

Review of essd-2019-146: A Fundamental climate data record of SMMR, SSM/I, and SSMIS brightness temperatures by Fennig et al.

This paper introduces an homogeneized and inter-calibrated data record of conically scanning passive microwave radiometer brightness temperature data covering 1978 – 2015. The paper provides a thorough description of the various steps involved, an analysis of the random and systematic uncertainties, and some results of an evaluation. The dataset itself is already made available by the CM SAF, along with ample documentation (ATBD, PUM, Validation Report). Although most of the material in the paper is extracted from the documentation, the paper is useful as a one-stop-shop reference.

The manuscript is very clear and comprehensive, and -as a user of the data record- I can only praise the attention to details and thoroughness of the paper. I highly recommend the publication of this manuscript in ESSD.

I include below some comments that will hopefully be useful for improving the manuscript further.

High-level comment:

The manuscript explains very well how the data record is prepared (ATBD), give some example of evaluation results (Validation Report) but does not touch into how to use the product (PUM). A PUM exists so this is not critical, but I would still encourage the authors to add a short section describing what the data record consists of (e.g. daily aggregated files per sensor, use of groups in the netCDF files, quality flags, etc...).

Along those lines, as a user of the dataset, it took me some time to understand that the data read from the netCDF files was the homogeneized (but NOT intercalibrated) data, and that an extra step was required to build the intercalibrated record. You have in this paper the opportunity to clearly (re-)state what the data files contain, and how to use them (adding the various correction layers). This terminology (homogenised, inter-calibrated) is anyway needed to understand the evaluation results, e.g. in Figure 8. Maybe the same terms can appear on Figure 1?

Detailed minor comments:

Line 35: This is the 1st time you introduce CM SAF. Define the acronym, or refer to the FCDR differently.

Line 60: Suggest to rephrase (“This is not the only FCDR of passive microwave radiometry...”).

Line 61: remove “respective”

Line 66: “This” data record... The GPM one, or the CM SAF one?

Line 72: please finalize your introduction with: 1) a discussion as to why the CM SAF FCDR was at all needed when others exist (e.g. wasn't the Wentz FCDR non-traceable and not free?) and 2) a short introduction to the structure of your paper.

Line 89: the high-frequency channels of F08 went bad quickly, maybe this can be noted here?

Line 90: Please note that the “footprint” is an instantaneous field-of-view. Also that you refer to the diameters of the 3dB ellipses. Cross- and along-track terminology could be introduced.

Line 106: F19 being launch in 2014 (before the end of the FCDR), your statement in the Abstract (“all SSM/I and SSMIS instruments”) is not strictly correct. But this is probably ok.

Line 197: Suggest to refer here to section 3.4 for further details on the sea-ice concentration and masking.

Line 283: Could you add a reference/citation for the 13 leap seconds?

Line 285: “It can take up to 7 days before a leap second is introduced to the data record” is this in the original RDR? Also, at how many occasions (out of 13) was the leap second introduced inconsistently between observation and ephemeris? If not many, mention the years?

Line 314: Consider changing heading to “Antenna pattern matching for high-frequency channels”.

Line 315: Change “it is important” to something like “it can be desirable”... many data producers choose to retain the high(er) resolution of the channels, at the cost of increase retrieval uncertainties.

Line 320: remove comma after “both”

Line 557: the «fence is working well»: add «(not shown here)» in this sentence already.

Line 674: Suggest to change header to «Intercalibration of sensors»

Line 683: please add a citation/reference for the F11 wind retrieval stability results.

Line 698: «highly elliptical orbit» (HEO) is often used for a spacecraft with Molniya orbit. Re-formulate to «orbit with higher ellipticity» ?

Line 716: Use the exact frequencies for the instruments. Do we really want to mention 85 GHz here (SSMIS had 91 GHz)? Re-formulate so that to make clear what you do with the high-frequency channels.

Eq 25: Can you name what the «#» Ts are? Should you add a sentence below this equation to re-name the various terms? For example $\langle T^h \rangle$ is defined in Eq 6 which was quite some pages ago.

