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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 3

We thank the referee for carefully reading the manuscript and supplying us with detailed comments, and accompanying valuable discussions on the subject. 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.

"My general comment is that this is a valuable work, worth publication, but structural modifications may be required in order to justify the use of WRDC pyranometer data

as a benchmark for reflectivity validations, and to avoid attempting to cover everything from measurements, modeling, comparisons, long term trend etc. in one paper."

Reply: A discussion will be added that will touch upon the following: pyranometer should be maintained and calibrated, and thus caution should be taken to use pyranometers as the benchmark. However, a large number of pyranometers is compared with three spaceborne instruments. And the spaceborne instruments are compared with UV-radiation measurements. We focus on the CMFs, however a discussion on ancillary data, and other influencing topics like stratospheric ozone absorption can not be omitted.

"I think the work on homogenization and quality control of the WRDC pyranometer data, as well as the long-term change in cloudiness for Europe in itself is worth a paper. This would provide a stronger basis for the following paper analyzing spaceborne reflectivity measurements. This applies also to the quality of the UV measurements."

Reply: The homogenization of the WRDC data was part of a COST project. We do not describe how this was done. We happened to be in the same community and thus could make use of this data set.

"The modeling of surface UV at the selected sites with surface UV measurements takes cloud effects, surface albedo and total ozone into account, but how was aerosol effects implemented? How was surface albedo estimated?"

Reply: 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.

"A best fit UV model has been applied for the validation of reflectivity based UV doses. The best fit model was based on a weighting of 5 different UV models, including neural network models adapted to the selected UV stations. Is this best fit model applicable

for other climate regimes also, so the LER data set can be utilized globally?"

Reply: This is a bit beyond the scope of this paper. The participating UV models are not intrinsically restricted to Western Europe, but required input data should be available. The model intercomparison, as described in Den Outer et al., 2010, yielded long-term UV data records for each site. Each data record comprises a merge of all modeled and measured UV doses. Such a data record is now used to compare satellite derived UV radiation for periods prior to the start of the actual ground-based UV-measurements.

"In figure 6, selecting RCF=0, a scatter in CMF_gb is seen for large SZA, due to the effect of misinterpreting cloud reflections as cloud free case and enhanced surface albedo. I miss a further discussion on this, attempting to separate cloud effects from albedo effects in spaceborne reflectivity measurements."

Reply: A more elaborated discussion will be given on this subject. However, we could not check whether our statement considering the misinterpretation is really the case since we do not produce the RCF-product or have the resources and access to produce the RCF ourselves. Nor is the actual data set on snow cover used for the RCF-algorithm provided. Additionally, we do not have ground-based observations of snow cover for all eighty WRDC-stations. We do observe, however, that the subset for which holds: RCF=0 and SZA>55 degrees, the data points that scatter correspond to ground-based measurements in winter and early spring. Other reasons than cloudiness are not easily found for pyranometers to deliver values for Fgb considerable smaller than one, also considering the large number of pyranometers we used for this study. Hence, we conclude that these data points belong to actual cloudy days. Now the only assignment left is the snow cover. Only a reflection (as measured by spaceborne instrument) that is erroneously attributed to snow cover instead of to clouds will lead to the observed effect. The cited webpage {http://acdb-ext.gsfc.nasa.gov/People/Joiner/OMCLDRR_README.htm} states however "Over snow/ice, the processing quality flag bit 5 is set to 1, and the cloud fraction is assigned to 1". The number of data points with 1 in our retrieved datasets is

just far too little, which makes this statement unlikely. Additionally, from a "UV-radiation protection" point of view it does not make sense to assign a '1' to RCF for snow covered surfaces.

"As far as I understand (page 72 lines 16-17) the measurements of LER is close to local noon whereas the groundbased CMF is based on daily sum of pyranometer data. If so, the time is not quite representative, and the paper discusses this in relation with cloud transport across the FOV. I would imagine using overpass time for selecting CMF_gb would improve the correlation with LER. Is this actually the case?"

Reply: We do not directly expect that selecting CMF-gb at time of the overpass automatically improves the correlation. In the introduction of section 3 we write 'The agreement of overpass data with a UV irradiance measurement at the time of overpass will not improve automatically when the FOV is narrowed. UV irradiance measurements have a large contribution of scattered radiation, even on cloudless days it is around 50 %, and a large area surrounding the site, 10–30 km, is of influence. The presence of clouds in the whole hemisphere is of importance and not only the clouds at zenith or in the direction of the sun. Decreasing the FOV would lead to assigning erroneously only the overhead clouds to be of influence.' But the main argument not to explore in this direction is that our objective is to obtain daily sums of UV-radiation. Daily sums are the building blocks for long-term assessments of UV-radiation on heath and environment.

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