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A novel technique to investigate volcanic sulphur dioxide emissions –First measurement results with imaging Fabry-Perot interferometer correlation spectroscopy

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The observation of volcanic sulphur dioxide (SO_2) emissions enables to monitor volcanic activity by quantifying degassing fluxes of volcanic plumes. Recently applied imaging techniques based on non-dispersive optical remote sensing (SO_2 cameras) reach a high spatial and temporal resolution. However, due to the limited spectral information, this technique lacks sensitivity, and selectivity and hence it is limited to high volcanic trace gas emissions and favourable measurement conditions.

We present the first measurements of volcanic SO_2 emissions with an imaging Fabry-Perot interferometer correlation spectroscopy (IFPICS) prototype in the UV spectral range.

The principle of IFPICS is to employ a Fabry Perot interferometer (FPI), replacing interference filters as wavelength selective elements. The FPI's periodic transmission profile correlates with the periodic structure of the SO_2 spectral absorbance, significantly increasing the spectral information for its detection. This reduces cross sensitivities (e.g. ozone interference, aerosols, clouds), allowing to use IFPICS also for weaker volcanic SO_2 emitters, increasing the range of possible atmospheric measurement conditions, and applying the technique to other trace gas species e.g. bromine monoxide or chlorine dioxide. Furthermore, IFPICS does not require calibration with gas cells since calibration with literature cross section is feasible.

The volcanic SO_2 column density distributions obtained at Mt. Etna, Sicily were recorded with 0.2 Hz and 400 x 400 pixels reaching a sensitivity of 1×10^{-19} cm^2 molec^{-1} at a detection limit of 3×10^{17} molec cm^{-2} s$^{-1/2}$, which is comparable to existing filter-based SO_2 cameras.

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