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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Dependence of cloud fraction and cloud top height on surface temperature derived from spectrally resolved UV/vis satellite observations" *by* T. Wagner et al.

Anonymous Referee #1

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The topic of the paper is relevant to the climate-cloud feedback discussion, and fits well in ACP. The correlation of cloud data from oxygen absorption measurements by satellite with surface temperature data is new and contributes independent information to the study of climate-cloud feedback. The conclusions from the paper are however quite weak. If the following major and detailed comments are taken into account, the manuscript could be accepted.

Major comments:

1. The paper describes an effort to correlate monthly cloud observational fields from GOME (CF and CTH) with surface temperature (ST) fields, and contains many corre-

lation figures. The spatial correlation patterns between CF and ST are at some places strong. However, there are several figures which do not show a clear result. For example, the spatial correlation plots of Fig. 11-13 are not convincing. They do not show a clear seasonal cycle and contain much noise. Please remove Figs. 11-13, or condense them. The paper should be more focussed and only show clear results.

2. The CTH is derived from the O2 absorption measurements and CF, as described in Sect. 3. The logical expectation of the reader is that in the remainder of the paper only CF and CTH are discussed. But this is not the case. In Sect. 4 the authors jump back and forth between discussing CTH and O2 absorption: Fig. 7 shows O2 absorption, Fig. 8 shows CTH, Fig. 9 shows O2 absorption, and Fig. 10 shows CTH. This is confusing. Since the O2 absorption is an intermediate quantity for retrieving CTH, it should not be shown so many times; Fig. 3 suffices. Only CF and CTH should be discussed. Both are independent cloud quantities. Also the title of the paper only mentions CT and CTH. Therefore, in Fig. 7 (bottom panel) O2 absorption should be replaced by CTH, and Fig. 9 can be removed.

3. The paper states that models should reproduce these observational results. This seems a too strong statement for results which are not always clear and convincing themselves. It is a pity that the authors do not show any model results. This would have strengthened the paper. The analysis does not go beyond the correlation, which is merely sufficient.

4. From the description of the CTH algorithm, it seems that the algorithm is missing two important processes: Rayleigh scattering and surface elevation. Is this true? If so, a quantitative estimate of this neglect should be given in Sect. 4.2.

Detailed comments

Title and related questions

1. The title is not covering the contents of the paper: the dependence of cloud proper-

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ties on surface temperature is not derived from satellite observations, but from correlation analysis between satellite cloud observations with surface temperature data.

2. The surface temperature (ST) data are not described at all. Please devote a subsection to the surface temperature data. Mentioning a URL is not sufficient.

3. Why are UV/vis satellite observations mentioned in the title? The UV channels of GOME are not used in this paper.

4. This brings me to the following question: The O2 absorption band is at 630 nm. The PMD measurements used for cloud fraction determination are probably visible radiation data but this is not specified in the paper. Please describe in Sect. 3 at which wavelength the effective cloud fraction is determined. It should be at a close wavelength to the O2 absorption band, otherwise the two properties should be scaled.

Abstract

Line 5 mentions the cloud radiative feedback. Line 19 mentions a cloud climate feedback. Is this the same feedback? If so, please use the same term.

Line 23: Please reformulate (see major comment 3)

Section 1

Line 10: Solomon

Line 22: The cloud fraction is an effective cloud fraction. This should be made clear from the start.

Section 2 is too short and can easily be fitted into Sect. 3.

Section 3

Sect. 3.1: Which range does the effective cloud fraction have? Is the cloud albedo used (which cannot be measured by GOME) or the cloud reflectance?

Sect. 3.2: which O2 band is used? Is there no overlap with other gases?

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Sect. 3.3: What is the unit of O2 absorption? In the figures of O2 absorption there is no unit used, but only a normalized quantity.

p. 17122:

l. 11: Which phase function is used for the cloud particles?

l. 12-15: Is the normalization also depending on viewing zenith angle and azimuth? Are the observations of O2 absorption normalized to the maximum observed during some period, e.g. per month? Please note that due to the normalization to the maximum, outliers may influence the result.

p. 17123:

l. 9: What do you mean with global surface elevation? The surface elevation of the pixel? If the CTH algorithm is not including surface elevation in the retrieval, this should be mentioned earlier. How will this neglect of surface elevation influence the CTH results of Sect. 4?

l. 11-12: Which specific agreement is meant? Which differences are found? Please note that the effective cloud fraction is not an ISCCP cloud quantity.

Section 4

p. 17124:

l. 14: Which radiative transfer modelling is meant here to determine the relation between CTH and ST? Do you mean thermal IR modelling + convection?

p. 17125:

l. 6: please specify if these errors are precisions (random errors) or accuracies (biases).

l. 20: Do you mean that Rayleigh scattering is not included in the retrieval of CTH? If so, please mention this in Sect. 3, and give here a value of its impact on CTH. This is

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also related to the impact of the possible neglect of surface elevation on CTH.

p. 17126:

l. 7: effect

l. 11: what is the magnitude found? Please clarify.

Section 5

p. 17128:

l. 19: What is meant with "cloud heating"? Do you mean excess radiative absorption in clouds which warms the cloud? Or do you mean positive radiative forcing at the surface or at the tropopause due to clouds? Please clarify.

p. 17129:

l. 3-4: remove: "changes associated with strong"

Figures and captions

Fig. 1: which geometry is used?

Fig. 2: The colour scale is unclear, because all cloud fractions between 30 and 100 % are blue.

Fig. 3: To which quantity is the O2 absorption normalized? Is the meaning of the quantity "normalized O2 absorption" here the same as in Fig. 1?

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 17117, 2007.