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

**RC3**: 'Comment on essd-2024-91', Anonymous Referee #3, 10 June 2024 reply

This article presents a concise and well-written overview of the theoretical basis and updates of the latest release of the SARAH climate data record. The article is a very useful source of reference information for potential users of this dataset and falls well within the scope of ESSD. There are a few minor points (in addition to/partly overlapping with the points mentioned by the other reviewers), which I ask the authors to address prior to publication.

A: Thank You very much for your constructive review and the positive feedback.

List of minor points:

* Abstract: language- and information-wise, I think that the abstract can still be improved. Specifically, I suggest to mention all parameters included in SARAH-3 (or at least the newly added ones?) and to explicitely mention the start data of the dataset. I do also think that the term SARAH-3 is used to frequently. The mention of „ICDR / near-real time processing“ directly before the statement „enabling climate monitoring applications“ seems mis-leading, as the near-real time extension of the data record is not really crucial for climate applications. The phrase „The SARAH.3 climate analysis reveals“ seems la strange start of this senetence (is this a „standardized“ analysis?). „good accuracy and stability“: can you give quantitative numbers here, e.g. for SSR?

A**:** Thank You for these constructive comments concerning the abstract. We will try to improve the writing, by giving some more fundamentals of the data record (parameters, start of data record, etc.). In our understanding a typical climate monitoring application is to calculate the anomaly of last month/year, and this would not be possible without having the continuous consistent extension of the time series. That’s way “climate monitoring” is mentioned close to the availability of the ICDR. We will also add some quantitative numbers.

* ICDR: I think the distinction between the CDR and ICDR needs to be described in more detail, including giving some guidance for users of this data record. While the start of the ICDR period is mentioned twice, this is still somewhat hidden in the description of meta-data, and I recommend to dedicate a paragraph to this at the start of Section 2. What is the plan/time-line for updating periods now covered by the ICDR to CDR-quality processing? If one is interested in climate trends, when should one wait for the availability of the CDR instead of calculating trends based on the spliced CDR/ICDR?

A: We agree that the description of the ICDR has been relatively short, and we will add some more information on it in the revised manuscript. There will be no update of the ICDR to CDR. The important thing is, that the ICDR-quality does not fall behind the CDR-quality. The ICDR extends the CDR as long as a new CDR will be available, which will likely will be extended by an ICDR as well. As far as we can see, trends based on CDR+ICDR data are valid, but a dedicated validation is recommended when the transition from CDR to ICDR is included in the time series. More information on the data validation and quality of the SARAH-3 CDR and ICDR can also be found in the SARAH-3 Validation Report via www.cmsaf.eu.

* L55: „All CM SAF data records are freely available without restrictions.“ While I am not a lawyer, I do not think this statement is true. Specifically, the clause to acknowledge EUMETSAT in the CMSAF license is a restriction as far as I can see (even if a very weak one), or not?! Please check/correct this aspect. (see https://cds.climate.copernicus.eu/api/v2/terms/static/eumetsat-cm-saf.pdf )

A: Thank You for pointing us to this aspect. We shall add the information about the need to acknowledge EUMETSAT CM SAF when used. The phrase “without restricitons” will be removed in the revised manuscript. The correct phrasing from the CM SAF website cmsaf.eu is “All intellectual property rights of the CM SAF products belong to EUMETSAT. The use of these products is granted to every interested user, free of charge. If you wish to use these products, EUMETSAT's copyright credit must be shown by displaying the words "copyright (year) EUMETSAT" on each of the products used.” Detailed information on the EUMETSAT license can be found here: https://www.eumetsat.int/data-policy/eumetsat-data-policy.pdf#download=1

* As mentioned in the introduction, homogeneity is a key goal for CDRs. Do you see any impact of transitioning to MSG? Can you also discuss aspects where sensor limitiation affect the algorithm choices. I guess you could have used the 1.6um channel for snow detection from SEVIRI. Does the difference in spatial resolutions between Metesat first and second generation have an impact?

A: Yes, homogeneity is very important for a CDR. We have not seen any major inhomogeneities in the MFG-MSG transition. However, a recent not yet published study by Ruben Urracca just found that there is a small inhomogeneity on the seasonal scale likely related to the MFG-MSG transition, which diminishes on the annual scale. Indeed, sticking to the visible-channel(s)-only-approach is also done for the sake of consistency and homogeneity, as there have been only very limited channels onboard the first METEOSAT generations satellite instrument MVIRI. The different spatial resolutions do not seem to have an impact on the temporal stability.

* I found it surprising that optical flow is used to identify snow in HelSnow, by an exclusion logic (i.e. if it moves, it cannot be snow). Did you consider using a constraint on temporal constancy instead (if reflectivity does not change significantly in time, it must be snow)? In addition, what window size and other parameter settings are used for inferring the optical flow?

A: Thank You for this comment. We did not use the temporal constancy to identify snow. This might be an option for future development, but due to the different illuminations (sun – satellite constellations) ich might be difficult to make use of this criteria. Further also the snow coverage might change of time, especially in case of a thin snow cover or in forest or urban areas, where snow falls down the leaves or is actively removed. For the optical flow we used the Farnebeack algorithm with standard settings through the OpenCV.org software library: “calcOpticalFlowFarneback(prevgray, gray, flow, 0.5, 3, 15, 3, 5, 1.2, 0);”, See https://docs.opencv.org/4.x/dc/d6b/group__video__track.html#ga5d10ebbd59fe09c5f650289ec0ece5af

* While I know PAR, I did not know the term DAL before. Can you please add some additional explanations what these parameters are used for/what spectral weighting is used?

A: DAL (Daylight) is a parameter that comes in [Lux] and is defined as the brightness the human eye is observing. It is a quantity that can serve the infrastructure planning user group like architects. Figure 6 (right) shows the weighting of the spectral bands to derive DAL. Daylight is defined and described here: https://cie.co.at/publications/daylight; Spectral information on Daylight can be found here: http://www.cvrl.org/

* Figure 9: I suggest to replace the SARAH2 image by a difference image (or add this as 3rd panel). I found it hard to quickly identify differences and think a difference image would help to highlight regions with significant changes.

A: Thanks for the suggestion. However, we think that the absolute values in Figure 9 in SARAH-3 and SARAH-2 reasonably show, together with the station data (dots), the better correspondence of SARAH-3 and the stations. We think that it makes sense to keep the 3rd (bottom left) plot as it easily shows the improvement of SARAH-3 over SARAH-2. Figure 9 bottom right shows that the derived snow mask nicely corresponds to the station observations. For better identification of the region of interest we propose to highlight that region by a circle in the updated manuscript.

* Larger context and outlook: I missed a reference to the comprehensive review of Huang et al., 2019 (*). For readers, it could provide additonal context, in particular with respect to your method and their section on „Current problems“. Can you add some thoughts on future improvements of SARAH? How will SARAH-3 be affected by the transition to MTG? (*) https://doi.org/10.1016/j.rse.2019.111371

A: Thank You for this values comment. We will refer to the comprehensive paper by Huang et al., 2019. We will also add some more information about future improvements of SARAH and the transition to MTG. In short, we plan to extend the spatial coverage by using also other geostationary satellites than METEOSAT prime. A main purpose of the CM SAF is the generation of long-term, homogenous data records and therefore we will continue to rely on the MVIRI-channel heritage. Developments are ongoing to assure a smooth transition to MTG. As Huang et al., 2019 also points out, a combined multi-satellite multi-platform global data record is a long-term goal.