**Catherine Prigent (Referee #2)**

General comments:

This paper presents a detailed and careful analysis of the original observations from SMMR, SSMI and SSMIS, to produce a high quality Fundamental Climate Data Record of passive microwave brightness temperatures. It summarizes a long term effort from the Climate SAF group. This FCDR is widely used by the passive microwave community, for multiple applications including reanalysis exercises in NWP centers. The document is a very informative and well written description of the different steps needed to obtain the FCDR, with a clear and honest quantification of the errors. This paper has to be rapidly published, after minor corrections. Our group uses this FCDR extensively. We appreciate the quality of the data, as well as the responsiveness of the Climate SAF to answer any question related to the dataset.

Minor comments:

*Referee comment*

Sections 3.6.3 and 3.6.6. These subsections might be too detailed. The figures include a lot of information that is not fully explained (e.g., axis, color scales). It should be possible to improve these figures. The orbit position is mentioned several times in the text. In the legend of the figures it is called fractional revolution. Can you clarify?

*Author's response*

The orbit position in the figures 3, 4, and 6 is presented as fractional revolutions, measured from the start of the orbit, which is when the spacecraft crosses the equator from south to north until one revolution is finished. In the figures 3a, 4a, and 6a each image column is exactly one orbit with the start of the orbit as the x-axis and the fractional revolution (from one equator crossing to the next) on the y-axis. This is also mentioned in the caption of figure 3 where it is first used.

*Author's changes to the manuscript*

We will update the figures to add axis labelling and colour information where it is missing. See also RC1 comments regarding figures. We will also explain the term fractional revolution in section 3.6.2 where figure 3 is referenced.

*Referee comment*

P 23. DMSP F11 is used as the reference, with different reasons to justify this choice. However, it might be worth mentioning that the overpassing time of this instrument drifted significantly during its life time, with large time differences with F08, F10, F13, and F14 during their overlapping periods. That can have potential effects on the intercalibration, especially over land.

*Author's response*

Yes, there is a drift in the F11 overpass time. The drifting of all DMSP satellites is a general issue for the inter-calibration. We are minimizing the impact of the diurnal cycle in the homogenisation step of the inter-calibration.

*Author's changes to the manuscript*

We will mention the overpass drifting of the satellites and note the potential effects on the inter-calibration in section 5.

*Referee comment*

P 25. L 740. The warm surface types are only considered for their polarization differences. Checking the inter-calibration of the polarization differences over warm scene is certainly informative, but how can it make sure that the TbV and the TbH are independently correctly inter-calibrated from an instrument to the next? The warm and stable targets are usually selected over the Amazon forest that shows a very small polarization difference (both TbV and TbH warm). Over deserts, it would be possible to have rather high polarization difference with TbV high and consequently TbH rather low, but over deserts, the diurnal variation of the surface temperature is large and would make it very difficult to compare instruments that do not have the same overpassing times. As a consequence, it is difficult to understand how the inter-calibration takes into account the full temperature range, including the warm scenes. Can the authors elaborate on this point?

*Author's response*

The point raised here is actually the reason why the TB polarisation difference is used explicitly in the inter-calibration. The polarisation difference over land must be preserved during the inter-calibration. The inter-calibration offset and scale factors of TBh and TBv are therefore not independent. The TB polarisation difference term, which is used for all surface types, acts as a constraint to the scaling factor. As a consequence, the inter-calibration scaling factors and offsets are mainly determined over the ocean at the cold end of the natural variability but are constrained over the whole spectrum (cold ocean, warm land).

*Author's changes to the manuscript*

We will extend the explanation of the inter-calibration model in section 5.2.

*Referee comment*

P 37. L 1118. Uncertainty of the radiative transfer model due to scattering effects: : : Scattering can play a role, but limited for frequencies below ~50 GHz. Uncertainties are more likely due to the lack of realistic cloud and rain information to feed the radiative transfer model, for all cloud and rain effects (emission, attenuation, and scattering).

*Author's response*

We agree that the unknown atmospheric state to feed the RTM has a significant impact. From our experience with SSM/I data, a scattering effect is observable for 37GHz and higher frequencies.

*Author's changes to the manuscript*

We will add the unknown atmospheric state to the uncertainty description in section 7.3.

*Referee comment*

P 38. L 1149 1150. FCDR: : : includes all possible surface types: : : Would it be relevant to mention that over land the inter-calibration might be less robust than over ocean, given that some procedures are only applicable over ocean (L 712-714), and some others are only taking into account part of the warm scene signal (L 740)? A word of caution for the users of the FCDR over land could be helpful.

*Author's response*

Yes, you are right. We have mentioned this limitation in the documentation of the FCDR but missed to mention it in the paper.

*Author's changes to the manuscript*

We will add the information in section 8 to explain a higher uncertainty of the inter-calibration over land areas.

*Referee comment*

Figures 2 to 10 would certainly benefit from some additional work. The axes should be clarified, with mention of the units. The legend of the different line colors should be added to the figures.

*Author's response*

Yes, the figures 2 – 10 can be improved.

*Author's changes to the manuscript*

We will improve the figures by adding colour bars, units and axis legends where missing.

*Referee comment*

Technical corrections:

- P 5. The spatial resolution of the SMMR instrument is not mentioned, whereas this information is provided for the other instruments
- P 6. L 181. MD5 hash: can you provide a reference and / or a few words of explanation?
- P 9. L 268-270. Channel numbers are not used elsewhere. Better mention their frequencies?
- P 13. L 387. : : : each scan pair that passES the quality control: : :
- P 13. L 400. : : : Earth'S counts
- P 26. L 798. : : : trends cloud have been not accounted for: : : Rephrase?
- P 31. L 933. The on-orbit calibration IS: : :
- P 32. L 972. Instrument design (suppress the S).
- P 33. L 1009. A factor of 1.48. Where does this factor come from?
- P 35. L 1044. This means that most: : :.
- P 35. L 1052. : : : and showS very similar: : :
- P 35. L 1057. This variability is caused by: : : Which variability are the authors talking about? The increase variability with frequency or the fact that the H polarization variability is larger than the vertical one? Rephrase to clarify?
- P 37. L 1112. It was further shown that: : : suppress the coma.
- P 37. L 1133. It becomes clear that: : : suppress the coma.

*Author's response*

Thanks for the corrections.

*Author's changes to the manuscript*

We will modify the paper accordingly and correct/clarify these minor issues.