DISCREPANCY BETWEEN SATELLITE- AND GROUND-BASED MEASUREMENTS OF SO_2 EMISSIONS FROM THE KILAUEA 2020/21 ERUPTION

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INTRODUCTION

- SO_2 emissions fluxes measured by satellite and ground-based instruments can differ.

AIMS

- Comparing the satellite and ground measured fluxes.
- Understanding their difference.

METHODOLOGY

- **Satellite**: TROPOMI instrument using the analysis toolkit PlumeTraj (as will be described by Catherine Hayer in her talk 5.3.6 on Friday 26th) which converts a single, snapshot image from TROPOMI into an SO_2 flux and fins the plume height for each pixel. The meteorological data is a 3D modelled wind field, the Global Forecast System (GFS) which measures wind speed, altitude and infraction.
- **Ground**: Ocean Optics Spectrometer onboard a vehicle travelling along the Crater Rim Road, southwest of Halema'uma'u crater[1]. The wind speeds were measured using an anemometer.

RESULTS

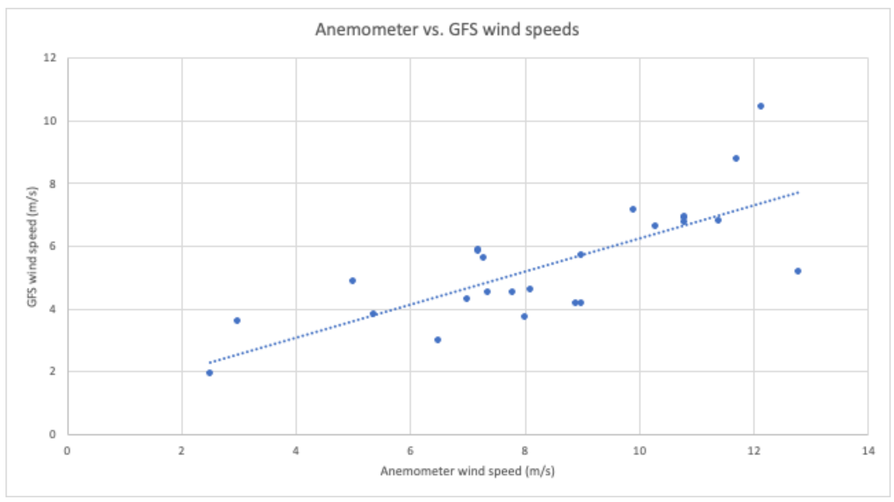

Figure 1: Wind speed comparison between modelled (GFS) wind speeds and measured (anemometer) wind speeds.

