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Atmospheric Measurement Techniques Discussions

Interactive comment on "Correcting spaceborne reflectivity measurements for application in solar ultraviolet radiation levels calculations at ground level" *by* P. N. den Outer et al.

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Reply to Referee 4

Thank you for carefully reading the manuscript and supplying us with detailed comments. We believe that in dealing with your comments, the clarity of the manuscript will be greatly improved. We will handle your objections successively. We copied part of each text block for identification purposes and wrote our reply directly underneath it.

"At the end of the introduction you define the focus of your paper..: 'Additionally, important health topics currently under debate are UV-induced production of vitamin-D and ... skin cancer caused by UV radiation. ... stand-alone cloud effect proxies are required

to address this topic.' Do you really define different cloud effect proxies in the present paper?"

Reply: We do not define different cloud effect proxies. We stress here that within the UV-research a 'stand-alone' cloud effect proxies is required, i.e. availability of a cloud proxy that can be applied to modeled clear sky effective UV values. Erythemal UV products, like the TOMS-UV, give much insight, but cannot be used for vitamin D productions or skin cancer risk assessments.

"The different time resolutions should be addressed: you use instantaneous satellite measurements to derive quantities (e.g. daily UV sums) for the whole day. This is in connection with the FOV resolution, but you should clearly explain it at the beginning and show the logical structure and the link between the different sections of your paper."

Reply: We present a discussion at the beginning of par. 3, the revised manuscript, however, will be written keeping this remark in mind.

"End of section 2: you have defined the data that you use. What about the aerosol effect? Is the CMF taking the aerosol effect totally into account? What is the accuracy?"

Reply: The focus is on cloud effect proxies to limit to size of the paper. Other interesting topics, e.g. variability due to aerosols, ozone (profile), where therefore not taken into account. We only have aerosol data for very limited number of stations and for relative short periods of time. The CMF includes little of the extinction induced by aerosols. Aerosols are often included by their climatology, which holds also for the satellite based UV-sums that are compared with the ground-based UV-measurements. A short discussion on the overall accuracy will be added. A more elaborated introduction on the use of ancillary data will be given, and a reference to the Den Outer et al. 2010 paper where essentially the same ancillary data has been utilized to produce the modeled data.

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"Sect. 2 A modeled daily UV sums => A modeled daily UV sum End of sect. 2.3. : : :the total number and WRDC stations: : :????"

Reply: We changed line 6, p 70 in: "The analysis includes 380k (93%), 140k(85%), 80k(70%) pairs of daily CMFs (spaceborne, ground-based) for the NIMBUS, EPTOMS and OMI period, respectively. Percentages indicate fractions with respect to the maximum number of pairs considering the time period and number of WRDC-stations."

"Sect. 3.: “The sky properties at mid day dominate because of the high solar elevation angle which delivers the largest portion of the total daily UV sum” What does the largest portion mean? Please give some numbers (in percent of daily sum)"

Reply: This is hard to summarize in a few lines since it strongly depends on the location and the day of the year. Also, one could argue that these numbers are or should be subject to cloud climatology. We will add a few numbers for clear sky conditions to give the reader a feel for what the "largest portion" can be.

"Please also specify what is a representative fraction of a cloud layer. Please give some examples of the movement of the clouds as a function of wind speed during a given time period and which FOV resolution you need to have these clouds in the FOV."

Reply: Unfortunately we do not fully grasp what the referee is requiring here. We believe that the answer to the referees question here is what we present as results in par. 3. We will better explain our way of thinking in this section. We come to the conclusion that an area of about 110km squared (1 degree lat.) yields the best correlations with ground-based observations of daily UV-sums. We term this area a representative fraction of the cloud layer overhead the UV-site. We then give a so-called "feel" for this particular area by calculation the average windspeed at 1350m for a Dutch meteorological site, supporting this observation. More research would require much more resources and is beyond the scope of the paper.

"Fig 5.: Have you written somewhere the connection between (1-LER) and Fsat?"

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Reply: This is generally defined at p66, L16, and more specifically in p73, L5. We will add this to the captions.

"I do not understand what you show in Fig. 6. Are the corresponding ground based CMFs of this subset (clipped data of OMICRF) satellite retrieved or measured? I think you should improve the explanations regarding this fig."

Reply: They are ground-based measured CMFs. We could say 'ground-based measured CMFs' at p74L29 and in the start of the caption of Fig 6 which then would read: "The subset of ground-based CMFs for which RCF = 0 is plotted (black symbols) as a function of SZA." In our paper 'ground-based' never indicates satellite derived quantities. See also p 66 L 16, at p.70 L11 we write "The GSI data is transformed to cloud modification factors by applying the algorithm described in Den Outer et al. (2005), and indicated as Fgb in the rest of this paper."

" You also need to explain in more details your 3 correction methods. E.g. how did you exactly correct to the one to one line. Did you divide the "fitting line" by 1?"

Reply: We will elaborate on the subject in the section where it is introduced.

"End of section 4.2. Discussion of fig. 8 is a little bit scarce. How good is the agreement in terms of per cent deviation. ..accuracy of the ground UV determination ...trends?

Reply: We will elaborate on this. However, we must keep in mind that the main focus of the paper is the consistency of LER as a cloud effect proxy. A list of absolute errors would draw the attention away from this and evoke also a discussion on the use and accuracy of the ancillary data. Therefore it was not included. Also a discussion on trends would have evoked similar discussions.

"My personal interpretation of fig 8 is that the Cor211 is the best. I think you should better explain which criteria you use to draw your conclusion regarding method Cor2A1."

Reply: A discussion will be added. A dependence of the agreement on the cloudiness itself is unwanted (i.e. the high overestimations shown in Fig 7 for CMF<0.3). A quanti-

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tative approach will be added to assess the "straightness" or "cloud cover independent" agreement.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 61, 2012.