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Interactive comment on "TEMIS UV product validation using NILU-UV ground-based measurements in Thessaloniki, Greece" *by* Melina-Maria Zempila et al.

Anonymous Referee #1

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General comments.

The manuscript by Zempila et al. describes the validation of TEMIS UV products (specifically daily doses for erythemal UV, Vitamin D production, and DNA-damage) with ground-based measurements at Thessaloniki, Greece. Ground-based measurements are from a multi-filter radiometer, which was calibrated against a Brewer spectrophotometer using a Neural Network (NN) technique. The NN model appears to have been developed specifically for the purpose of the paper. It presents by itself a laudable addition to the suite of methods used for measuring solar radiation at the Earth's surface. The description of the NN method alone warrants publication. Comparisons of the NN model's output with Brewer measurements and measurements of a YES UVB-1

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radiometer indicate that the technique works as intended, resulting in only small biases and random variations.

The topic of the paper is relevant to the audience of ACP, and the method applied are scientifically sound. I therefore recommend publication of the manuscript, provided that my general and specific comments below are taken into consideration.

Some rationale should be provided why TEMIS data were evaluated with NILU-UV measurements and not directly with Brewer measurements, which should be the most accurate. While the calibration of NILU-UV measurements against the Brewer measurement with the NN technique is a very interesting novel approach, it involves an extra step leading to an increase in the uncertainty of ground-based measurements. I realize that that NILU-UV data have much larger temporal resolution than Brewer measurements but it is not clear whether this is important considering that only daily dose data from TEMIS were evaluated. For example, are there large gaps in Brewer measurements, which would favor the NILU-UV data set? Is there an analysis that shows that the high temporal resolution of the NILU-UV data is critical for satellite data validation?

Differences between instruments are often given with a 0.01% precision. Considering that the uncertainties of all datasets are much larger, I suggest to round percentages to 0.1% throughout the paper, including the figures. This would also improve the readability of the text.

Specific comments

P2, L7: The sentence "Furthermore ..." is confusing. It implies that the production of Vitamin D is detrimental. Mention the benefits of Vitamin D and then discuss that there may be an ideal UV exposure, which balances the harmful and beneficial effects of UV radiation!

P3, L30: I note that the 1987 CIE norm for the UV index has been updated. See: Webb, Ann R., Harry Slaper, Peter Koepke, and Alois W. Schmalwieser. "Know your standard: clarifying the CIE erythema action spectrum." Photochemistry and photobiology 87, no. 2 (2011): 483-486. for details. Considering that TEMIS uses the old (1987) norm, it is OK to use this norm throughout the paper, but the new norm could be mentioned.

P4, L9: I note that the action spectrum for DNA damage suggested by Setlow (1974) is only defined for wavelengths up to 365 nm. The parameterization by Bernhard and Seckmeyer (1997), which was based on a suggestion by the NDSC steering committee (now NDACC), uses 370 as the terminal wavelength. In contrast, the spectrum drawn in Figure 1 goes up to 400 nm. The difference between the longest wavelength (365, 370, or 400 nm) is not negligible because additional contributions from the UV-A decrease the sensitivity to ozone considerably. The authors should ensure that the definition used by TEMIS is identical to that used in their work. Because the list of authors also includes colleagues that are involved in creating new versions of TEMIS products, I suggest that they carefully consider the latest definitions of the erythemal, DNA-damage, and Vitamin D action spectra when preparing a new TEMIS version.

P4, L13: Please specify the wavelength shift!

P5, L6: No. Equation (1) already defines the UV Index. So either delete this sentence or define Eq. (1) and the subsequent descriptions at erythemally weighted irradiance. In the following sentence, UVD should be calculated by integrating the erythemally weighted irradiance instead of integrating the UVI.

P5, L9: If a cloud fraction within a 0.5° x 0.5° grid cell is defined, the resolution of the satellite must be much better than 0.5° x 0.5°. What is it?

Eq. (4) is curious. If Ag is zero, fA should be 1. Yet it is 0.9775. When Ag is 1 (e.g., pristine new snow), it should be about 1.5 for erythemally weighted irradiance, yet it is only 1.3. Because Eq. (4) is part of the TEMIS code, it cannot be changed, however, it should be pointed out that the equation (which was empirically derived from measurements at two urban sites) may not be a good parameterization for large parts of the area relevant to the TEMIS UV product, which includes Scandinavia.

P6, L25: “are less than 5.6%”. Delete “less than”. (The concept of “uncertainty” defines a distribution (typically normal) and 5.6% defines the width of that distribution.)

