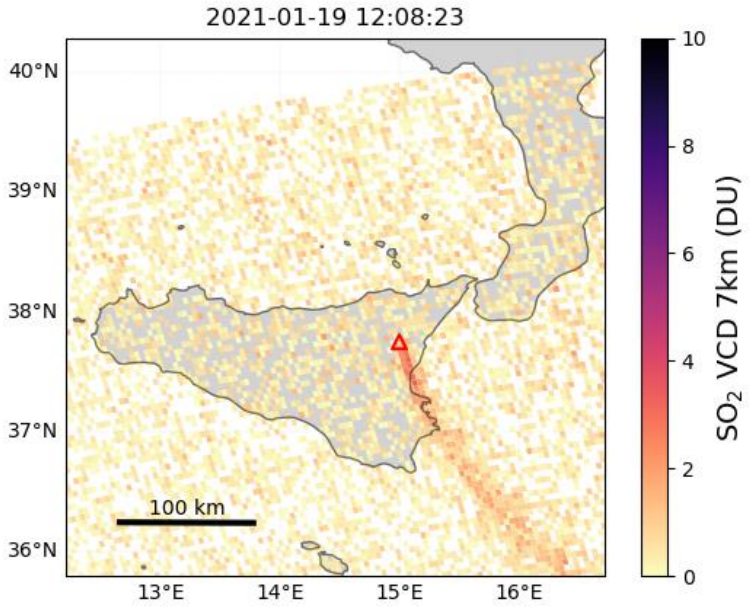

Figure 2: SO2 column amounts reported from TROPOMI assuming a 7 km plume height on 19 January 2021

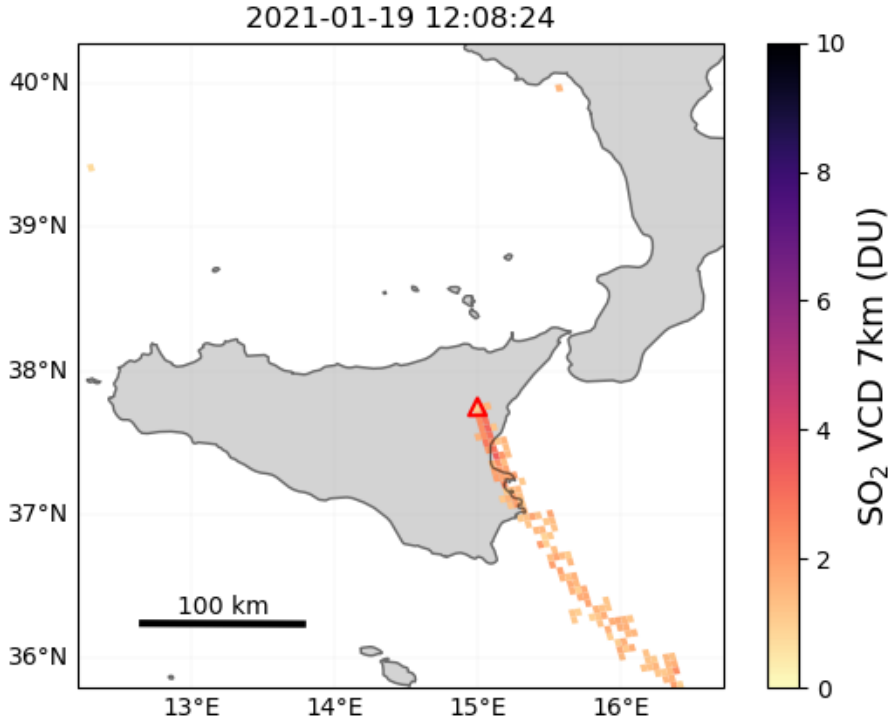

Figure 3: Filtered, selected SO2 column amounts reported from TROPOMI assuming a 7 km plume height on 19 January 2021. Only points with SO2 values greater than three times the reported error were used.

