

Reply to Review #2 of the manuscript “Determination of circumsolar radiation from Meteosat Second Generation”

We would like to thank the referee for the constructive comments. Some valid questions concerning the performance of our method were raised in the review. We hope the following answers are able to resolve these concerns. In the following reviewer comments are *italic*.

In my opinion the validation part is however weak: 1) In the validation section is not shown that an improvement has been obtained by using the Baum v3.5. 2) Only the diurnal variations of CSR during three chosen days showing satellite retrieved CSR and SAM retrieved CSR are shown. The agreement is not that impressive. The reader may ask himself whether the good agreement was obtained by chance or whether it may also be seen on other days. The comparison on the second day (6. June 2011) which is shown is not satisfying at all. 3) A mean absolute deviation of 0.07 was obtained. Considering the absolute values of the CSR between 0.01 and 0.45, I am personally not convinced that this shows a “good agreement”. 4) Are the assumptions regarding the cloud optical characteristics also valid for Winter time?

General remark: Meanwhile a time series of 1 year length (May 2011 – Apr. 2012) of processed ground measurements is available. Accordingly the validation was extended from roughly 200 data pairs to approximately 2000 data pairs. The validation measures did not change excessively, though (see Tab. 1 in this document).

The manual screening for sub-scale water clouds was limited to a shorter period of two months (May and June 2011).

In the following we would like to address your points individually.

1) In the validation section is not shown that an improvement has been obtained by using the Baum v3.5.

After the evaluation of the short time series of approximately one month’s length as in the discussion paper the “Baum v3.5” optical properties seemed favourable due to smaller MAD, RMSD and bias compared to “Baum v2.0”, although the differences are not excessive. Now that we have evaluated one year of data it is not really evident which optical property dataset is to be

Table 1: Results of the comparison of CSR measured from ground and retrieved from SEVIRI for different setups: Rank correlation $r_{\text{rank,CSR}}$, Pearson correlation r_{CSR} , mean absolute deviation MAD, root mean square deviation RMSD, bias and the number of compared data pairs N . Values in parenthesis show the results for the short time series as originally presented in the discussion paper.

Optical Properties	$r_{\text{rank,CSR}}$	r_{CSR}	MAD	RMSD	Bias	N
Baum v2.0	0.54 (0.60)	0.50 (0.53)	0.11 (0.12)	0.16 (0.16)	4% (39%)	2021 (208)
Baum v3.5	0.48 (0.54)	0.44 (0.44)	0.11 (0.10)	0.15 (0.14)	-11% (11%)	1890 (194)

preferred. None optimizes all validation measures. One can assess however that the new “Baum v3.5” optical properties yield lower CSR values by tendency than “Baum v2.0”. The text was changed accordingly (Abstract, Sec.3.3 and Conclusions) with the preference for “Baum v3.5” removed.

2) Only the diurnal variations of CSR during three chosen days showing satellite retrieved CSR and SAM retrieved CSR are shown. The agreement is not that impressive. The reader may ask himself whether the good agreement was obtained by chance or whether it may also be seen on other days. The comparison on the second day (6. June 2011) which is shown is not satisfying at all.

We have chosen these days since they offer some continuous time periods with thin cirrus clouds which allows to see a temporal evolution compared to other days where only few data points are scattered over the day. Certainly such choice is always subjective but as you already suggested, the second day, for example, was certainly not chosen for its outstanding agreement between the two datasets.

However to dispel any concerns regarding a subjective selection of the presented data, we updated the figure. Thereby we objectively selected the three days which contain the most data pairs. We limit ourselves to the time period Mai 2011 – June 2011 to allow a comparison between the manually filtered and original time series. This way the days 11 May, 05 June and 11 June with 107 of the 407 data pairs in total were selected for display.

One can see that the satellite retrieval in general produces a temporal evolution like the ground measurements, however with timing and amplitude

errors. Our interpretation of the plot is that a good share of the scatter between the satellite retrieved and ground measured values stems from collocation errors. Of course the method may also fail due to water cloud contamination, partial cloud cover, false cloud detections or false a priori assumptions in the cloud property retrieval.

The paragraph introducing the corresponding figure with the time series plots was rephrased and moved further down.

3) A mean absolute deviation of 0.07 was obtained. Considering the absolute values of the CSR between 0.01 and 0.45, I am personally not convinced that this shows a “good agreement”.

The text was changed to “A validation of retrieved CSR values with SAM based measurements shows that considerable errors must be expected if instantaneous values are compared [...] Nevertheless the frequency distribution of the satellite derived CSR is in good agreement with the ground measurements if the two “Baum” optical properties were used.”

4) Are the assumptions regarding the cloud optical characteristics also valid for Winter time?

We have no information about the cloud particle composition or their change with the seasons. The satellite retrieval is with high probability more error prone in winter time as the mean sun zenith angle is larger than in summer. One might also speculate over more low level clouds below cirrus during winter time than during summer time compromising the results. However, we have no indication that the method per se fails during winter time. The validation measures for the whole year are not that much different from the ones for May and June 2011.

