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MERIS albedo climatology and its application to FRESCO+ cloud and NO2 trace gas retrieval from SCIAMACHY

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We present a new land surface albedo climatology compiled from MEdium Resolution Imaging Spectrometer (MERIS) Albedomap data and demonstrate its favourable impact on the derivation of cloud parameters and tropospheric NO2 columns from UV/VIS sensors. MERIS black-sky albedo (BSA) data from October 2002 to October 2006 were aggregated to a grid of 0.25° x 0.25° for each month of the year and for 13 spectral channels between 412 nm and 885 nm. MERIS includes channels at 754 nm and 775 nm which are located close to the spectral windows required for O2 A-band cloud retrievals and which are not available in other surface reflectivity datasets with comparable spatial resolution. The FRESCO+ cloud retrieval algorithm has been developed to retrieve cloud parameters from UV/VIS sensors like SCIAMACHY or GOME. So far, FRESCO+ relies on a relatively coarse resolution surface albedo climatology (1° x 1°) compiled from GOME measurements in the 1990's which introduces several artefacts, e.g. an overestimation of cloud fraction near coastlines and over bright surface targets. Substituting this GOME Lambertian equivalent reflectivity (LER) data base with the MERIS BSA climatology generally improves the FRESCO+ retrieval as demonstrated by a comparison for two selected months (January and June 2006) with cloud parameters from the Heidelberg Iterative Cloud Retrieval Utilities (HICRU) algorithm. The MERIS BSA overall improves the correlation from 0.92 to 0.96 and reduces the RMSE from 0.08 to 0.05 relative to HICRU. In particular small cloud fractions are in better agreement with HICRU which is of importance for atmospheric trace gas retrievals which rely on accurate cloud information at small cloud fractions. Furthermore, overestimates along coastlines and underestimates in the Intertropical Convergence Zone introduced by the GOME LER are eliminated. For the same two months, tropospheric NO2 columns were calculated with the MERIS BSA data set and compared with the columns obtained with the GOME LER for the domain of Europe. As expected, the differences between the two data products resemble the pattern of the reflectance differences which are largest along coastlines. The new MERIS albedo data base is generally applicable to cloud retrievals from satellite instruments covering the O2 A-band or the O2-O2 absorption band around 477 nm. Finally, recent studies demonstrated that the choice of the albedo dataset can have a strong impact on the remote sensing of tropospheric trace gas vertical columns. Therefore, the by-product of MERIS 442 nm black-sky albedo can be applied to NO2 remote sensing and the BSA at 620 nm, 665 nm, and 681nm could be integrated in current H2O retrievals.