

Interactive comment on “Experimental and modeled UV erythema irradiance under overcast conditions: the role of cloud optical depth” by M. Antón et al.

Anonymous Referee #1

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The authors describe an interesting new method to estimate erythema irradiance under cloudy skies. Like in previous approaches, erythema irradiance under cloudy skies is calculated by multiplying clear-sky erythema irradiance with a cloud modification factor (CMF). However, instead of relying on empirical methods to estimate the value of CMF, the authors use cloud optical depth determined by the AERONET “cloud mode” algorithm to determine the effect of clouds on erythema UV. This method has the advantage that it is not affected by human subjectivity. For example, when cloud attenuation is estimated from visual observations of cloud cover, the result depends on the experience of the observer. The method proposed by the authors can be implemented operationally, resulting in a higher data yield than many alternative approaches.

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The main disadvantage of the method is that it can only be used for optically thick clouds (cloud optical depth (COD) larger than 15) over vegetated (green) surfaces. In addition, the accuracy of the method is limited by the accuracy of the AERONET COD data. Results presented by the authors suggest that AERONET overestimates COD. However, since the AERONET “cloud mode” has only been developed recently, there is hope that the retrieval method will be refined, which in turn would reduce the uncertainty of calculating CMF values from AERONET COD data. For example, AERONET reports COD in the visible and future algorithms may afford the calculation of CODs in the UV from AERONET measurements.

The methods used by the authors are scientifically sound, however, I wished that the term “significant” was used more carefully. Rather than saying that a given effect is “not significant” it would be better to quantify the uncertainty that the effect has on the outcome of a measurement or simulation. Examples of inappropriate uses of “significant” are provided in the Specific Remarks section.

I recommend publication of the manuscript, provided that my comments below are addressed appropriately.

Specific Remarks:

P21243, L4: delete “human beings because they are involved in” (otherwise it sounds as if photochemical processes throughout the atmosphere have a direct effect on humans and that this effect is the most important one for human well being).

P21243, L4: change “dispersion” to “scattering”

P21244, L29: it should be mentioned here that the measurement of cloud optical depth is an indirect method for the large optical depths (e.g. COD > 10) discussed in this paper because the attenuation of the direct solar beam cannot be determined. (In contrast, the measurement of aerosol optical depth is straight forward because the attenuation of direct sun light can be directly measured with sun photometers).

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P21246, L20: the sentence “AERONET COD are retrieved from the average of the ratios of the difference to the sum of two zenith radiances at 440 and 870 nm (ten ratios in 1.5 min).” is incomprehensible. Please split into two or three sentences and explain unambiguously.

P21246, L22: Please explain what is meant with “standard ground-based flux method”. Provide a reference if available.

P21246, L23: Please explain what algorithm is meant with “This algorithm”

P21246, L27: It is stated that the algorithm requires the presence of “green vegetation”. This is a rather relative statement. How much “green vegetation” is required? In the following line, the albedo for 440 nm and 870 nm is specified, but not for a green wavelength (e.g. 555 nm). For example, what would be the minimum albedo at 555 nm required for implementing the method?

P21251, L12 (and P21242, L14): With respect to the sentence: “... suggests that the radiative transfer code overestimates the clear-sky experimental data.” This implies that the reason for the difference is the radiative transfer code. This may not be true. For example, on P21246, L2, the authors state that their instrument was calibrated against a Brewer spectroradiometer that has an uncertainty of 7%. It is therefore quite possible that the code is correct and the measurements are too small. The sentence discussing the discrepancy between measurements and model should be phrased more carefully. I also like to point out that most model input parameters are identical for UVER^{cloudy_mod} and UVER^{clear_mod}. So if the model values really were too high (for example, because OMI ozone were biased low), these errors would cancel when calculating CMF_{mod}.

P21253, L12 - L 23: The authors conclude that variation of the model parameters “effective droplet radius”, “geometrical thickness of the cloud” and “altitude of the cloud” introduce no “significant systematic error in simulating cloudy UVER data”. I disagree. Figure 3 clearly shows that these parameters have a systematic (non-random) effect,

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which I would consider significant. Rather than saying that the effect is not significant, the authors should quantify the uncertainty (in absolute and relative terms) in the retrieved CMF values (as a function of COD) resulting from using fixed cloud parameters. The use of “significant” in P21253, L12 is also not appropriate. A better word would be “important”.

Comments to language:

P21242, L18 and P21255, L25: change “main responsible” to “main reason responsible”

P21243, L2: change “reduced” to “small”

P21246, L6: change: “is designed to the retrieval” to “is designed for the retrieval”

P21246, L6:: delete “exclusively”

P21246, L19: change “change” to “changes”

P21246, L23: change: “difference around” to “difference of around”

P21252, L4: rephrase to “Geometrical depth of the cloud layer is evaluated by means of four different thicknesses: 1 km (Scenario A.1), 2 km (Scenario A.2), 3 km (Scenario A.3) and 4 km (Scenario A.4). The height of the cloud bottom was set to 2 km above sea level and the effective radius of cloud droplets was set to 10 μ m for all four cases.

P21253, L6: change to: “... cloud height. The relative differences... scenario are smaller than 5% for the ...”

P21253, L15: change “whether” to “when” (although the whole sentence needs rework, see my comments in the Specific Remarks section).

P21253, L28: change “...visible wavelengths (440 and 870 nm), being here...” to “...visible wavelengths (440 and 870 nm). There are ...”

P21254, L21: change “...1%, being this” to “...1%. The model COD is the defective

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optical thickness resulting from the iteration.”

P21254, L29: change “reaches a large percentage of ” to “is”

P21256, L5: change “range, being known the. . .” to “range. The method exploits the wavelength-dependence of cloud scattering.”

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 21241, 2012.