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Determination of cloud height from TROPOMI Ring effect observations

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The determination of effective cloud properties like cloud fraction and cloud height is important for the correction of cloud effects on tropospheric trace gas products derived from satellite observations. Moreover, information on cloud properties is interesting in itself, because clouds are important in many aspects of the atmosphere-earth system.
Information on cloud height is usually retrieved from UV/vis satellite observations from the shielding effect of clouds on atmospheric absorptions of the oxygen molecule (O_2) or dimer (O4). Alternatively, information on cloud height can be obtained from measurements of the so-called Ring effect, the filling-in of solar Fraunhofer lines due to rotational Raman scattering on air molecules. Algorithms based on the Ring effect have the advantage that they are much less affected by changes of the effective albedo (caused by surface effects and clouds) than the absorptions of O_2 and O4. Also, the wavelength interval used to determine the Ring effect is analysed is much closer to the wavelength ranges used to retrieve most atmospheric trace gases in the UV/vis.
However, in spite of the rather strong spectral signature of the Ring effect, the analysis of the Ring effect is complicated by possible spectral interference with spectrograph straylight. Also, the wavelength dependence of the Ring effect has to be considered. For TROPOMI observations, a further problem occurs, since the boundaries between the different spectral channels are optimised for trace gas analyses, but are not the optimum choice for the analysis of the Ring effect.
In this study, we present how these problems can be successfully addressed. We also present first results of effective cloud height retrieved from TROPOMI and how they depend on the observational geometry and surface type. Finally, the new cloud height results are compared with other cloud height algorithms.