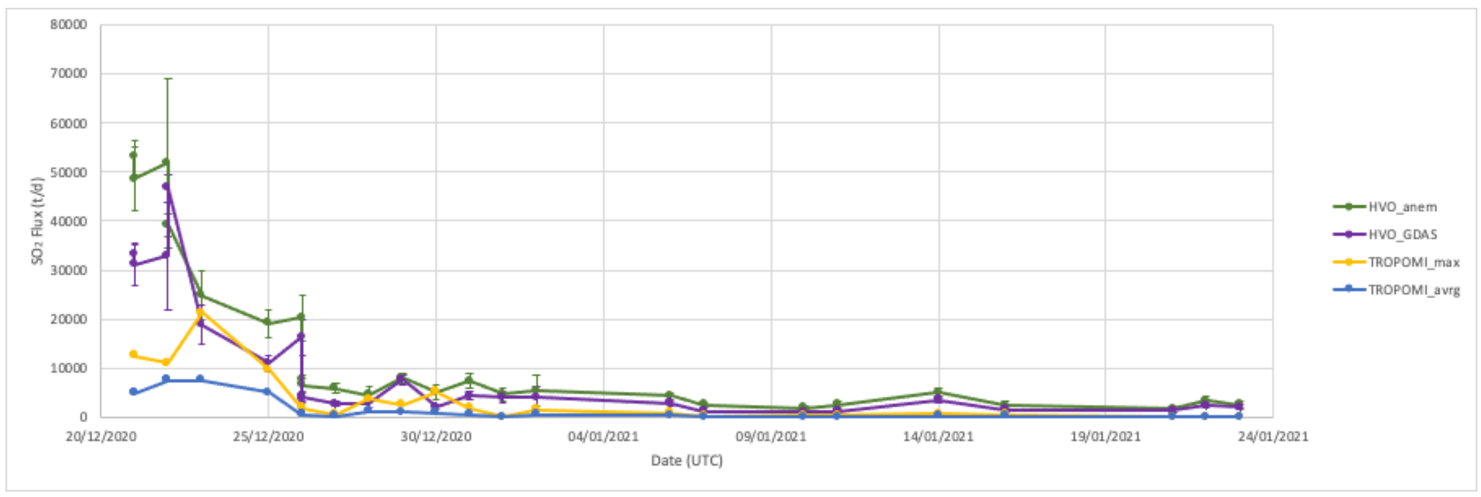

Figure 2: Flux time series from 21 December 2020 to 23 January 2021. This graph relates the first month of the eruption. The green line shows the ground-measured fluxes (as given by the Hawaii Volcano Observatory) with error bars. The purple line shows the ground measurements using GFS wind speeds to measure the flux, with error bars. The yellow line shows the satellite-based measurements with only the maximum flux reached for each 24 hours. The blue line shows the average flux of the satellite-based measurements.

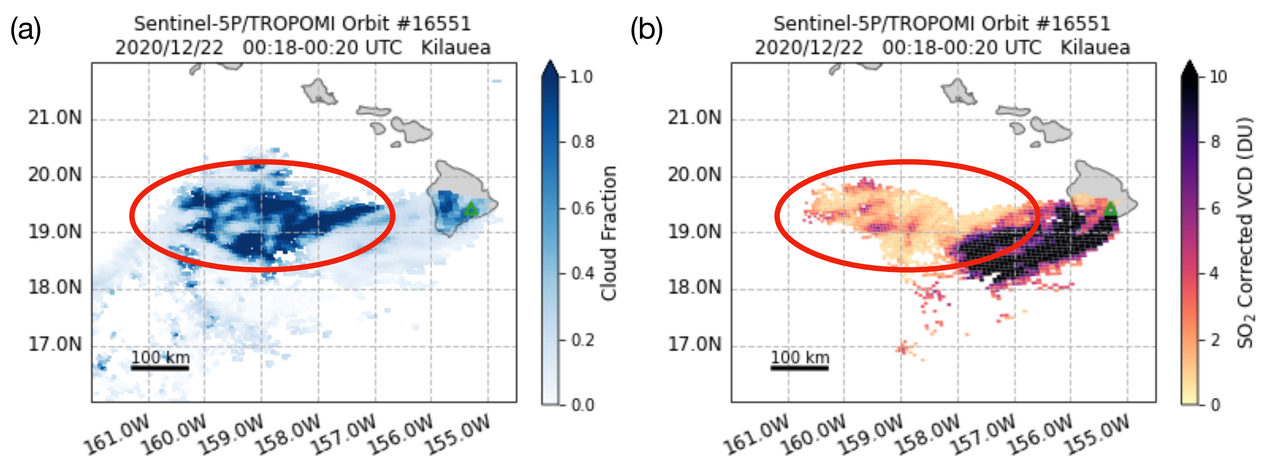

Figure 3: TROPOMI images analysed by PlumeTraj. (a) Cloud fraction over the SO_2 plume. A value of 0 suggests no meteorological cloud and a value of 1 shows opaque meteorological cloud above the SO_2 plume. The red circle shows where cloud coverage is highest. (b) Corrected Vertical Column Density. The red circle is in the same position as in (a) and shows particularly lower SO_2 VCD compared to the rest of the plume.

DISCUSSION & CONCLUSION

- There is discrepancy between satellite- and ground-based measurement however the emission trend is the same (Figure 2 - green versus blue and yellow lines).
- The anemometer wind speeds are consistently larger than the GFS wind speeds (Figure 1).
- In order to make a just comparison, the wind speed values must be the same for both types of measurements.
- By changing the wind data from anemometer reading to GFS, we find that the ground-based emission fluxes drop to values similar to the SO_2 fluxes measured by satellite data (Figure 2 - purple and yellow lines).
- Meteorological clouds above the SO_2 plume underestimate the satellite-based measurements as they mask the signal (Figure 3) and hence reduce the calculated fluxes.

REFERENCES

[1]USGS. 2021. December 2020 - May 2021 Eruption. [online] Available at: <https://www.usgs.gov/volcanoes/kilauea/december-2020-may-2021-eruption?qt-sciences_support_page_related_con=0#qt-sciences_support_page_related_con>