



## **The influence of polarization on box air mass factors for UV/vis nadir satellite observations**

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Tropospheric abundances of pollutant trace gases like, e.g., NO<sub>2</sub>, are often derived by applying the differential optical absorption spectroscopy (DOAS) method to space-borne measurements of back-scattered and reflected solar radiation. The resulting quantity, the slant column density (SCD), subsequently has to be converted to more easily interpretable vertical column densities by means of the so-called box air mass factor (BAMF). The BAMF describes the ratio of SCD and VCD within one atmospheric layer and is calculated by a radiative transfer model.

Current operational and scientific data products of satellite-derived trace gas VCDs do not include the effect of polarization in their radiative transfer models. However, the various scattering processes in the atmosphere do lead to a distinctive polarization pattern of the observed Earthshine spectra.

This study investigates the influence of these polarization patterns on box air mass factors for satellite nadir DOAS measurements of NO<sub>2</sub> in the UV/vis wavelength region. NO<sub>2</sub> BAMFs have been simulated for a multitude of viewing geometries, surface albedos, and surface altitudes, using the radiative transfer model SCIATRAN. The results show a potentially large influence of polarization on the BAMF, which can reach 10% and more close to the surface. A simple correction for this effect seems not to be feasible, as it strongly depends on the specific measurement scenario and can lead to both high and low biases of the resulting NO<sub>2</sub> VCD. We therefore conclude that all data products of NO<sub>2</sub> VCDs derived from space-borne DOAS measurements should include polarization effects in their radiative transfer model calculations, or at least include the errors introduced by using linear models in their uncertainty estimates.