

Data-set linked to manuscript:

A multi-purpose, multi-rotor drone system for long range and high-altitude volcanic gas plume measurements

Bo Galle¹, Santiago Arellano^{1*}, Nicole Bobrowski^{2,3}, Vladimir Conde¹, Tobias P. Fischer⁴, Gustav Gerdes⁵, Alexandra Gutmann⁶, Thorsten Hoffmann⁶, Ima Itikarai⁷, Tomas Krejci⁸, Emma J. Liu^{9,10}, Kila Mulina⁷, Scott Nowicki^{4,11}, Tom Richardson¹², Julian Rüdiger⁶, Kieran Wood¹², Jiazhi Xu¹

¹Department of Earth, Space and Environment, Chalmers University of Technology, SE 41296, Gothenburg, Sweden

²Institute for Environmental Physics, University of Heidelberg, D-69120 Heidelberg, Germany

³Max-Planck Institute for Chemistry, 55128, Mainz, Germany

⁴Department of Earth and Planetary Sciences, University of New Mexico, 87131, Albuquerque, NM, United States

⁵GerdesSolutions AB, 128 41, Stockholm, Sweden

⁶Department of Chemistry, Johannes Gutenberg-University, 55099, Mainz, Germany

⁷Rabaul Volcano Observatory, P.O. Box 386, Rabaul, Papua New Guinea

⁸HAB Electronic AB, 34140, Ljungby, Sweden

⁹Department of Earth Sciences, University of Cambridge, CB2 3EQ, Cambridge, United Kingdom

¹⁰Department of Earth Sciences, WC1E 6BS, University College London, London, United Kingdom

¹¹Quantum Spatial, Inc. Albuquerque, NM, United States

¹²Department of Aerospace Engineering, University of Bristol, BS8 1TR, Bristol, United Kingdom

Correspondence to: Santiago Arellano (santiago.arellano@chalmers.se)

Supplement

S1. Data files

The Excel-book file amt-2020-452-raw_data contains all data used for the figures presented in this article. Each sheet is named according to the figures in which data was used and the instrument from which data was obtained, e.g. data_fig11&14_MultiGAS for the data used for figures 11 and 14 using the MultiGAS (Chalmers) instrument.

Most sheets contain the full dataset coming from the instrument, not all parameters are needed for the data presented in the figures of the article. Data that was used for the figures are marked with an orange/pink background.

The following descriptions correspond to the columns on each data-sheet:

data_Fig1_UAV

Data file extracted from a “ulog” file containing a series of parameters from the multi-rotor navigation sensors. The plotted columns contain:

Time stamp in μ s

Roll angle

Pitch angle

Yaw angle

Thrust factor
Latitude UTM
Longitude UTM
x-distance from reference position
y-distance from reference position
z-distance from reference position (inverse of altitude)

data_fig5_Sunkist:

Data file as recorded by the Sunkist instrument. It contains:

Date UTC
Time UTC
CO₂ data at instrument resolution (calibration from U. Mainz) in ppm
SO₂ data at instrument resolution (calibration from U. Mainz) in ppm
Temperature in °C
Pressure in Pa
Relative humidity in %

data_fig8_MultiGAS, data_fig12&15_MultiGAS, and data_figS1_MultiGAS

Data files as recorded by the MultiGAS instrument, stored in internal memory, and sent to ground-station in real-time. It contains:

Time UTC
Date UTC
Lat UTM
Lon UTM
Temperature in °C
Pressure in Pa
Relative humidity in %
Altitude in m ASL
SO₂ signal (uncalibrated) from working electrode in ppb
H₂S signal (uncalibrated) from working electrode in ppb
NO signal (uncalibrated) from working electrode in ppb
NO₂ signal (uncalibrated) from working electrode in ppb
NO₂ signal (uncalibrated) from auxiliary electrode in ppb
H₂S signal (uncalibrated) from auxiliary electrode in ppb
NO signal (uncalibrated) from auxiliary electrode in ppb
SO₂ signal (uncalibrated) from auxiliary electrode in ppb
CO₂ signal (uncalibrated) from auxiliary electrode in ppm

x-tilt angle in deg
y-tilt angle in deg
z-tilt angle in deg
Wind speed from anemometer in m/s
Wind direction from anemometer in deg
Activation of pump for bag sampling (0/1)

data_fig9_UAV

Data file extracted from a “ulog” file from the multi-rotor navigation sensors. Plotted columns contain:

Time stamp in μ s
Latitude of reference point (home position) in deg
Longitude of reference point (home position) in deg
x-tilt angle in deg
y-tilt angle in deg
z-tilt angle in deg
Horizontal wind speed (x) in m/s
Horizontal wind speed (y) in m/s
Vertical wind speed (z) in m/s
Horizontal wind speed, calculated from components x and y of wind speed, in m/s

data_fig10_WindSpeed

Time series of wind speed obtained from three different methods: (i) modeled data from ECMWF ERA5 Re-analysis database (C3S, 2017) retrieved at hourly resolution, 0.25×0.25 deg horizontal resolution, and 16 pressure-levels from ground to about 10 km ASL. This data is then interpolated at the location of the summit of Manam. (ii) Wind data measured by the drone using anemometer and drift-method. (iii) Wind data measured from ground using the dual-beam method described in Johansson et al. (2009). The columns contain:

Date UTC
Time UTC
Horizontal component of wind speed in m/s

data_fig11&15_MobileDOAS

Data file produced from an evaluation with the MobileDOAS software (Johansson et al., 2010) of data collected by the instrument during a traverse with the drone. It contains

Time UTC
Latitude UTM
Longitude UTM
Altitude m ASL
SO₂ vertical column density in ppm*m

data_fig13_MultiGAS

Data from MultiGAS instrument after calibration and other corrections. It contains

SO₂ volume mixing ratio in plume in ppm

CO₂ volume mixing ration in plume in ppm