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The information content of skylight polarisation in MAX-DOAS trace gas- and aerosol profiling applications

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Multi-AXis Differential Optical Absorption Spectroscopy (MAX-DOAS) is a well-established measurement technique for the detection of atmospheric aerosol and trace gases: ultra-violet and visible radiation spectra of skylight are analyzed to obtain information on different atmospheric parameters. An appropriate set of spectra recorded under different viewing geometries ("Multi-Axis") allows retrieval of aerosol and trace gas vertical distributions as well as aerosol properties by applying numerical inversion methods. Currently one of the method's major limitations in ground-based applications is the limited information contained in the measurements that reduces the sensitivity, particularly at higher altitudes.

It is well known but not yet used in MAX-DOAS profile retrievals that measuring skylight of different polarisation directions provides additional information: The degree of polarisation for instance strongly depends on the atmospheric aerosol content and the aerosol properties and – since the light path differs for the light of different polarisation - the set of geometries available for the inversion is extended. We present a novel polarization-sensitive MAX-DOAS instrument (PMAX-DOAS) and a corresponding inversion algorithm, capable of using polarimetric information to significantly extend the information content of the measurements. The improvement over conventional "unpolarised" MAX-DOAS approaches will be discussed, based on both, synthetic data and real measurements.