ESSD https://doi.org/10.5194/essd-2024-91

RC1: 'Comment on essd-2024-91', Anonymous Referee #1, 10 May 2024 reply

The described surface solar radiation climate data records (CDR) product SARAH is important and helpful for understanding the climate system, model evaluation, renewable energy application, etc. This preprint introduces a new version, SARAH-3, which updates the CDRs and motivates and explains new updates in the applied methods and their impact. The preprint is very well written and illustrated, but I have some questions and suggest some minor improvements to be made.

- Abstract: the reader would like to see the covered region here already (SARAH is not global)

A: Thanks for the comment. Yes, it is important to mention early on that SARAH-3 is not global. This information will be added to the abstract.

- Abstract: Name the seven parameters of Climate Data Records explicitly here for clarity, as you mention Interim CDRS later in the abstract.

A: Yes, we will name all seven parameters already in the abstract.

- Introduction: for some applications, it might be helpful to use a fitting top-of-atmosphere CDRs dataset. Can the authors suggest a data set?

A: Thanks for this question. There is the global CM SAF CLARA-A3 (DOI) data record available which includes top-of-atmosphere fluxes but is given on different spatio-temporal resolution. There is also the CMSAF “Top of Atmosphere Radiation MVIRI/SEVIRI Data Record” (https://doi.org/10.5676/EUM_SAF_CM/TOA_MET/V001) data record providing daily and monthly means for Feb 1983 to April 2015. This data is one the same spatial resolution covering a slightly larger area. A publication analyzing CM SAF surface and top-of-atmosphere solar radiation is given in the references (Pfeifroth et al., 2018.)

- Line 78: -> "SARAH-3 paramters, abbr & units". It sounds strange that "units are included" in the dataset.

A: Will be revised ro read: “Parameters included in SARAH-3, incl. their abbreviations and units

- Sec. 2.1: Is there no reference available for HelSnow?

A: Unfortunately, there is no dedicated reference for HelSnow available. HelSnow is first introduced and explained in this publication.

- Line 114: Why no units? What is 160? I guess pixels, but guessing is risky. So, is the displacement speed more than 160 pixels/30 min in the case of MVIRI?

A: You are right, Thank You for this comment! – we forgot to add some essential explanations concerning the numbers. Indeed, the unit of the optical flow speed generally is pixels per image sequence (30min in this case). For our application we wanted to have

much more contrast at low speeds, so the resulting optical flow speed in truncated at 1 and stored as 8-bit greyscale image with a maximum value of 255. This means a value 255 corresponds to an optical flow speed of 1 pixel/30 min, and a threshold value of 160 for MVIRI corresponds to a speed of 160/255 ~ 0.63 pixel/30 min. As for SEVIRI the native pixel size of the visible channels is larger, the speed threshold is reduced accordingly to 112/255 ~ 0.44 pixel/30 min. In other words, the threshold used for the optical flow speed is quite low in order to assure clouds are excluded from the snow detection process. These explanations will be added to the updated manuscript.

- Figure 3: units? What is optical flow (a term from image processing?)? Displacement?

A: Thanks for this comment. “Optical Flow” indeed is a term from image processing. It is method that can detect a change of objects from one image to another. One output of “Optical Flow” is the speed of an object or pattern from one time step to the next in units of pixels per image sequence. Different “Optical Flow” Methods are related functionalities are included in the OpenCV software library, which is used for HelSnow. We will add some general information to the manuscript.

- Sec. 2.1.: Is snow ageing and thus the change of snow albedo of relevance? Even considered?

A: Thanks for this comment. You are touching an important point. Actually, it is of special importance not only if there is snow but also how the snow albedo is like. As HelSnow tries to detect snow every day, snow ageing can be detected (in case of clear-sky) and is then considered in HelSnow. However, the snow albedo is kept constant in case no surface (snow) detection is possible.

- Line 146: How much would the results degrade if ERA5 snow-cover were used (after interpolation)? In other words, what is the quantitative added value of HelSnow?

A: The snow mask of HelSnow is of lower accuracy compared to the snow coverage given by ERA-5, which is partly due to the fact the snow can only observed during clear-sky situations. The advantage of using HelSnow is not only to have a snow mask but to also have the actually observed snow reflectivity for each pixel which and time. For example, snow in the forest appears much darker than snow on grassland. The actual snow reflectivity is important to estimate a reasonable effective cloud albedo (CAL).

- Line 187: SID = ??? How derived?

A: For the calculation of SID we would like to refer to Müller et al., 2015 and Skartveit, A., Olseth, J.A. and Tuft, M.A. (1998) An Hourly Diffuse Fraction Model with Correction for Variability and Surface Albedo. Solar Energy, 63, 173-183. We will point to these references for SID in the revised manuscript.

- Do you use ERA5-Land snow cover? The ERA5_Land snow cover does not assimilate snow observations! ERA5 does, but not in complex terrain.

A: Thank you for the valuable comment. Yes, we are using ERA5-Land snow cover for the SARAH-3 CDR. The high spatial resolution and reasonable quality were suited for our purposes.

- Sec. 2.5.4: Is a change in aerosol concentration over time considered? MACC does not

cover the entire SARAH period? How can you discuss trends without including AOD change? A reference for MACC?

A: A reference to MACC will be added to the manuscript. Yes, in SARAH-3 we are using a monthly climatology of aerosol information. This means the direct aerosol effect is constant over time. The indirect aerosol effects (brighter clouds longer lifetime of clouds in case of more aerosols) are included through the clouds itself. Assuming the SARAH-3 data record is homogeneous over time, the surface radiation trend would be underestimated assuming there is a negative trend in aerosol concentration. Overall, we see that for Europe the trends in surface irradiance between SARAH-3 and surface reference measurements fairly agree (see Figures 14 and 15) which indicates that the direct aerosol effect plays a minor role for the observed surface irradiance trends. The majority of trends and decadal variability seems to be cause by changes of clouds. The observed underestimation on the trend in SARAH-3 of 0.6 W/m2 trend might be due to missed direct aerosol effect.

- Table 3: Strassburg -> Strasbourg?

A: Thanks for the comment. Will be changed accordingly in the updated manuscript.

- Line 379: "and its functions"?

A: Thanks. Will be corrected in the updated manuscript.

- Figure 11: Absolute Bias is called MAD elsewhere?

A: Thanks for the comment. We try to be consistent throughout the manuscript. “Absolute Bias” and “MAD” (Mean Absolute Difference) are synonyms. We will go through the manuscript to stick to a consistent wording in the revised version.

- The references list needs to be sorted and, therefore, difficult to check.

A: Thank You for the comment. We will re-order the reference list to be in alphabetic order.