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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.

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We thank anonymous referee #1 for the helpful comments. Our specific responses are given below.

R: Title and throughout the text: Why actinic flux "density"? The standard usage is simply actinic flux. There is already confusion in the nomenclature (e.g. fluence rate, spherical irradiance, scalar flux), so adding a new name will not help.

A: We agree with the reviewer in so far that indeed there is a lot of confusion in our field with terminology. That was exactly the reason why we have chosen to consequently use the correct term "actinic flux density", instead of the shorter and unfortunately more

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widespread (though incorrect) term "actinic flux" throughout the entire manuscript. A simple look at the units will explain what we mean. We start with the radiant energy Q which is a well-defined and established physical quantity and which can easily be measured. Q as an energy is given in units of 1 J = 1 W s. The flux Phi of the radiant energy (radiant flux) is subsequently given as the temporal change of Q, i.e., Phi = dQ / dt (with t representing time). In this way Phi carries the unit of 1 J / s = 1 W (a power). This is the usual way to define a flux. If the radiant flux is additionally related to a surface then a so-called "flux density" is defined. In case of a plane surface we call it the "radiant flux density" (or irradiance), in case of a spherical surface we talk about an "actinic flux density". Following from their definition both have the unit of 1 W m-2. The quantities shown in our paper have exactly this unit. Unfortunately, in numerous publications this clear distinction between "flux" and "flux density" is not consequently made. It is rather more common to use the term of "flux" in cases where clearly "flux density" is meant. A simple look at the units helps to clarify this confusion. This is the reason why we use the term "actinic flux density" which is the only correct one, though not very common, for the radiant quantities we mean in our paper.

R: 13420/10: A more original reference is Nack, M.L. and A.E.S. Green, Influence of clouds, haze, and smog on the middle ultraviolet reaching the ground, Appl. Opt. 12, 2405-2415, 1974.

A: The reference was included.

R: 13421/7-10: This sentence is a bit misleading. Were the deviations really due to using 1-D model instead of 3-D model? Or simply because the vertical distribution of aerosol optical properties was not known? This should be stated more precisely or removed.

A: These deviations are most likely caused by uncertainties in the vertical distribution of aerosols and surface characteristics, however experimental uncertainties may also have an impact, especially at low altitudes.

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R: 13424/12: Is shading from balloon a problem?

A: No, not significant (The effect of shading has been discussed by Webb et al 2004). The cube was suspended 30m and then 40m beneath the balloon basket (therefore about 35 - 45m beneath the main body of the balloon). Lowering the cube up and down did not change anything so we took that to imply that at 30m there was not a significant effect of shading. The balloon is no more than about 6m in radius, and as the sun was not directly overhead there was no shadow on the cube - the balloon effect would have been to reduce only sky radiation from a small portion of the sky. Radiative transfer calculations for the sky conditions present during the flights suggest that the signal in the upward pointing sensors was decreased by about 2-3% due to presence of the balloon.

R: 13432/23-25: Don’t all actinic flux instruments allow calculation of J values? The more useful information is that a full spectral scan was completed in xx seconds (2 seconds?).

A: Indeed, all spectral actinic flux instruments allow calculation of J values. Therefore this sentence was partly deleted.

R: 13442/18: Here, a 1.1x1.1 km2 resolution is called "high";, while on lines 12-13 a 1x1 km resolution is called "coarse." Please clarify, and also decide on km2 vs. km.

A: The first sentence containing the word "coarse" is a relict of a description of satellite pictures in general but should not be related to the AVHRR product. Therefore, we deleted this sentence without substitution.

R: 13442/21: might want to explain why, e.g. "...under overcast conditions (when groundbased instruments such as the Brewer could not determine the O3 column)."

A: We changed this sentence to "...under overcast conditions (when groundbased instruments such as the Brewer could not determine the O3 column from direct irradiance measurements), the data..."

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R: 13443/20: "which could technically be parameterized" - was it, or not?

A: We changed the sentence to "...which was be parameterized..."

R: 13443/21-23: does this refer specifically to BRDF? Not clear as stated.

A: We changed the sentence to "Homogenized radiation data sets have been prepared..."

R: 13443/24: This is a case where the word "precision" is clearly better than "accuracy", since accuracy also refers to the realism of the situation, e.g. are the model inputs really representative of the actual environment?

A: Precision is correct.

R: 13444/1-2: It seems strange that the agreement between 1D and 3D models is better than the MYSTIC statistical uncertainty, and suggests that the statistics may have been done incorrectly.

A: The statistics was done correctly. In a limited time one can of course only run a limited number of photons. And for the 1E9 photons which were run for this comparison, the remaining statistical noise was 0.01% (2 standard deviations) while the difference between MYSTIC and disort was still smaller than 0.01% from which we conclude that MYSTIC and disort were equal within 95% confidence. If we had run 1E11 photons the noise would have decreased to 0.001% and maybe we would then have seen a systematic difference exceeding 2 standard deviations but 1E11 photons would cost in the order of 10-20 CPU days.

R: 13444:14-17: of course, this method will run into some troubles in boxes/layers that have no absorbers at the wavelength of interest (division by zero). Presumably the code has some protection against this?

A: Indeed, the method will run into troubles when there is no absorption. But for our application this case never occurred because the actinic flux was only evaluated at

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wavelengths where photolysis occurs, that is, where the absorption cross section is larger than zero. In case that the actinic flux has evaluated at a non-absorbing wavelength, a tiny test-absorber needs to be introduced (small enough not to affect the result). The method allows to use nearly arbitrarily small test absorptions without introducing numerical noise.

R: 13446/8-10: the seasonal variation of peroxy radicals is a poor proxy for the very well known seasonal variation in UV radiation. Suggest deleting this sentence.

A: We followed the suggestion.

R: 13454/19-21: presumably this increase is ABOVE or IN the clouds.

A: The increase is related to the region above the clouds. Changed.

R: Table 1: What is meant by cloud amount? Is it fractional area coverage?

A: Yes, the cloud amount represents here the fractional area coverage of the clouds. Changed.

R: Editorial suggestions: 13421/3: replace "Beneath" with "In addition to" 13426/26: replace "lead" with "led" 13429/23: Units should include Watts (W m-2 nm-1) 13434/23: "data mining" is redundant 13434/26: replace "make" with "makes" 13435/3: delete "resulting from radiant fluxes" (redundant, and what exactly is a radiant flux?) 13435/8: what is meant by "high level"? can delete? 13436/23: replace "(That is solid)" with "(i.e. solid)" 13437/20: replace "was" with "were" 13442/11: replace "data was" with "data were" 13442/27: replace "were" with "was" 13445/4: place a comma "," after algorithm 13445/26: meaning of acronym APOLLO was already defined at 12442/15-16. 13448/9: the sentence "...agree within the uncertainty limit where they coincide." seems odd. Perhaps "...agree within the uncertainty limit at wavelengths where they overlap." 13453/2: replace "were" with "was" 13453/9: replace "agree" with "agrees" Fig.7, titles on top of panels should read "photolysis frequency" not "flux density" Fig.9 caption: replace "airborned" with "airborne". Also "turkoise" with "turquoise"

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A: We have adopted all editorial suggestions. We also changed the titles on the top panels of Figure 8 for consistency.

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