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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Cloud and surface classification using SCIAMACHY polarization measurement devices" *by* W. A. Lotz et al.

Anonymous Referee #1

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Review of the manuscript "Cloud and surface classification using SCIAMACHY polarization measurement devices" by W.A. Lotz, M. Vountas, T. Dinter and J.P. Burrows

The authors present a scheme of global thresholds to discriminate between cloudy and non-cloudy pixels as well as between cloud types (especially water and ice clouds) and different surface types (water, land, vegetation, desert, snow, ice and sun glint). On the one hand, the discrimination between clouds, surface, snow/ice and cloud free pixels is similar to existing publications, as mentioned by the authors (Krijger et al., 2005). For the discrimination between cloudy and cloud-free pixels over surfaces not covered by ice, the operational product OCRA is a better approach than the presented scheme. But on the other hand, some parts of the algorithm are quite interesting, especially the detection of sun glint and cloud phase, because a new approach is used

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for the determination of important information directly from SCIAMACHY data. But as outlined below, it is not worked out by the authors, that the retrieved thresholds are appropriate in general, including different seasons, viewing geometries, surfaces and dates of measurements. The paper should therefore only be accepted with major revisions, if the points stated below are clarified.

For the detection of clouds and the discrimination between different cloud types three values are used:

- the average between the PMD intensities (b)

- the range between the intensities of three PMDs normalized to the average r (similar to the saturation as used for pre-classification in the OCRA algorithm).

- the intensity of PMD 5 (near-infrared)

For surface classification (including sun glint), additional quantities are used: the vegetation index, the relation between PMD 7 and PMD 4, the relation between PMD 5 and PMD 4 and the intensity of PMD 4.

The authors should add further references dealing with PMD cloud retrieval, especially publications of the OCRA algorithm, because the values b and r are quite similar (but not identical) to the values used in the OCRA algorithm for pre-classification. The authors may choose publications dealing with GOME data, because the SCIAMACHY algorithms are often based on earlier publications dealing with GOME-1 data.

With respect to Table 3/4, I think sensitivity studies have to be done to determine the conditions suitable for the usage of global thresholds, e.g. limits of the solar zenith angle, the surface albedo and the heterogeneity of the measurement in cloud cover and surface type. The last point is partly discussed by the authors, but not concerning the most interesting parts of the algorithm (cloud phase, sun glint).

- the measured PMD intensities depend on the satellite geometry (solar zenith angle, line of sight angle, relative azimuth angle). For high solar zenith angles ($>$60 degrees)

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these effects are not negligible.

- The cloud classification does not take the surface albedo into account, which is important in the case of partly cloudy pixels, but also for completely cloudy pixels, if the optical thickness is low. For several surface types the PMD intensity in PMD 5 for cloud free scenes is higher than the whole range defining "ice clouds" in Table 3. The strong effect of the surface albedo to measured intensities is the major reason, why simple cloud screening algorithms as developed in the 1990s for GOME are usually no more used with GOME/SCIAMACHY except for very rough estimations with an accuracy of about 20% in effective cloud fraction. But for the discrimination between water and ice clouds a higher accuracy is required.

- Which corrections are used for the PMD intensities (ESA corrections, individual corrections) except dividing the radiance by solar irradiance and the cosine of the solar zenith angle? Is the instrument degradation taken into account?

- on p. 9863 the authors mention, that a huge amount of MERIS data is used to determine liquid water classification. If the authors are able to apply a huge amount of MERIS data, i would suggest that a quantitative intercomparision of the retrieved cloud phase with MERIS should be added to the paper to show the reliability of the method. With respect to the points above, I think that the possible conclusions of the presented case studies are quite limited.

- The statement in the abstract, that there is a good quantitative agreement between MERIS and the presented algorithms should be removed. For "water" the mismatches are nearly as large as the matches (20898/27801). The study indicates, that the reason is the heterogeneity of the measurements, but the problem is, that the people who want to use this algorithm with SCIAMACHY data has to deal with the algorithm without additional subpixel information.

- The statement, that the algorithm can be applied to GOME-2 after adapting the thresholds should be removed (p. 9870) because the PMD in the infrared (PMD 5)

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is not available on GOME-2.

- a validation of the sun glint retrieval including a huge dataset with different conditions (seasons, solar zenith angle, regions on earth) would improve the paper, but is perhaps not easy. I would say, that it is not mandatory to add such a validation, if the authors are able to show the reliability of the cloud phase retrieval using an quantitative intercomparison.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 9855, 2008.