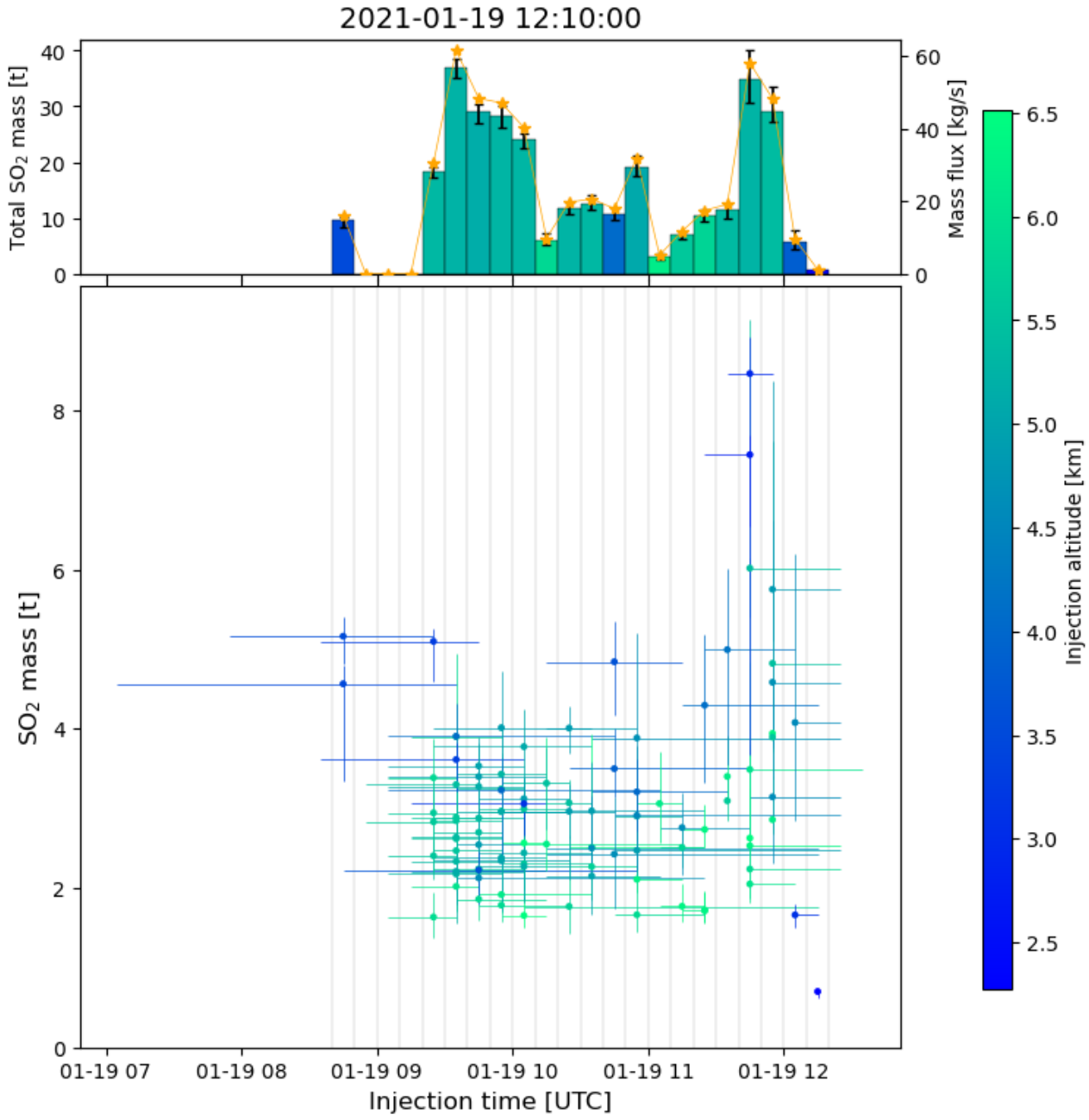

Figure 4: SO2 masses for each pixel in the scene reported in figure 2. In the main panel we see the SO2 mass as a function of time, coloured by the injection height and with error bars reflecting the uncertainty in height and time. In the upper bar chart we report the integrated mass every 10 minutes on the left scale and the SO2 flux (integrated mass/time) on the right scale. This reveals a highly dynamic emission rate that requires comparison with geophysical data.

