VO-TCS Report on Quality and Assurance

V2.0

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For Ground based UV spectra (DOAS)

Quality assurance

DOAS stands for Differential Optical Absorption Spectrometry (DOAS) [1], [2]. Ultraviolet light from the sun, scattered from aerosols and molecules in the atmosphere, is collected by a telescope. Light is transferred from the telescope to the grating spectrometer by a quartz optical fiber. In-cloud spectra are analyzed against clear-sky and dark spectra and the differential slant column of various gases, primarily SO2, is derived.

Through the support of the FUTUREVOLC project, a version of the NOVAC ScanDOAS instrument was developed that is adapted to high latitudes with low UV radiation and severe meteorological conditions. Two major developments were made: the standard Ocean Optics SD2000 spectrometer was replaced by the more UV-sensitive Ocean Optics Maya2000 Pro spectrometer, and the scanning device was modified to avoid external moving parts to make it more robust in freezing conditions. The scanning device was modified by replacing the rotating hood with a quartz window with a closed scanner with a cylindrical quartz tube, and a cylindrical lens was included in the optical system. This changed the field of view (FOV) of the instrument to be rectangular instead of circular, covering the full 7.2° angle used as the scan interval. A fixed exposure time of 200 ms was used. Co-adding 15 spectra resulted in a total time of 2 min for one scan to be completed.

Quality check:

DOAS was the primary monitoring tool for monitoring the 6-months long eruption at Bárðarbunga volcano in 2014-2015 (Holuhraun eruption) [2]. At the onset of the fissure eruption, a ScanDOAS instrument, DOAS 25, was prepared at the Icelandic Meteorological Office (IMO) and installed at the eruption site on the second day of the eruption (64.9337, -16.6757). In the first week of September, a second ScanDOAS instrument, DOAS 27, was installed, which was made available through cooperation with Prof. Konradin Weber at Fachhochschule Düsseldorf (64.897, -16.634). Data transfer and real-time evaluation was fully implemented at IMO within the first couple of days of the eruption. After about two weeks, DOAS 27 was surrounded by active lava flows and eventually stopped transmitting data in the absence of sufficient power. DOAS 26 was installed in the middle of November (64.8204, -17.1471) and was moved around the eruption site in response to the advancement of the lava to its final location (64.8856, -16.5604). During and after the remaining months of the eruption, the ScanDOAS instruments, DOAS 25 and DOAS 26, were operational when there was adequate power. The instruments measure from the line-of-sight to the eruption to +/- 15°.

The service provides accesses to raw data in .pak format from two of these ScanDOAS, namely DOAS25 and DOAS27, from 31 August 2014 to 27 February 2015 when data was aquired. .pak files can be opened with the NOVAC scanning DOAS software downloadable from https://novac-community.org/ . As of time of writing the newest version of the software is available from https://novac-community.org/wp-content/uploads/2021/07/NovacProgram-v3.3.zip .

[1] Platt, U.; Stutz, J. *Differential Optical Absorption Spectroscopy: Principles and Applications*, 1st ed.; Springer: Berlin, Germany, 2008; ISBN 978-3-540-21193-8.

[2] Pfeffer, M.A.; Bergsson, B.; Barsotti, S.; Stefánsdóttir, G.; Galle, B.; Arellano, S.; Conde, V.; Donovan, A.; Ilyinskaya, E.; Burton, M.; Aiuppa, A.; Whitty, R.C.W.; Simmons, I.C.; Arason, Þ.; Jónasdóttir, E.B.; Keller, N.S.; Yeo, R.F.; Arngrímsson, H.; Jóhannsson, Þ.; Butwin, M.K.; Askew, R.A.; Dumont, S.; Von Löwis, S.; Ingvarsson, Þ.; La Spina, A.; Thomas, H.; Prata, F.; Grassa, F.; Giudice, G.; Stefánsson, A.; Marzano, F.; Montopoli, M.; Mereu, L. Ground-Based Measurements of the 2014–2015 Holuhraun Volcanic Cloud (Iceland). *Geosciences* **2018**, *8*, 29. https://doi.org/10.3390/geosciences8010029