L6, L33: According to the text, only UVB-1 data were corrected for the degradation of the instrument’s absolute spectral response. According to my knowledge, also NILU-UV instruments are subject to drifts. If the NILU-UV channels have drifted, as I suspect, a paragraph should be included in the manuscript describing how these drifts were corrected. How often was their calibration adjusted based on comparison with the Brewer? When comparing with the Brewer, did you take into consideration that the time associated with the Brewer measurements is different for every wavelength and did you interpolate NILU-UV measurements to the times of Brewer measurements?

Section 3.2.1: Follow-up to the previous comment: what was the time associated with a effective doses calculated from the Brewer measurements? Since a Brewer spectrum takes several minutes to record, the time is ambiguous.

Figure 2: Replace “mu” in legend with “Average”

P9, L3: What is the variable “n”?. Line 12 suggests that n is the total number of data records. However, if log(n)ˆ1.5 = 36, n would be about 8E10 or 80 billion. This number must greatly exceed the number of NILU-UV data records!

First paragraph Section 3.2.3: The description of the calculation of effective Vitamin D dose could be improved. For example: (1) Calculate effective dose for the response function of the UVB-1 (2) Convert this instrument response function weighted dose to erythemal dose taking into account SZA and total ozone (e.g., as described on page 6, line 29). (3) Convert erythemal dose to Vitamin D dose using the parameterization suggested by Fioletov et al. (2009). (4) Apply correction (Eq. (5)).

P11, L9: The empirical relationship for DNA-damage effective dose is indeed very complex. What was the idea behind this complicated parameterization?

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Eq. (6): In the second term, replace UVI with CIE.

Eq. (8): The term CIEˆ3 appears twice, with coefficient a4 and with coefficient a6. This makes little sense. CIEˆ3 should only appear one with the coefficient a4+a6= -0.0354.

P13, L10: Delete “exact”

Figure 5: The seasonal variation in 2011 appears to be much stronger than in other years. What is the reason? Wildfires? Perhaps there is something interesting that could be learned!

P15, L10 “. . .respectively.” > “. . .respectively (Figure 7).”

P17, L7 and Figure 8: The right side of Figure 8 only shows 5 discontinuities. I would expect many more if cloud information is updated every half hour, as the text indicates.

P17, L13: How were cloud-free data characterized? What dataset was used to determine sky condition?

P19, L8 and Figure 10, and P22, L6: I don’t see much difference in the slope for AOD < 0.4 and > 0.4. Perhaps the difference would become more obvious if the symbol size in Figure 10 were to be reduced.

Appendix A: Please specify the numbers of s1 and s2 (or the range if the numbers are not constant).

Technical corrections:

While the quality of the language is generally good, many sentences are too long and this affects the readability. Whenever possible and appropriate, the authors should reduce the length of sentences and split them in two.

P2, L5: Change “UV sunlight” to “solar radiation in the UV range”. By definition, “light” should only be used to describe wavelengths visible to the human eye.

P2, L6: Delete “extreme”. Mutations can technically be triggered by only one photon.

P3, L5: “. . . product services started in the 2003 and . . .”

P3, L13: “following for example changes in the operationally assimilated . . .2003) which were initially based on the . . ..and later on GOME-2 . . .”

P3, L20: “. . .SEVIRI instruments that have been operational. . .”

P3, L32: “The UVI-CIE is given as a dimensionless number . . .”

P4, L16: ‘bare’? Finding a better word is indeed challenging. Perhaps: raw, uncorrected, approximate, first-guess. . .

P4, L17: “. . . is then calculated from UVI’ by . . .”

P6, L10: “. . . triangular-like slit resulting in a bandwidth of 0.55 nm FWHM.

L6, L13: higher SZA > larger SZA (so not to confuse with “higher Sun”)

P9, L21 and figure 3: I don’t see any change in the colors of between a training fraction of 50% and 90%, consistent with the text. So if the proportion of training data has almost no effect, why is it so important to discuss this and include a figure? Is your point to illustrate that that your results are basically independent of t/n? The left figure could be simplified by plotting MSE versus the number of neurons.

P9, L33: “ballpark” > “rough” or “approximate”

P15, L10: datasets are > datasets is

P18, L7: either of the > all

P18, L11: Move “on average” to end of sentence.

P19, L24: “in the” > of

P21, L25: moments > periods

P21, L28: “limits the dataset by almost 75%” > “make up only 25% of the dataset” (if that’s what you want to say)

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