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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.

W. A. Lotz et al.

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We thank referee 2 for fruitful comments

Reply to "Specific comments"

1. Referee comment: Page 9861, line 21-22, "A well-tuned set of threshold for b, r, and R5 help to classify ice, water and generic clouds as well as, (see Tables 3/4)". What is the threshold for generic clouds, which is not clear from Table 3, 4.

- While developing SPICS several PMD ground pixels could not be classified uniquely as ice or water cloud. The corresponding values ranged in between the thresholds intervals. These pixels were classified as "generic clouds". Further analysis showed that this classification interferes with other parameters retrieved. For the time being we have therefore discarded "generic clouds". This

change will not hamper the logical flow of the manuscript. In principle this category is helpful, therefore it will be subject of analysis in a next study (see also: reply to referee comment 7).

2. Referee comment: Page 9861, line 25, Multiple classification are allowed. Are there any reasons to allow the multiple classification? For example in table 3, ice cloud bright white and white have overlap in r, b range. As I understand that the authors check the b, r values to determine the clouds, then use R5 to separate water and ice clouds. I suggest that the authors explain in a few words how table 3 is used. It is not very clear to the reader if only list the values.

- SPICS is organized with respect to three classication groups: clouds, sun glint and surfaces (as described at 9860/18). Usually multiple classification is not performed within one classification group, i.e. only one cloud classification can be assigned to one ground pixel (currently). The referee is right. The information given might not be sufficient to reproduce the results. We will add information how to use table 3 and 4 and will clarify how to deal with multiple classifications.

3. Referee comment: Page 9862, line 10, the authors mentioned that the NDVI n depends on the health state of the plant. Does it depend on the season as well?

- The NDVI is defined as the difference between near-IR and visible reflectances divided by their sum. It is related to the amount of green vegetation on the surface. Large NDVI values correspond to greener areas while small NDVI values correspond to arid areas. Therefore, if the plant/leaf state changes with season, the NDVI will change correspondingly. As SPICS thresholds have been determined using multiple seasons the NDVI threshold can only be a compromise between actual accuracy and seasonal independence (see also: reply to referee comment 7.)

4. Referee comment: Page 9863, line 8, for sun glint "The proper geometrical con-

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ditions: an absolute value of an azimuth difference of 40 degree between line of sight and sun position..." Have you tried to calculate geometrical conditions for sun glint from the scattering angle as used by de Graaf and Stammes (2005)?

- Yes, we have tried this approach and found it is a reliable and straightforward way to describe sun glint. During our study we found that the polarization ratio in combination with additional geometrical constraints leads to comparable results. A pure geometrical approach such as the one by de Graaf and Stammes has to take into account changes in reflection due to water roughness. Usually this is done by parameterization of the zenith angle with respect to wind-induced sea surface roughness (Cox and Munk, 1954) or by defining an adequate Δ zenith or reflection angle. Our approach is more convenient due to the parametrization of sun glint's zenith angle dependency using polarization ratios.

5. Referee comment: Page 9864, line 5, 10, 15, I am confused by the '>=R5< '?

- The referee is right. This subsection includes some typos mixed with erroneous limit values. However, all interval definitions shown in table 3 and 4 remain correct. We will check and fix all interval values referenced in the text (primarily in section 3.2):

  a. 9864/4: "should be within the following interval: 0$\geq \rho_{54}P >$0.2" -> "should be within the following interval: 0$\leq \rho_{54} <$0.2"

  b. 9864/5: "where the reflectance R_5 should be 0.06$\geq R_5 <$0.018" -> "where the reflectance R_5 should be 0.0015$\leq R_5 <$0.0360"

  c. 9864/8: "that $\rho 54$ should be larger or equal 1.7" -> "that $\rho 54$ should be larger or equal 1.67"

  d. 9864/12: "on antarctica" -> "over Antarctica"

  e. 9864/15: "of land pixels: 0.05$\geq R_5 <$0.092." -> "of land pixels: 0.084 $\leq R_5 <$ 0.185".

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Interactive Comment

6. Referee comment: Page 9866, line 15, 'Both figures also reveal strength and weakness: SPICS is capable to detect even geometrically thin clouds.' How do you know it is geometrically or optically thin clouds? Perhaps it is better to use optically thin clouds here.

- We agree and will change the sentence accordingly.

7. Referee comment: In the conclusion the authors also described the future plans, such as more validations. It is very important to have more validations. I often wonder if the thresholds depend on season, latitude and so on.

- The thresholds defined here must be understood as a compromise with respect to potential dependences on geo-location and seasons based on the full SCIAMACHY data set since 2002. We agree, that further validation is necessary, especially to check the quality of classifications for such highly temporal and spatial variable objects like clouds. Also, the discrimination of water and ice clouds needs to be monitored. At a spatial resolution of SCIAMACHY's PMDs (7 km $\times$ 30 km) scenes often contain different cloud phases. Here, a class like mixed ("generic") clouds needs to be (re-) introduced and validated.

Reply to "Technical corrections:"

1. Page 9856, line 26, O2-A-band -> O_2 A-band, 2 is subscript.

2. Page 9857, line 10, please change the "sun-glint" to "sun glint", to be consistent in the paper.

- Changes will be introduced!

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