Response to review by anonymous referee #4

Opening remarks

We warmly thank the four anonymous referees and Tim Hewison for taking the time to review our manuscript and to provide valuable feedback. As there are commonalities between several of the reviews, we start with some general remarks.
To begin, we emphasise that our goal is not to encompass the entire AWS mission. First of all, this would be very challenging to cover within a standard manuscript length and would approximately double the number of co-authors. For example, the primary objective of AWS is numerical weather prediction (NWP), and addressing the aspects and applications of AWS within this area could be a manuscript in itself. The manuscript's aim is instead to provide the necessary information to understand the design of the AWS radiometer and to utilise the L1b data from this instrument. In the revision, we focus on improving the text around these aspects based on the provided feedback, as well as adding some new information.
A related question is how much in-orbit characterisation to include. Here, we hope to have an understanding of the difficulty of compiling the manuscript at the same time as the team is preoccupied with the satellite's commissioning phase. The initial aim was to submit the manuscript in 2024. In particular, the sudden deviating behaviour of the 174 GHz receiver (Sec. 6.3) caused significant concern and resulted in a substantial delay in the manuscript. Nevertheless, our approach is to include some initial basic results, primarily to indicate that the findings from the on-ground tests appear to be valid. We have added a sentence to exemplify this further and on the same time indicate the range of aspects that has to be considered. We avoid going further to leave room for one or several upcoming articles that are entirely focused on in-orbit testing. In addition, to fully cover the in-orbit testing would again require a considerable extension of the list of authors. This work is ongoing and far from complete. At least one update of the L1b processing algorithm is foreseen.
In summary, we find it reasonable to focus on the development of the instrument up to the launch. On this side, we think the manuscript is already more information-rich than usual. This brings us to an unstated objective. It is already difficult to find in the open literature the relevant background information about the satellite instruments we use for research. The trend towards new space and more substantial commercialisation risks making the situation worse; with this manuscript, we aim to demonstrate that this need not be the case.

The replies below refer to the revised version of the manuscript we have prepared.

Replies on referee's comments

- "Considering that the instrument has been on orbit for several months at the time this manuscript was submitted, I would expect more comprehensive on-orbit performance information than just the individual channel noise estimates. It would be useful to see these, along with comparisons to heritage instruments such as ATMS and MHS, to demonstrate the viability of the "new space", small satellite approach. Otherwise, this is an excellent and informative manuscript for users of AWS data."
    - We understand and appreciate the wish to learn more about AWS, but we argue against this extension as explained in the opening remarks.
- "Figure 13: It would be helpful to illustrate the locations of the AWS 3x and 4x channel bands in these plots."
    - We agree and have updated Figure 13 accordingly.
- "Line 215: It is mentioned that the instrument is designed to minimize geolocation error here, but no geolocation accuracy statistics are presented. Especially considering the novel feedhorn arrangement, this would be particularly useful to assess in this manuscript."
    - We don't claim that AWS is designed to minimize geolocation at an overall level, just that the placement of the star trackers is selected considering the thermo-elastic effects. In line with the Opening remarks, we don't go into details of the geolocation accuracy. There will be a dedicated journal article on the subject.
- "Lines 365-368: A lot of information is given here about parameters that are important for real-world radiometric accuracy and at the end of the paragraph, it is stated that the accuracy is better than 1 K for all channels. However, how exactly was this determined (e.g., how was non-linearity assessed, was the on-orbit thermal cycle modeled during the calibration testing, what on-orbit maneuvers were used to calculate spillover)?"
    - Sec 4.5 has been rewritten and hopefully better clarifies the approach and ambition of the tests.
- "Line 434: I believe this should be The impact of measured SRFs is hard to *assess*."
    - Yes, that was a mistake. However, the paragraph is now rewritten, in response to a comment by another referee.
- "Table 4: Are the on-orbit NEDT values also scaled to a 300 K scene? I would assume so but it is not explicitly stated. Also, are they derived from the variance of counts in the warm calibration sector, cold calibration sector, or both (and what receiver temperature was assumed)? Also, since it is mentioned in the Discussion section, it would be nice to have the striping index added to this

table, since that is a standard performance parameter for microwave radiometers."

- On request from several of the referees, the way NEDTs have been derived is now described (in Sec 4.4). The same calculation approach was used for on-ground and in-orbit data, clarified in Sec 6.2. The scaling to 300K was mentioned, but is now made clearer in Table 4. An assessment of striping we leave for future publications, as mentioned in the Opening remarks.