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Accurately retrieving effective cloud fractions and effective cloud height from GOME-2 and OMI measurements for the verification of Sentinel 5(P) algorithms

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Clouds are one of the most important drivers of meteorology and responsible for numerous feedback mechanisms within the climate system. Apart from this and in particular, many satellite retrievals require an accurate and reliable parameterisation of the cloud distribution within to constrain their radiative transfer. Tropospheric trace gas retrievals are affected even by small cloud fractions within the field of view of the instrument increasing the uncertainty of the measurement.

To improve the accuracy of tropospheric trace gas retrievals, highly accurate cloud fractions are required as input, particularly for small cloud fractions. This requirement led to the development of the Iterative Cloud Retrieval Utilities (HICRU) originally developed for the Global Ozone Monitoring Experiment (GOME). HICRU retrieves the lower threshold maps iteratively from the measurements themselves and is therefore relatively robust against systematic biases. However, recent low Earth orbit satellite missions, and those to be launched in the near future, feature measurements at large viewing angles compared to GOME. Therefore, the HICRU algorithm needed to be revised.

We present a new implementation of the HICRU approach developed for the verification of the Sentinel-5P algorithm for effective cloud fraction. It is based on top-of-atmosphere radiances using an empirical parameterisation of the viewing angle dependence and was applied to GOME-2 PMD measurements. Furthermore, differences to an approach based on Lambertian equivalent reflectances are discussed, which may be beneficial for the application for satellite instruments featuring an even wider swath than GOME-2.

For the retrieval of the effective cloud height, we present recent advances in the application of retrieved optical thicknesses of the Ring effect, which are intended for the verification of operational Sentinel-5 cloud algorithms.