Some figures dealing with the validation e.g. one x-y graph (SAM retrieved CSR vs satellite retrieved CSR) should be added.

We added a scatter plot for the period May–June 2011 showing data with and without manual screening. In general the scatter is large. If the circumsolar radiation at a certain moment is required large errors must be expected. The manual cloud screening reduces the scatter somewhat.

I also think that some figures showing the differences between Baum 3.5 and Baum 2.0 (eg. Fig. 6 or 7, or fig. 10) could be removed instead.

Figure 6 was removed.

The Baum v2.0 results should be included in the validation.

“Baum v2.0” is now considered in the validation measures tables, the scatter plot and the histograms.

The mean relative deviation should also be considered.

Both, the SAM time series and the satellite derived time series, show a large dynamic range. At times extremely high relative deviations can therefore occur, in particular for very low CSR values. The maximum of the relative deviation, for example, is in the order of one million percent. Its sensitivity to outliers renders the mean relative deviation meaningless in this context. However, we have calculated the median relative deviation which is more robust in regard to outliers.

I agree that fig. 12 showing the frequency distribution of CSR may be of importance for the solar energy community. I do however not think that this is sufficient for a model validation. Do we really need such a sophisticated model only to show a frequency distribution?

We have compared a CSR parameterization by Neumann et al. (1998) to the SAM results. Neumann et al. (1998) developed this parameterization by regression from simultaneous DNI, GHI and CSR measurements. Therefore it is only applicable where local DNI and GHI measurements are available while our method can be applied at any location in the field of view of Meteosat Second Generation (MSG). We tested the parameterization by Neumann et al. (1998) which is given by Eq. (1) with DNI/GHI measurements performed next to the SAM instrument.

$$\text{CSR} = 70 - 65.948 \cdot \frac{\text{DNI}}{\text{GHI}} \cdot \frac{(90^\circ - \theta_{\text{sun}})^{0.669}}{15.822} \quad (1)$$

It turns out that this regression model provides higher correlation values (0.86) than our method. This comes to little surprise as collocation errors are avoided by the parameterization. However, the shape of the histogram differs distinctly from the one calculated for the SAM measurements. To be fair, it should be noted however, that the model of Neumann et al. (1998) was established not for cirrus covered skies alone. Nevertheless, it is remarkable that the presented method to derive circumsolar radiation from MSG measurements which is based on physical principles alone and not in anyway tuned to measurements produces a CSR distribution which exhibits a low bias and a similar histogram to the measurements. The histogram shown

in this document (Fig. 1) including the values obtained from the Neumann et al. (1998) parameterization shows that this is not a matter of course.

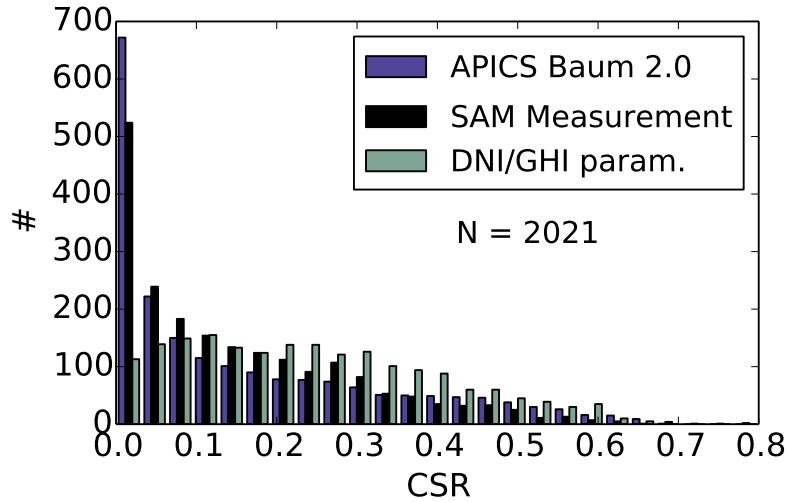


Figure 1: Histograms of the circumsolar ratio (CSR) time series measured by SAM and retrieved from SEVIRI used for the validation (2.5° field of view, not manually cumulus screened). In grey the histogram obtained from the CSR parameterization from Neumann et al. (1998) (Eq. 1) applied to DNI/GHI measurements next to the SAM instrument is shown.

p.5846: this simplifications => these simplifications

Corrected.

Some sentences such as “Please not that our definition of. . . “ are very close to spoken language. The paper is often written in first person plural. Third person single would be more appropriate. Editorial language check is required.

The manuscript was revised accordingly.

In the figure captions the acronyms should be written out so that the figures are self explaining.

This advice was implemented wherever practical.

Bibliography

A. Neumann, B. von der Au, and P. Heller. Measurements of Circumsolar Radiation at the Plataforma Solar (Spain) and in Cologne (Germany). In Proc. of Int. Solar Energy Conf. Solar Engineering. ASME, 1998.