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Volcanic halogen emission and their interaction with the atmosphere

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The chemical processes in volcanic plumes are inadequately understood today. A better understanding of it could lead to an improvement of the forecast of volcanic eruptions by monitoring gas emissions. One powerful class of gas emission measurement methods are optical remote sensing techniques. The Differential Optical Absorption Spectroscopy (DOAS) is one of them and can simultaneously measure several trace gases.

Recently, a series of field studies was carried out with Mini-MAX-DOAS instruments at two volcanic sites, Mt. Etna and Mt. Villarica, in order to evaluate the mechanisms for BrO formation in volcanic plumes. We demonstrate an increase of the BrO/SO2 ratio with the aging plume, and that BrO is below detection limit in proximity of the active vents of the volcanoes, but already present in the spectra 1.5 km downwind. ClO and OClO were detected as further active halogen compounds in volcanic plumes. ClO could already be detected next to the source (in contrast to BrO), and shows no significant increase in the ClO/SO2 ratio in the aging plume. The BrO/SO2 variations were additionally studied for short time series at Mt. Etna 2004 and 2005. They were compared with filter pack measurements. The meteorological influence on the data set is not fully explored yet, but first results on this topic will be presented. However, the measurements suggests that BrO study can be useful to gain additional informations about volcanic processes. This is supported by measurements of the individual craters of Mt. Etna (the North East Crater and Voragine), suggesting an enrichment of halogens at the NE crater (or a depletion of SO2) in comparison with the Voragine crater; this is also supported by routine filter pack measurements carried out over 2004.