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Spatially distributed OClO-profiles in the volcanic plume of Mt. Etna, Sicily

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The study of the chemical composition of volcanic plumes is important both for the understanding of volcanic processes and the influence of volcanic activity on the atmosphere. Reactive halogen-species such as BrO, ClO, OClO are abundant in volcanic plumes and can have several effects on the atmosphere (e.g. local ozone depletion by catalytic halogen-reactions).

Multi Axis Differential Absorption Spectroscopy (MAX-DOAS) is an established method to determine reactive components in volcanic plumes by analysing scattered sunlight which has traversed the plume.

We present MAX-DOAS measurements that were performed at Mt. Etna, Sicily in September 2012 with a newly developed MAX-DOAS-instrument. Both, vertical and horizontal plume-scans as well as point measurements were done in distances of several hundred meter up to 30 km from the emission source. For the first time it was possible to measure spatial distributions of the halogen compound chlorine dioxide (OClO) in a volcanic plume. OClO column-densities (SCDs) up to $2 \cdot 10^{14}$ molecules/cm^2 were measured in an area of about 2 km around the emission source. OClO/SO_2-ratios between $1 \cdot 10^{-5}$ and $4 \cdot 10^{-4}$ were determined. Along with the evaluation of OClO the species bromine monoxide (BrO) as well as sulphur-dioxide (SO_2) were evaluated for each data set. BrO-SCDs up to $1.1 \cdot 10^{15}$ molecules/cm^2 and BrO/SO_2-ratios between $2 \cdot 10^{-5}$ and $5 \cdot 10^{-4}$ were determined.

Assuming a plume width of less than 1 km the measured values correspond to OClO and BrO concentrations of several hundred ppt in the plume.

From the measured OClO- and BrO-SCDs and by assuming steady-state between the production of OClO from BrO and ClO and its photolytic destruction, ClO concentrations between 70 ppt and 1.0 ppb were derived.

We will discuss these results and their importance to improve our knowledge about chlorine-chemistry in volcanic plumes.