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Fabry-Perot interferometer-based remote sensing of SO_2

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We studied SO_2 degassing from volcanoes and monitored the corresponding SO_2 fluxes. Besides the effect on climate and the hazardous effects at a local scale, the absolute magnitude of SO_2 fluxes or ratios of SO_2 with other volcanic gases can be an indicator for volcanic activity and even help to understand and model processes in the interior of volcanoes. Due to its characteristic absorption structure, high abundance in the volcanic plume and low atmospheric background, SO_2 can be easily identified and quantified by remote sensing techniques. DOAS and FTIR became standard techniques for volcanic SO_2 measurements. Along with the development of portable devices they offer the advantage of simultaneous measurements of multiple gas species. However, both techniques often need complex data evaluation and observations are usually limited to a single viewing direction. Spatially resolved measurements, which are for instance required to determine gas fluxes, frequently have to be obtained sequentially leading to a relatively low time resolution.

A further, today nearly established method to determine SO_2 emission fluxes is the "SO_2 camera". The SO_2 camera has the advantage of a high spatial and temporal resolution, but is very limited in spectral information using only two wavelength channels and thus being less selective. Cross-interferences with volcanic plume aerosol, the ozone background, and other trace gases frequently cause problems in SO_2 camera measurements.

Here we introduce a novel passive remote sensing method for SO_2 measurements in the atmosphere using a Fabry-Perot interferometer (FPI) setup. The transmission profile of this FPI consists of periodic transmission peaks that match the periodic SO_2 absorption bands in the UV. In principle, this method allows imaging of two-dimensional SO_2 distributions similarly to SO_2 cameras. Interferences of standard SO_2 cameras are greatly reduced with the FPI method. In addition, this technique can also be applied to other trace gases (like BrO, OClO, or HCl) and allows the construction of small, robust devices, delivering accurate measurements without intricate data evaluation.

We present calculations on the FPI system and first laboratory measurements with a one pixel prototype of a FPI SO_2 device. These findings demonstrate the advantages of our novel approach.