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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modelling UV irradiances on arbitrarily oriented surfaces: effects of sky obstructions" *by* M. Hess and P. Koepke

M. Hess and P. Koepke

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We appreciate very much the constructive criticisms of both reviewers. We accounted for all and in addition the new version of the manuscript has been revised by a native English speaker.

Anonymous Referee #1

General comments ————————-

A method is introduced that principially allows for a calculation of UV irradiances on oriented surfaces and under conditions where the sky is obscured by natural or man-made structures. Consistency checks have been performed to test the model. Two examples are presented that illustrate the application potential of the method.

The paper is well structured and the tool seems to be useful for the simulation of various

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conditions, although the concluding phrase: '... allows to model ... UV irradiances for all(!) applications relevant to biological systems' appears a little bit jaunty.

We agree and improved this point

The authors claim that the method represents a suitable tool for systematic studies.

From a practical point of view and in order to further underline the usefulness of the model it would certainly be interesting to know more about possible concrete applications in the field of environment, public health, and consumer protection:

- Which are the most important environmental conditions that can practically be handled, i.e. also with respect to a manageable compilation of the model input?

These points now are mentioned at the end of chapter 2.3

- Who are the main end-users, user groups, user institutions, or services that could benefit from this tool and corresponding modification factors?

This question is answered at the end of the introduction

- Where are the limits of the model? For example, is it really possible to account for all cloud conditions?

Clouds now are discussed as an obstructing object.

- Wouldn't it be useful to perform a further comparison with results of a 3-d radiative transfer model for a given input? At least since the authors state that they have upgraded a 1-d model by introducing 3-d effects.

This recommendation is beyond the idea of the paper and is planned to be performed with an appropriate co-author in a further publication.

I recommend publication after adding substance that refer to these points. Above all this would open up the new perspectives in a more coherent way. Please take also into account the following remarks. I further recommend that the paper is read by a native

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English speaker.

We followed this suggestion

Specific comments ——————

Page 3365, Chapt. 2.5, last paragraph: Please make clearer the second sentence. In the second measuring series of the sky obstruction and tilt modification factor starting at 9.25 UT I see an increase of the SOTMF with increasing distance that is smaller than the calculated SOTMF, correct ?

This paragraph has been rewritten

Page 3366, 2. paragraph: Formulation could be clearer, for example: In other azimuth directions where the average angles of incidence relative to the mountain surface facets are larger lower UV radiances are resulting.

We changed the text following the suggestions

Page 3367, Chapt. 3.1, Figure 5: In case of snow cover the maximum SOTMF is shifted to about 9.5 UTC. Probably also a 3-d effect which could briefly be explained.

The reasons for the asymmetry now are discussed in more detail

Page 3368, 4. paragraph, last sentence: Please formulate it more clearly.

The sentence has been improved

Minor and Technical comments ——————————-

- Figure 1: It would be advantageous to have the information that AA = 0 deg corresponds to south also in the Figure caption.

- Chapter 2.3 'SKOP': Brackets under b) are redundant

- Page 3365, 3. paragraph: GMT has meanwhile be replaced by UTC (Universal Time Coordinated). Please use UTC.

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We decided to use Central European Time to get maximum Sun height close to noon

- Page 3368, 3. paragraph: Please write '...between 9 and 10 UTC, ...'

- Figure 7c, caption: Please write '... for the Munich street canyon ...'

- Please write '... erythemally weighted ...'

Improved

Anonymous Referee #2

This paper gives a relevant contribution to the knowledge of the assessment of personal exposure to UV irradiation in various environments. The paper presents a new computation procedure, based on a chain of radiation models that allows simulating UV irradiances (in terms of UV Index) on anyhow inclined and oriented surfaces. Additionally the proposed procedure takes also into consideration the sky obstruction due to objects like mountains as well as buildings. Particularly important is the fact that the procedure allows to compute a modification factor ("Sky Obstruction and Tilt Modification Factor", SOTMF) that allows to compute in a more realistic way UV Index values of tilted and eventually shadowed surfaces on the basis of horizontal values. Only minor revisions (listed hereafter) will be necessary for the publication of this paper.

For the benefit of the reader and of possible users it would be useful to give indications about the computer characteristics required as well as the computation time for each single run.

The information has been added.

The spectral resolution of the radiative models (5 nm) appears quite close to the limit considered acceptable in terms of accuracy of the outputs.

Some results have been recalculated with a spectral resolution of o.5 nm. The differences are less than 1.5 % and even lower for the modification factors, be-

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cause they are the ratio between two radiation quantities which have been modeled with the same spectral resolution. The effect is mentioned in the text,

Comments on Fig. 2. It should be defined in the text the relative position of the receiving surface respect to the wall in terms of the distance of the receiver from the wall and its height respect to the top of the wall. The indications given in the figure caption (the receiver is positioned “half of the sky”) may not be clear enough.

The information has been improved

Comments on Fig. 3. How is explained the difference between simulated and measured values when the sensor was at 0.07 m from the wall and the fact that with the sensor at 0.07 m from the wall it measured two different values of SOTFM (0.84 at 9.25 and 0.8 at 9.5) while the models indicate the same value of 0.8?

This paragraph has been rewritten

Page 3365 line 12: it would be helpful to add the solar zenith angle at which measurements were performed.

Page 3365 line 13: it should be worth to clearly state that the sensor was in front of the south looking face of the wall.

It should also be specified that the receiving surface of the sensor was positioned horizontally.

Text improved

Is there any reason to use two different terms in the text (wall reflectivity) and in the legend (wall albedo) of Fig. 3?

No, sorry, improved

Comments on Fig. 4. There is a discrepancy between the figure caption (13:00 GTM) and the text (12:00 GTM) (page 3366 line 18) concerning the time of the simulation.

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In the figure the area with the higher value of radiance is centred at a value of about 40_ ZA that is quite different from the ZA of 25.4_ indicated in the text (page 3366 line 18).

The time difference was a mistake which now is improved, and time changed to CET. The maximum of the irradiance lies at the position of the Sun, which however is not in the center of the orange area. Unfortunately it could hardly be seen due to the selection of the changing colours with respect to increasing radiation. It has been improved in a new figure 4.

Comments on Fig. 5. It would be worth to stress the asymmetry of the diurnal curve of SOTMF shown in this figure that is likely due to the different contribution of the east and west side of the mountains. Moreover it is remarkable the additional effect of the mountain albedo: the asymmetry increases, in fact, with increasing of the mountain albedo. This behaviour is likely due to the orographic configuration of the area.

The text has been improved

In the conclusions it is recommended not to refer to trees as object whose interference with UV radiation is assessed by the proposed models combination. In this case in fact it should be necessary to consider also the partial transparency of the tree canopy that is not considered by the models.

The idea of the reviewer is correct. This way of partial transparency we used in an earlier paper on UV radiation in a plant stand (Schween and Koepke, 2005, Modelling the UV-exposure within a plant stand during a vegetation period, Meteor. Z. 14(2), 129 – 135) However, with respect to the time that has to be considered for UV-effects and the permanent movement of the leaves, a description of the obstruction due to trees by an average transparency larger than zero seems to be adequate.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 3357, 2008.