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Assesment of Independent Macrophysical Cloud Properties in the Oxygen A-Band

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Precise information about clouds is of high importance for the retrieval of atmospheric trace gases, especially in the troposphere. In this work, we investigate the number of independent macrophysical cloud properties that can be retrieved from the O_2 A-band, in the context of trace gas retrievals. The cloud parameter retrieval assumes a single homogeneous cloud layer characterized by fractional cloud cover, cloud-top height, cloud geometrical thickness and cloud optical thickness. Additional information required for cloud-property retrieval, includes the surface properties, the viewing geometry and the pressure and temperature distribution. To assess the retrieval feasibility, we use a set of simulated spectra in the wavelength range of 758-770 nm, for different combinations of cloud, surface and geometry parameters. The inversion is performed by using Tikhonov regularization with an *a priori* parameter choice method. Values of the condition number, defined as the ratio between the largest and the smallest values of the Jacobian matrix, are analyzed and the degree of ill-posedness is evaluated for retrievals involving multiple (four, three and two parameters) and a single cloud parameter. For four and three parameters, the high degree of ill-posedness and the multiple minima of the cost function yield unreliable results. It is shown that information contained in the O_2 A-band spectra is enough to retrieve only two independent cloud parameters. Best results are obtained for the joint retrieval of (a) cloud-top height and cloud fraction, or (b) cloud top height and cloud optical thickness.