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Novel SO2 Spectral Evaluation Scheme Using the 360-390 nm Wavelength Range

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Differential Optical Absorption Spectroscopy (DOAS) is a well established spectroscopic method to determine trace gases in the atmosphere. During the last decade, passive DOAS, which uses solar radiation scattered in the atmosphere as a light source, has become a standard tool to determine SO_2 column densities and emission fluxes from volcanoes and other large sources by ground based as well as satellite measurements. For the determination of SO_2 column densities, the structured absorption of the molecule in the 300-330 nm region (due to the $A^1B_1 \leftarrow X^1A_1$ transition) is used. However, there are several problems limiting the accuracy of the technique in this particular application. Here we propose to use an alternative wavelength region (360-390 nm) due to the spin-forbidden $a^3B_2 \leftarrow X^1A_1$ transition for the DOAS evaluation of SO_2 in conditions where high SO_2 column densities prevail. The sensitivity reduction due to the rougly two orders of magnitude smaller differential absorption cross section of the later transition is largly compensated by the higher intensity of solar radiation and more favourable radiation transport at longer wavelengths.

We will present example results for both wavelength regions applying the novel and the standard evaluations to Gome-2 satellite data and groundbased MAX-DOAS measurements. We show the novel range to have considerable advantages, in particular when the particle content of the plume is high and when measurements are performed at large distances from the area of interest. We will show by radiative transport modeling that apparent differences in the derived SO_2-column for the two wavelength ranges can be explained by differences in radiation transport and briefly discuss the importance of these results for global and local flux estimates and volcanological interpretation.