Geophysical Research Abstracts
Vol. 17, EGU2015-12798, 2015
EGU General Assembly 2015

Mapping the BrO/SO_2 ratio in the plume of Popocatépetl, Mexico with Imaging-DOAS

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Differential Optical Absorption Spectroscopy (DOAS) in the ultraviolet and visible wavelength region has become a widespread tool, not only to study the chemistry of trace gases such as sulphur dioxide (SO_2) and halogen oxides (e.g. BrO, OClO) in volcanic plumes. It can also be used for volcano monitoring by observing SO_2 fluxes and the molar ratio of BrO to SO_2, which is a possible precursor for dynamic changes in the shallow part of a volcanic system like other halogen/sulfur ratios. This acquisition of this ratio is convenient as it can be measured with comparatively simple UV DOAS instruments.

Imaging-DOAS (IDOAS) utilizes the push-broom or whisk-broom technique to create a hyperspectral image of a section of the sky, then the DOAS evaluation is applied to each pixel to derive trace gas slant column densities (SCDs). Hereby images of the SO_2 and BrO distribution can be created, allowing to study the chemistry in different parts of the plume. This is especially interesting for the case of BrO, which is produced in the atmosphere and not directly emitted by volcanoes.

Here we present IDOAS measurements carried out at Popocatépetl volcano, Mexico, during April 2010 and 2011. SO_2 SCDs of up to $2 \cdot 10^{18}$ molecules cm^{-2} and BrO SCDs of up to $7 \cdot 10^{13}$ molecules cm^{-2} were detected. The determined BrO/SO_2 ratios range around $3 \cdot 10^{-5}$, comparable to several other volcanoes in the Americas. An increase in the determined BrO/SO_2 ratios with distance from the vent, i.e. plume age, can be observed.