Eq 26: I could not find other occurrences of «APC» used as an operator in the text, and am unsure what APC(T#A) means in practice. Does T^{ic} means «inter-calibrated»? By adding text around Eq 25 and 26 you will help the reader.

L736: «on the lower SSMI(S) resolutions» do you mean «frequencies» here?

L742: Should the two sentences: «This selection of TBs uses the Earth ... thus no extrapolation is required.» be moved at the end of the paragraph? Currently they seem to fall in the middle of the description of your matchup-database (first described as morning/afternoon maps, then to monthly).

L744: would it be more correct to say that «little interpolation is needed»? One could imagine that the averaging in monthly 1x1deg grids will dampen extremes that will be (slightly) outside the vicarious calibration range...

L751: so if I understand correctly, the ocean scenes entering the inter-calibration (cold vicarious target) use the angle correction, but not the sea-ice or land (hot vicarious target). I suggest you add a sentence to make this explicit to the reader, and maybe discuss why this is a viable approach.

L781: So contrarily to SSMI(S) only a cold vicarious calibration target is used, correct?

L1046: where does the range 0.7 K to 1.1 K comes from? Add a citation, or a cross-reference to one of your sections.

L1037: «EIA normalisation and diurnal cycle». I get what the EIA normalization is, but what is the correction for diurnal cycle? Where is it described?

L1038 to L1064: a suggestion is to refer to Figure(s) from the ATBD when referring to «not shown» results.

L1065: suggestion to rename this heading to something like «double differences for SMMR» (I am aware SSM/I_{F08} results are shown, but the core is SMMR?).

L1156: This is commented here, but should probably be addressed at an early stage in the manuscript. What do you mean with RDR exactly? Is it the SSM/I and SSMIS data you first accessed as a source to building your FCDR? Can you refer to it with a

L1171: ... and Lavergne et al. (2019) used the full FCDR for building their sea-ice concentration data record.

L1175: Since no AMSRs are currently on-board you could refer to the family of AMSRs rather than the specific AMSR-3 (which is not firmly committed at time of writing). An FCDR of AMSRs compatible with the SMMR+SSM/I+SSMIS CMSAF FCDR would be greatly beneficial for many applications, including sea-ice.

L1175: You spent a lot of efforts (and text) due to accessing Njoku's SMMR L1B (instead of T_as) which was a limitation to your harmonization process. Are you aware of plans for someone to release the «raw» SMMR data record, so that you could improve the first part of your FCDR? I would have added here some sentences calling for such a release, especially if (funded) data rescue activities must be activated.

L1250: you could add an acknowledgement for ERA20C.

Figure 2. Because some colors are rather similar (e.g. plum and violet) it would help if a legend box was added in the plot area. Consider using thicker lines.

Figure 2. What causes the up-and-down variations for some channels (seemingly the high-frequency ones). Is it because the along-scan correction is different for A- and B-scans? If the case, would it be better to show 2 lines per high-frequency channel? If needed, add a sentence L474 about this feature.

Figure 3, left panel. «The x-axis represents the time of the orbit start at ascending equator crossing». Is the x-axis with unit «day»? If so, add it. Did you consider using a red-gray-blue colormap to avoid the rainbow one? On right panel, thicker lines would help.

Figure 4, same remarks as Figure 3.

Figure 5, same remarks as Figure 2.

Figure 6, same remarks as Figure 3. In panel 6b you do not show sections that are detected by the Laplace filter, nor the smoothed spline. Is it intentional?

Figure 7, same remarks as Figure 2. According to the caption, you use cyan for h18 (horizontal pol) while you were using it for v19 (vertical pol) for SSM/I (Fig 2) and SSMIS (Fig 5). Is this intentional? It would be better to use the same colors for all sensors.

Figure 8: add a legend box for the line colors. I do not understand what the grey lines are. Do they show a spread value (1-standard deviation?) between the available sensors within one day, while the colored lines are the mean daily anomalies? Please clarify.

Figure 9 and 10: add a legend box for the line colors.