

Review comments on
“Validating global horizontal irradiance retrievals
from Meteosat SEVIRI at increased spatial
resolution against a dense network of
ground-based observations” by Wiltink *et. al.*

Summary and contributions

The authors present a global horizontal irradiance (GHI) retrieval based on measurements with the MSG-SEVIRI at high resolution (HR) of $1 \times 1 \text{ km}^2$ compared to its standard resolution (SR) of $3 \times 3 \text{ km}^2$. With the aid of MSG-SEVIRI's High-Resolution Visible (HRV) channel GHI is downscaled. The accuracy of the HR retrieval compared to its SR retrieval is validated against a dense network of ground-based pyranometer observations. Additionally, the sensitivity of the results to temporal and spatial averaging and its dependence on cloud regimes is studied in detail.

Various algorithms to retrieve GHI from satellite measurements exist, to my knowledge however, incorporating the spatial information of the HRV channel to increase resolution of GHI retrieval was never considered. The results are sufficient to support the most interpretations/conclusions and are likely to be highly relevant for solar photovoltaic applications, climate and weather evaluations, as well as for scientific applications as cloud-radiation studies.

The manuscript provides a contribution to methodology that can be transferred to other satellite instruments, e.g. the Advanced Baseline Imager or the Advanced Himawari Imager. It is well-organized and scientific results and conclusions are presented in a clear, concise, and well-structured way. In my view after some minor changes, the presented work is worth publishing in 'Atmospheric Measurement Techniques'. Please find my detailed comments below.

General Comments:

- 1) The authors introduce abbreviations such as SR, which stands for standard resolution, HR (high resolution). Please check text and be consistent using the abbreviations. Also, different abbreviation versions appear but mean the same, eg:
 - i) MSG SEVIRI
 - ii) MSG-SEVIRI
 - iii) SEVIRI
 - iv) Meteosat SEVIRI
- 2) Following international agreements (IUAP document U.I.P.20 and others), the representation of physical units has been defined by corresponding standards. Correct practice for representing units in figure is using round brackets. Square brackets around a unit are incorrect, although this is still a widespread custom. Please take this standard into account in all figures. If a physical quantity has no unit remove brackets.
- 3) The first paragraph in subsection 4.1 (lines 246-250) describes methodology. Lines 274-284 (subsection 4.1) as well as lines 404-411 (subsection 4.4) discuss findings. Please, consider moving the paragraphs to their respective sections.
- 4) Captions of Figures 3, 4, 5, 8, and 10 describe mostly the same (box-and-whisker plots of ...) Please consider to shorten the captions. For example: "The same as in Figure 3 but for ..."

Specific Comments

- 1) page 1, line 6: ground observation → ground-based observations
- 2) page 2, line 29: "... from national measurement networks." Please give a citation or an example
- 3) page 2, line 38: (MSG) → (MSG; Schmetz et al., 2002)
- 4) page 3, line 61: "... HR SEVIRI retrieval ..." → HR retrieval
- 5) page 3, line 72: HD(CP)² stands for?
- 6) page 4, line 87: global horizontal irradiance = GRI
- 7) page 4, line 88: extremely rare limit (ERL; give citation)
- 8) page 4, line 88-89: "...used, given ..." → used, and given
- 9) page 4, equation 1: punctuation mark
- 10) page 4, line 91: "... are not plausible ..." → "give some reasons"

- 11) page 4, line 94: "... reduction of roughly 5 to 10 % in the number of valid sensors." I wonder how all the 99 sensors (data points referring to e.g. Fig. 3) can be in one box-and-whisker plot?
- 12) page 4, line 97: Satellite data → Geostationary satellite data
- 13) page 4, line 98: ... we make use of the data from the MSG weather satellites ...
- 14) page 5, line 104-105: insert the sentence "The Meteosat satellites ..." inbetween "(EUMETSAT)." and "Four satellites" on page 4 line 99
- 15) page 5, line 112: Please consider highlighting the 31 HR pixels in Fig. 1 or at least mention in section 2.2 that only those HR pixels have been used that include valid pyranometers.
- 16) page 5, line 124: GEO stands for?
- 17) page 5, line 127: NWP stand for?
- 18) page 5, line 128: 2.2.2 Cloud Physical Properties (CPP)
- 19) page 5, line 129: write only CPP algorithm
- 20) page 6, line 142: 2.2.3 Solar Irradiance under Clear and Cloudy Skies (SICCS)
- 21) page 6, line 143: write only SICCS
- 22) page 7, line 168: punctuation mark
- 23) page 7, line 185: SEVIRI retrievals → MSG-retrievals or satellite retrievals? Check the following pages.
- 24) page 8, Table 1: shift to section 3.2.1
- 25) page 11, line 247: The authors described, by visual inspection the amount of valid sensors is reduced by roughly 5-10%. I wonder how the RMSE was computed for each of the 99 sensors?
- 26) page 13, line 278: is diminished → diminishes?
- 27) page 13, line 286: "... half daily averages." A day has 24 hours. Half a day has 12 hours. There is no half-daily average. The authors maybe like to highlight on the approx. 6-hourly average. Furthermore, the averaging time 'daily' in Fig. 4 refers probably to the daytime average?
- 28) page 15, line 307: The clear sky (Fig. 5a) and overcast (Fig. 5c) days ...
- 29) page 15, line 313: non-significant vs insignificant (e.g. figure captions)
- 30) page 15, line 333: ... Belgium (not shown).
- 31) page 18, line 359: ... reach values above ...

