UNIVERSITÄT HEIDELBERG
INSTITUT FÜR UMWELTPHYSIK

Im Neuenheimer Feld 229, 69120 Heidelberg
www.iup.uni-heidelberg.de

Master thesis (M.Sc. Physics)

Retrieval of O_4 and the colour index from NOVAC data

Background:

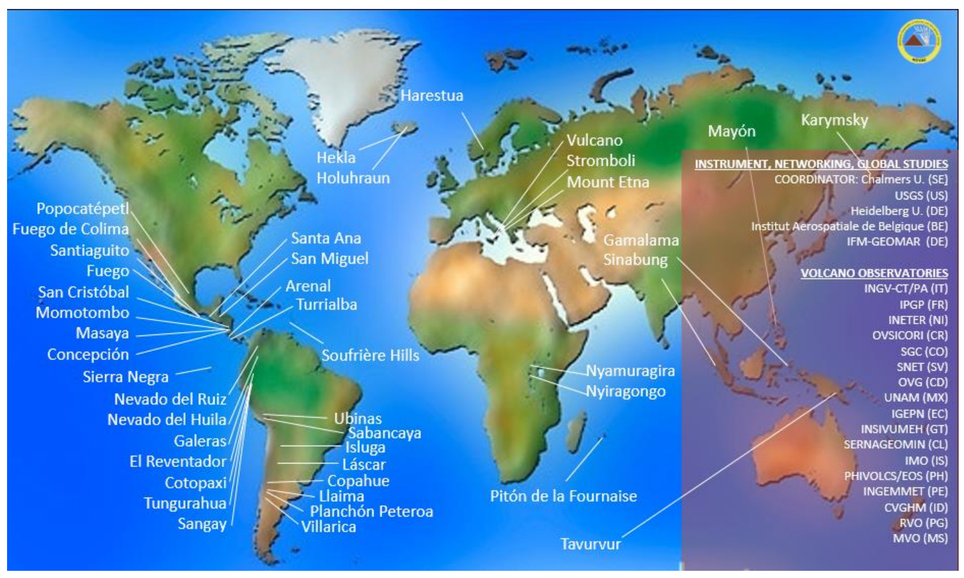
The Network for Observation of Volcanic and Atmospheric Change (NOVAC) monitors the concentrations of SO_2 and BrO in the gas plume of 42 volcanoes since 2005 using scanning UV-spectrometers. The volcanic gas data are retrieved from the recorded spectra by applying Differential Optical Absorption Spectroscopy (DOAS; Platt & Stutz, 2008). SO_2 is directly emitted from volcanoes but volcanic bromine is expected to be emitted predominately as HBr and subsequently partially converted in the atmosphere to BrO. The molar emissions ratio Br/S is proposed as a proxy for pressure-dependent volcanic processes. Thus the BrO/SO_2 data from NOVAC poses a proxy for volcanic gas composition which is unique in temporal and spatial coverage. In order to retrieve the original volcanic Br/S signal, however, possible variations in the conversion rate from HBr to BrO due to variations in the ambient conditions have to be identified and corrected. Such dependencies on ambient parameters have been examined in field studies, in lab experiment, and by simulations. Although several constraints have been found, in particular the intensity of solar radiation, there is not yet a concluding set of dependencies quantified. However, there is a possible solution: NOVAC spectra allow to retrieve O_4 data and the “colour index” (the ratio of the intensities at short and long wavelengths, both proxies for the cloud cover (e.g. Wagner et al., 2016) and thus for the solar radiation intensity. A statistical analysis of the impact of those additional parameters on the BrO data should allow for a comprehensive empirical fundament for HBr to BrO convertion in volcanic plumes.

Overall goal:

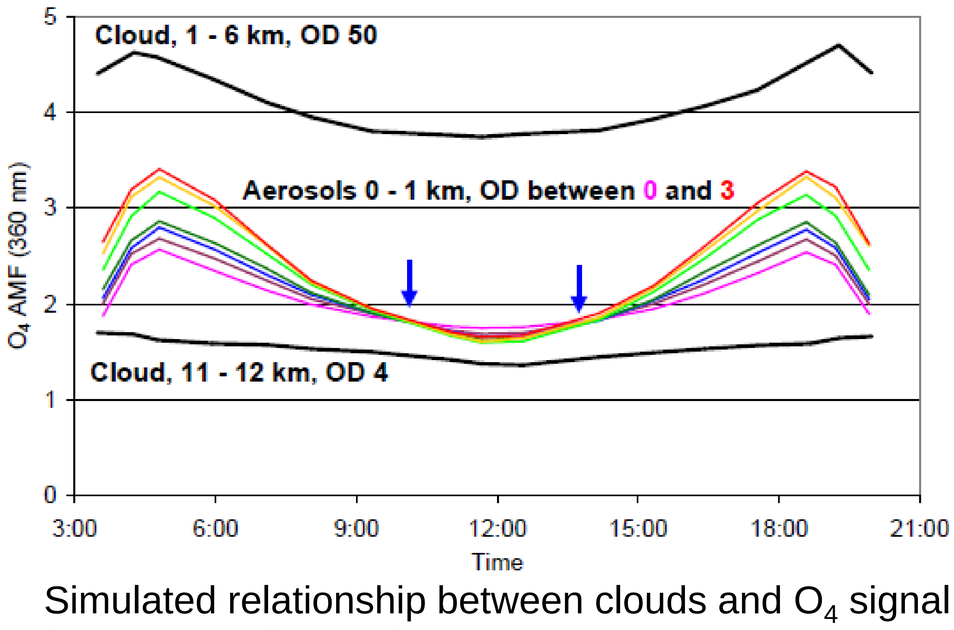
Establish a robust retrieval routine of O_4 and the colour index for NOVAC data. Identify correlations of the different data retrieved from NOVAC. Adopt findings to select for suitable BrO data.

Work plan:

- Familiarise yourself with DOAS evaluations of scattered sunlight spectra, atmospheric radiative transport, O_4, and the colour index.
- Adjust the O_4 DOAS-fit and colour index to NOVAC data
- Perform a comprehensive analysis between the different data from NOVAC for a set of given volcanoes.
- Propose a selection algorithm which e.g. rejects data with high probability for anormal HBr to BrO conversion rates



Volcanoes and institutions of the NOVAC network



Simulated relationship between clouds and O_4 signal (Wagner et al., 2016)

Requirements:

- Interest in optics and spectroscopy
- Approach to programming and statistics
- Start date: anytime

Contact:

Florian Dinger fdinger@iup.uni-heidelberg.de
Dr. Nicole Bobrowski nbobrowski@iup.uni-heidelberg.de
Prof. Dr. Ulrich Platt: Ulrich.Platt@iup.uni-heidelberg.de
Prof. Dr. Thomas Wagner thomas.wagner@mpic.de

Time stamp: 21.03.2018