Atmos. Meas. Tech. Discuss., 4, C42–C45, 2011
www.atmos-meas-tech-discuss.net/4/C42/2011/


**Atmospheric Measurement Techniques Discussions**

# *Interactive comment on* "Surface solar irradiance from SCIAMACHY measurements: algorithm and validation" *by* P. Wang et al.

**Anonymous Referee #2**

Received and published: 17 February 2011

The paper describes a new algorithm to calculate broadband surface solar irradiance from Sciamachy satellite measurements. Results of the method are compared with data of the BSRN network of pyranometers and the International Satellite Cloud Climatology Project. The new dataset introduced by the authors is a welcome addition to the pool of surface irradiance data. The topic is appropriate for AMT, and I recommend publication after considering the following minor comments:

Introduction, page 3: It should be better described how the EUMETSAT CM-SAT and Heliosat algorithms relate to (1) the algorithm described in the paper and (2) the "Pinker and Laszlo" algorithm introduced earlier in the introduction. For example, the authors could state early in the introduction that their method is based on algorithms a, b, and c, etc., before they start describing these algorithms and their method in more detail.



Page 3, line 22: At this point it is not clear how the "cloud index" is defined. This is confusing. Mention that the definition is provided in Section 2.1.2.

Page 6: At the top of page 6, the authors mention that cloud parameters can either be retrieved from oxygen absorption spectra (I presume the oxygen A Band) or from polarization measurements. They then introduce the FRESCO algorithm. It should be made clear how this algorithm relates to the earlier works by Koelemeijer et al., 2001; Kokhanovsky et al., 2006; Acarreta et al., 2004; Loyola, 2004; and Grzegorski et al., 2006 cited earlier. For example, does the FRESCO algorithm take polarization measurements into account or is it only based on Koelemeijer et al., 2001 while the other references just indicate that the problem can also be tackled with a different approach?

Page 6, lines 10-19: This section is difficult to understand and should be rephrased. For example, how is the cloud albedo value estimated "properly"? What happens if the assumption of the cloud albedo value does not match the albedo of the real cloud? Are there calculations to determine the sensitivity of the algorithm to the initial choice of the albedo value? What does "effective" mean in "effective cloud index"?

Page 10, Equation (4): Change "0.2" to "-0.2". Also, albedo can only be between 0 and 1. If the "cloud index" is interpreted as albedo, it should also range between 0 and 1. Eq. (2) confirms this. (When it is completely cloudy, R equals R_max, and n becomes one. In turn, if the scene is cloud free R equals R_min and n comes 0.) How can n become smaller than -0.2 (Eq. (4) after correction) or larger than 1.1 (Eq. (7))? I understand that surface irradiance under scattered clouds can become larger than the clear-sky irradiance, but I don't understand how this observation is considered in the calculation of n (Eq. (2)) or c (Eq. (3)). Also, how can cloud enhancement (i.e. k>1) be interpreted in the context of the independent pixel approximation where the contributions of the clear and cloudy fractions of the pixel are treated independently and combined in a linear fashion?

Page 12, lines 3-5: Please make clear that the choice of input data for water vapor column density, aerosol optical thickness, single scattering albedo, and broadband surface albedo is discussed in Section 2.4.

Page 14, line 15: It is stated that all climatological databases are based on monthly mean data. Does that mean that the same dataset is for applied every year? For example, is the ancillary dataset for the month of July applied to Sciamachy July data regardless of the year, or does the ancillary dataset change from year to year? Also, how sensitive are the retrieved surface irradiance values to variations of the actual values from the monthly mean? It might be interesting to calculate one months of data using daily averages and compare to results obtained with the monthly average.

Page 16, line 21 ("...because the FRESCO effective cloud fraction is not accurate over bright surfaces in deserts due to the surface albedo problem ..."): That basically means that the FRESCO algorithm cannot be trusted over desert areas, such as the Sahara. If so, this should be mentioned in the Conclusions.

Figure 7 and Figure 9: The color scales are linear, not logarithmic.

Table 1: What are the values in the second column (BSRN W/m2)? Is it the average of all measurements that were used for Figures 5 and 6?

Page 27, line 14: Why would low temporal resolution cause a systematic negative bias?

Technical comments:

Page 5, line 15: Define LT (i.e., local time)

Page 9, line 10: Change "Define.." to "By defining..."

Page 11, lines 17-19: Delete "the" in "the correction formulas and parameterizations" as these formulas and parameterizations have not been introduced yet.

Page 25, line 5: Change "required detailed cloud parameters as input, which is com-



pletely different as the Heliosat method." to "that requires detailed cloud parameters as input, which is completely different from the Heliosat method."

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Interactive comment on Atmos. Meas. Tech. Discuss., 4, 873, 2011.