- 32) page 19, line 381: judge → decide
- 33) page 19, line 385: Separating → Sorting
- 34) page 19, lines 389-390: I wonder what your expectations were?
- 35) page 20, lines 392-393: So basically it is not the cirrostratus cloud regime itself, which is the most spatially and temporally varying one (page 19, lines 389-390). It is due to the variability of underlying clouds, if I understand correctly? May the authors add a comment on that.
- 36) page 20, line 412: "When the different CRAAS regimes are compared, ..." → Comparing the different CRAAS regimes, ...
- 37) page 21, line 431: either write (Madhavan et al, 2016) or ... by Madhavan et al. (2016).
- 38) page 21, line 452: remove "anyway"
- 39) page 457: "... is much smaller ..." → negligible
- 40) page 23, line 474: "The relative ..." The meaning of the sentence is unclear to me.
- 41) page 23, line 479: ... as is explained next.
- 42) page 24, line 516: the RMSE of the HR retrieval is smaller than the SR retrieval?
- 43) page 25, line 519: For the latter condition, ... ?
- 44) page 26, 555: The authors describe they examined the probability density distribution of daily averaged irradiances for many days, but it seems to me they show in Fig. A1 (upper right panel) the absolute frequency of observations (Count). Please clarify.
- 45) page 30, line 565: remove "presented in this paper"
- 46) page 30, line 567: Meteosat SEVIRI vs. MSG-SEVIRI
- 47) page 30, line 569: remove Schmetz et al. (2002)
- 48) page 30, line 570: remove NWCSAF (2021)
- 49) page 30, line 571: remove Carrer et al. (2018)
- 50) page 30, line 572: remove Gschwind et al. (2019); Inness et al. (2019)
- 51) page 30, line 574: remove Tzallas et al. (2022)
- 52) page 31, line 602: Check hyperlink
- 53) page 31, line 609: provide the DOI

- 54) page 32, line 626: provide a hyperlink or DOI
- 55) page 33, line 690: Journal or publisher is missing
- 56) page 34, line 697-999: Journal or publisher is missing
- 57) page 34, line 701: Provide a hiperling to the ATBD
- 58) page 34, line 713: proof if the publication is still a preprint

Comments referring to Figures

- 1) Figure 1: at the lower bound the SR and HR pixels are cropped. Please show the pixels
- 2) Figure 2: On a printout the light-green and green dots are hardly to distinguish. The authors perhaps make use of different markers, e.g. dots vs triangles
- 3) Figure 3, caption: The authors describe that dotted lines around the annotation boxes indicate that the difference between HR and SR is insignificant at a 95% confidence level according to the Mood median test. However in the figure there is no dotted line visible at all.
- 4) Figure 5, caption: High-Resolution (SEVIRI-HR) and ... see comment on abbreviations
- 5) Figure 6, upper left and lower right panel: I wonder if the yaxis (upper left panel) and the xaxis (lower right panel) shows the relative or the absolute frequency? What do the dashed curves stand for? Is it probability? The authors may consider removing the dashed curves, because they are not described in the text.
- 6) Figure 6, upper right panel: The authors my consider adjusting the colorbar limits to the extrema of the difference in correlation between HR and SR in order to use the full color range. Also, there is difference between
 - i) Correlation HR-SR, and
 - ii) difference in correlation between HR and SR
 Please clarify.
- 7) Figure 7, panels b, f, j, n: The \tilde{J}_4 domain is hardly visible. The authors my consider to mark it in green or red.
- 8) Figure 8, xaxis labels: The authors mix in the labels the number of observations (Nobs - absolute frequency) with relative frequency (given in percent). Please clarify.
- 9) Figure 9, caption: see comment on Figure 5
- 10) Figure 9, caption: Last sentence, remove "adopted elsewhere in this study"

- 11) Figure 10, caption: see comment on Figure 5 and 9
- 12) Figure 10: The authors may consider to adjust the yaxis limits in order to increase the box-and-whiskers, e.g. [10 60]. Figure A1, upper right panel: Please clarify which quantity is shown, the absolute, relative frequency or the probability density (unit?).
- 13) Figure A2: The authors may consider to remove the xaxis label, because the tick-labels show a date. There is no need to mention Time [-]
- 14) Figure A3: see comment on Figure A2. Also, the authors may consider using white instead of black to illustrate invalid data.