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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Influence of clouds on the spectral actinic flux density in thelower troposphere (INSPECTRO): overview of the field campaigns" *by* S. Thiel et al.

S. Thiel et al.

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We thank anonymous referee #2 for the useful comments. Our specific responses are given below (Comments of Referee in Italic)

1)P. 13419, line 10, and pp. 13443, line 12 until p. 13444, line 17: The exploitation of the three-dimensional radiation transfer model MYSTIC is mentioned at the end of the first paragraph. While reading the entire manuscript, the reviewer was not able to find graphs for MYSTIC results, even though MYSTIC was described in some detail in section 4 of the manuscript. Thus, the reader is given the impression that results to 3D radiative effects will be found in this paper. This is not the case. - Please correct.

Answer (A): We would like to add a Figure 12 showing a comparison of ground base

measurements and results of the RT-model MYSTIC. The following text would be inserted directly before the conclusion chapter.

"Figure 12 shows results from three-dimensional radiation transfer calculations using the MYSTIC model and ground based measurements during the flight on May 25 2004 of the second campaign in Bavaria. Considering the experiences gained during the first campaign, the regular triangular flight pattern had been replaced by a more random one which allowed better retrieval of the actual cloud structure. For such a large domain, the time-dependent cloud amount needs to be taken into account: During the flights the cloud-fraction increased remarkably. The retrieved cloud-field is thus a cross section along the increasing cloudiness. The comparison of Figure 12 shows the resulting normalised fluxes of all five stations and the simulated area-mean, standard deviations, and extreme values.

The difference between the observations at the individual sites illustrates the variability within the domain. While the actinic flux at the Buchhofen station is very close to the cloudless sky simulation, the sky at Spiegelau was overcast after 9:00, probably caused by orographic clouds forming at the mountain. Nevertheless, the range of simulated values matches nicely the observations. In particular the lowest values of the simulation agree almost perfectly with the lowest observed data. On the other hand, the enhancement predicted by the model is somewhat larger than the enhancement observed at Spiegelau, Buchhofen, and Eggenfelden."

The caption of Figure 12 will be: "Comparison of ground based measurements and 3D-calculations from the radiation transfer model MYSTIC on May 25, 2004 in Bavaria (second campaign). The radiative transfer calculations were done for 11:30 UTC where the simulations agree well with the observations with respect to the average and the variability."

2)P. 13426, line 27: please add "diameter" to "size range of 0.5-47 μm".

A: O.K.

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3)P. 13429, line 23: The reviewer does not understand the units of the lower irradiance limit. Is this limit in terms of photons per unit surface per unit wavelength interval? Please correct appropriately.

A: We have corrected the typo (missing "W").

4)P. 13436, line 23: "non-spherical (That is solid) particles"; the term in parentheses can be replaced by "solid", because that is the situation the authors really refer to.

A: We have changed the parenthesis to "...(i.e. solid)...".

5)P. 13436, line 26: typo "retieved"

A: O.K.

6)P. 13440, lines 4-13: What is the difference between "Ultralight" and "microlight"? Is it not the same platform?

A: Ultralight aircraft are generally called microlight aircraft in the UK and New Zealand, and ULMs in France and Italy. Some countries differentiate between weight shift and 3-axis aircraft, calling the former microlight and the latter ultralight (http://en.wikipedia.org/wiki/Microlight). In the text we used both words for the same platform. But to avoid further misleadings we use the word ultralight instead of microlight.

7)P. 13442, line 27: "were assumed" -> "was assumed"

A: O.K.

8)P. 13450, line 27, and all other occurrences (also figures): which colour is meant by "wine"? Please correct.

A: We took the colour name directly from the english version of the ORIGIN software package. But to avoid mistakes we changed "wine" to "ruby".

9)P. 13451, line 1: "the profile which is much more rotund"; usage of the term "ro-

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tund" is a rather unusual one; a term like "the profile having stronger curvature" or similar seems to be more appropriate. Secondly, the authors are asked to provide an explanation why the curvature behaves in this particular manner. What are the physical explanations? Is this an effect appearing near the lowermost layers (lowermost 100-200 m) directly above the surface?

A: First, we agree with the reviewer to change the wording. We used "more pronounced curvature" instead of "rotund profile".

To explain the physics behind we would like to summarize some experiences from previous campaigns:

-The occurrence of the profile curvature is independent of solar zenith angle for most of the day (Junkermann, 2005)

-A pronounced curvature occurs only in cases with moderate to high aerosol concentrations within a single aerosol layer. Multiple aerosol layers might not lead to such a pronounced curvature (not published).

-Increasing aerosol concentration in a single aerosol layer leads to increasing curvature effect

-Different aerosol types behave different; desert dust is less effective than continental aerosol (Meloni et al., 2003, Junkermann 2000)

We assume that the physics behind bases on the wavelength dependent scattering properties of the aerosols which is depending on a specific combination of the aerosol size distribution and refractive index. The conversion of the incoming direct fraction to diffuse radiation first of all leads to an increase of actinic radiation in the upper part of the aerosol layer. This is similar to the transfer of actinic radiation through a cloud. But the effect is less pronounced than in a cloud and does not lead to a significant local maximum. The lower part of the profile (within the layer) is directly depending on the extinction coefficient of the aerosol layer (exponential decrease). Both effects,

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increasing actinic radiation in the upper part of the layer and the exponential decrease towards the ground lead to the observed "belly shape" of the profile. The observed difference between the J(O1D) profile and the J(NO2) profile could be explained by the wavelength dependence of Mie-scattering. A more detailed analysis would require more information about the aerosol and is beyond the scope of this paper. In addition, however, it should be noted that model calculations show a similar behaviour like the measurements; that means that the effect is already included in the radiation transfer models.

10)P. 13453, line 12: typo "to high" -> "too high"

A: O.K.

11)P. 13454, lines 11-25: For the reader it is not clear find why the authors at exactly this point make reference to other published INSPECTRO work, because the findings listed do not follow from the content (figures/results) of the present paper. Certainly, INSPECTRO was a very important project with new and innovative results. This paragraph should entirely be placed, for example, in the introductory section. Another appropriate location would be to re-formulate section 7's title to "Comparison of observations with 1-D radiative transfer models and with a simulated 3-D cloud field", and to add this paragraph there.

A: We moved the discussion of cloudy conditions into the section 6 "Spectral actinic flux density measurements".

12)P. 13454, line 26-29: The authors announce that the INSPECTRO data sets belong to the most accurate and best characterized validation sets worldwide. Therefore, it is recommended to add a web address through which interested readers and researchers can obtain access to the INSPECTRO data.

A: We add the passage: "The data set is stored on the NILU data base but not yet publicly available as the research groups analysis of the data is ongoing. However, the

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usage of the data set is possible after contacting the authors."

13)P. 13455, line 15: typo "spectophotometers"

A: O.K.

14)P. 13458, line 29: typo? "libRadtransoftware" -> "libRadtran software"

A: O.K.

15)P. 13459, line 11: typo "homogenous"

A: O.K.

16)P. 13459, line 22: typo "Venem" -> "Venema"

A: O.K.

17)P. 13471, caption Fig. 9: typos "airborned", "turkoise", "groundbased"

A: O.K.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 13417, 2007.