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The Monte Carlo radiative transfer model "PROMSAR" for the interpretation of DOAS remote sensing measurements

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The evaluation of scattered radiation measurements made by DOAS (Differential Optical Absorption Spectroscopy) remote sensors requires the use of radiative transfer models of the atmosphere. DOAS remote sensors measure the slant column of an atmospheric trace gas, which is the integrated trace gas concentration along the light path. This quantity is a function of the solar zenith angle, the wavelength of radiation, the detector line of sight and also depends on the vertical structure of the atmosphere. A new quantity must be introduced to compare measurements under different viewing geometries, which is the vertically integrated trace gas concentration (vertical column). This leads to the equation of the Air Mass Factor, which is the quantity used to convert the slant column of a trace gas into its vertical column.

PROMSAR (PROcessing of Multi-Scattered Atmospheric Radiation) is a radiative transfer model that considers the effects of multiple scattering by molecules and aerosols, giving a more realistic description of the radiation transport in the atmosphere than that given by single scattering models.

This model is based on a backward Monte Carlo technique which allows the user to simulate the trajectories of individual photons in the atmosphere, which is modelled with a plane multi-layer user defined geometry. PROMSAR code calculates the mean path of the radiation within each layer in which the atmosphere is sub-divided and uses it to work out the Air Mass Factor of a trace gas whose atmospheric vertical profile is

required. The model can also be used to simulate, in zenith and off-axis configurations, the slant column measurements in order to obtain information about the gas vertical distribution by comparing the measured values and the simulated ones.

A description of the model and some comparisons with the slant column measurements are presented together with the perspective of its future applications.