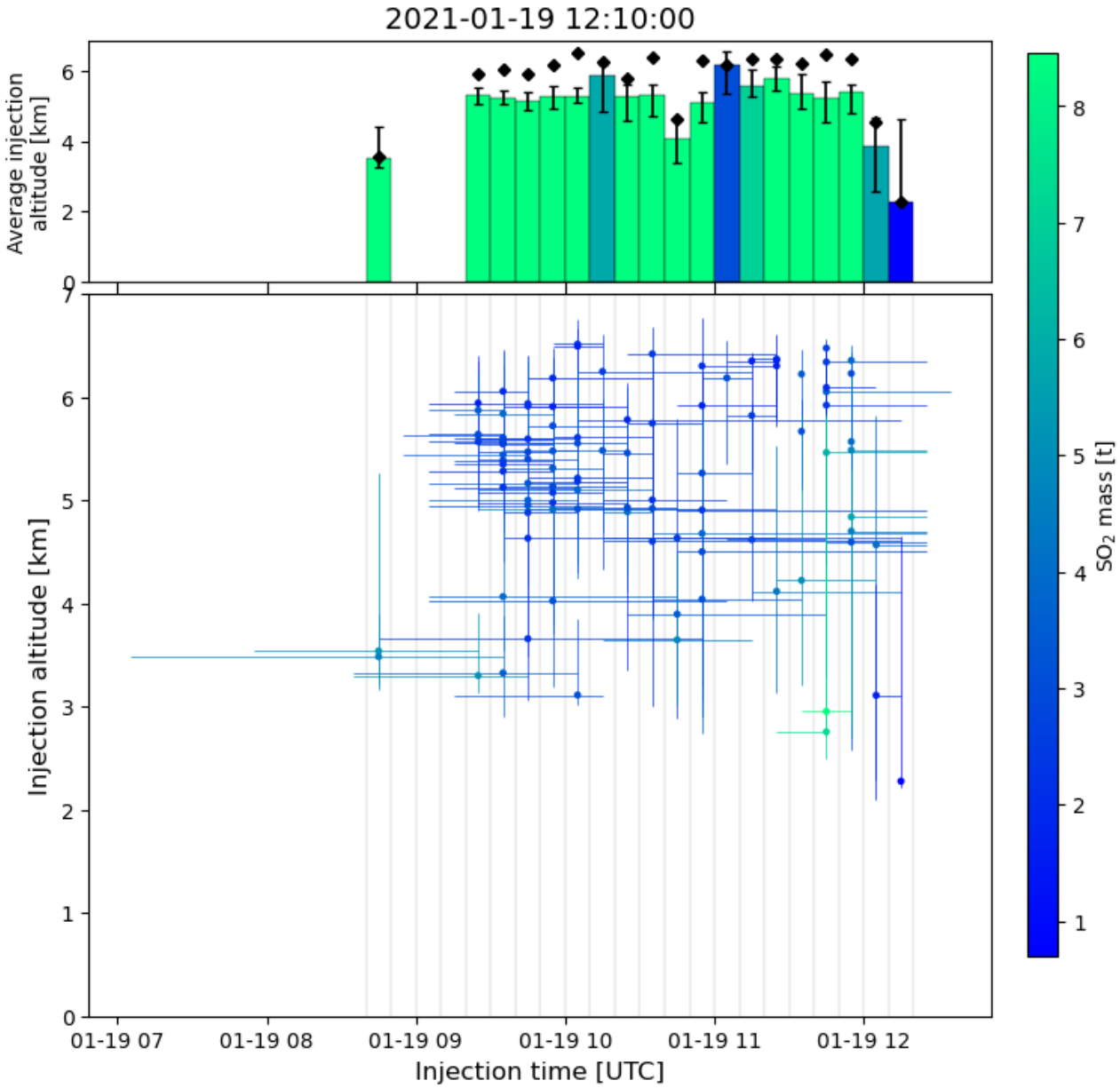

Figure 5: SO2 injection altitude for each pixel in the scene reported in figure 2. In the main panel we see the SO2 pixel height as a function of time, coloured by the SO2 mass and with error bars reflecting the uncertainty in height and time. In the upper bar chart we report the average height and standard deviations, with a black diamond showing the peak pixel altitude. The pixel time series shows a trend suggesting a slight lowering in altitude between 9 and 12 UTC.

Reference list

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