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Retrieving reflectance background maps for cloud characterisation in the UV/vis - A new approach accounting for surface BRDF and degradation effects

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We present a newly developed approach for retrieving background reflectance maps from UV/vis satellite measurements. The algorithm builds on the principles of the Heidelberg Iterative Cloud Retrieval Utilities (HICRU, Grzegorski et al., 2006). Our main goal is to improve the accuracy of measurements of small cloud fractions, because the accuracy of satellite retrievals for tropospheric trace gases (e.g. NO_2, HCHO) strongly depends on this parameter. In general, however, cloud retrievals from various UV/vis satellite could benefit from the presented approach depending on application, and the importance for improving our understanding of clouds is evident. Furthermore, retrieved minimum reflectance maps are applicable in studies of, e.g., land cover changes, surface BRDF effects and aerosols.

The most important feature of our approach is the derivation of the minimum reflectance map for a certain satellite sensor and wavelength range from the measurements themselves. Therefore, a sufficiently long time series of reflectance measurements is required. Another advantage of our algorithm is that it integrates measurements of the entire instrument swath. The algorithm builds on the assumption that the surface is relatively dark compared to any type of overlying clouds. Therefore, it is limited to regions not permanently covered by clouds, ice or snow. Even though the algorithm transforms measured reflectances to Lambertian Equivalent Reflectances (LER), thereby removing the viewing-angle dependent contribution of Rayleigh scattering, minimum LER values are still found to significantly depend on both viewing zenith angle (VZA) and time (orbit number). Most challenging, the VZA-dependence itself is in some cases time-dependent. Therefore, our approach features a minimum LER parametrised by time, VZA, and scattering angle. It is found that this parametrisation is capable to sufficiently describe systematic effects (e.g. surface BRDF) as well as instrumental effects (e.g. degradation) in the wavelength range between 375 and 757nm.

As a result, effective cloud fractions can be retrieved more accurately and with reduced biases as function of VZA and time. In this presentation, reflectance background maps and effective cloud fractions are derived from radiance measurements by GOME-2A. The effects of wavelength, spatial resolution, and spatial aliasing are discussed. The retrieved degradation is compared to the preliminary degradation model provided by EUMETSAT. Finally, systematic differences to operational products of the effective cloud fraction - FRESCO and OCRA - are discussed.