

# ***Interactive comment on “A review of sources of systematic errors and uncertainties in observations and simulations at 183GHz” by H  l  ne Brogniez et al.***

## **Anonymous Referee #1**

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Review of:

A review of sources of systematic errors and uncertainties in observations and simulations at 183 GHz

By Brogniez and co authors.

==== General comments

This paper nicely reviews the current understanding of an important issue in atmospheric science, namely substantial unexplained discrepancies between spectral observations of the atmospheric water vapor line at 183GHz and predictions of those observations based on independent measures of atmospheric water vapor (and other

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properties) and established radiative transfer models (driven by laboratory measured and, in some cases, field-validated spectroscopy information).

I am happy to recommend this paper for publication in AMT, though have some suggestions as to how to improve the clarity of these discussion in places. Most of these are detailed in the more specific comments below.

My only major comment is that I feel more discussion could be made of the potential sources of calibration error in the spaceborne instruments. Section 2.4 mainly focuses on field of view and channel shape calibration and gives little discussion of the important role of spectrally-varying radiometric calibration, a potentially important source that instrument teams should be alerted to.

Put briefly, all instruments have a non-linear Brightness Temperature (BT) to counts calibration curve. Naturally, instrument designs are optimized to keep as close as possible to the linear regime (with the the counts vs. BT curve only flattening out at far larger BTs than are expected to be observed). However, the degree of system non-linearity, however small, is dependent on the total brightness temperature seen across the entire receiver pass band, not that in individual channels. In other words, the calibration of an individual channel is dependent on the total signal seen across all channels (and, indeed, in regions in the receiver passband not covered by any measurement channels). It turns out that the approach taken in nearly all microwave instruments of calibrating against spectrally flat hot and cold targets completely masks this effect. In cases (such as the one discussed here) where a strong spectral line is being observed, the spectral shape distortion introduced by the gain compression effect can be a few K, far larger than the non-linearity that would be seen when looking at a spectrally flat black body target (typically 0.1 K or smaller) that is the simplistic test usually undertaken in pre-launch calibration.

While it is beyond the scope of this paper to discuss this issue in detail, I suggest that the authors mention this factor in section 2.3. In addition, I urge the nadir microwave

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community to investigate this source of calibration error in more detail. Including such a recommendation in section 3 would strengthen the paper.

In a few places the discussion in the manuscript is a bit garbled and unclear (at least to me). I encourage the authors (including the co-authors) to take the time to ensure that the wording is as clear as possible to the unfamiliar reader to themselves. This is not an issue of English (the standard of which is excellent in this paper), rather one of unclear phraseology. I detail these cases below.

==== Specific comments

— Page2

Line 32: "quantification of" -> "quantifies"; also "separation of" -> "separates".

Line 35: "... from their procedures of calibration" -> "from their calibration procedures"

Line 43: "in the" -> "using the". Also, you use the term "183.31 GHz" a lot, sometime to refer to the specific line, which is fine. However, you sometimes say "183.31 GHz channels" when you actually mean channels as much as 4 GHz or more away from 183.31 GHz. Might there be some way to make that clearer? Quoting 5 significant figures seems inappropriate for those cases. How about "channels in the 183 GHz region"? I'll highlight some of these cases later.

Line 43/44: "on Megha-Tropiques" -> "on the Megha-Tropiques spacecraft"?

Line 47: "in a 0.3-0.7K" -> "with a 0.3-0.7K".

Lines 48 to 57: Given that you quantify the inter-instrument agreement (line 47), it's better to also quantify in words in the text the biases discussed here that are, after all, the subject of this paper.

Line 55: Where in the "line wings"? How many GHz away?

— Page 3

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Line 62: "It" -> "This"; also "which" -> "that"

Line 69/70: This sentence is garbled. How about: "Knowledge of absolute errors is important for climate applications such as reanalysis, where the need to detect small changes in the mean state is paramount."

Line 70: "knowing about" -> "knowledge of"

Line 91: "ones" -> "contributions"

— Page 4 and 5

No issues

— Page 6

Paragraph from 165 to 177: This discussion might be better placed in section 3 rather than here. This paragraph talks about instrument/model biases in IR that mirror those in the microwave discussed in the paper as a whole. Accordingly, having it in a section called "Radiative transfer modeling and spectroscopy" doesn't feel right to me.

— Page 7

Line 199: The use of the word "lower" in combination with "confidence" can be confusing (is more better or worse? The same is the case for "resolution", "precision" and "accuracy"). You are saying "confidence limits" which does help, but I wonder if changing "are lower to "have lower values" (or "have smaller values"?) might be even clearer?

Line 207-214: This discussion is very hard to follow, see some specifics for individual lines below. However, I would urge the authors to work together to make this discussion as clear as possible.

Line 209: ", insensitive to vertical" -> ", and thus insensitive to the vertical"

Line 210: "would provide" confuses the message. Is it "can provide"? If so, does it?

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Why not simply say "provides"? Perhaps because it doesn't actually agree? How about "can quantify agreement with..."?

Lines 212-214: This sentences is still very unclear to me. The sentence implies two things are being compared, but then uses the phrase "together with" which implies we're still discussing the first one.

— Page 8

Line 219: Comma needed after "Finally"

Line 225: Specific example of where quoting 5 significant figures on the frequency is inappropriate.

Line 246: "while they naturally" -> "even though they". Again, 183.31 GHz too precisely quoted.

Line 250: add "the" between "specifying" and "shape"

— Page 9

Line 252-255: Again, I don't really follow the logic here. When talking about the "model cloud and precipitation fields" do you mean things like particle shape/size etc. discussed on the previous page, or do you mean (or also mean?) the cloud amount? If you mean all of the above, then a first guess departure would indicate some problem with the first guess itself would it not. Forgive me if I'm missing some obvious point here.

Line 253: Perhaps insert "(observed minus predicted)" after "departure" just to be clear.

Line 253: "selection" -> "selected"?

Line 254: "missing" -> "failing to identify and omit"?

Line 260: comma needed after "exist"

Line 261: "and rely" -> "relying"

Line 269: by "the biases" you mean the ones using the non-cloud-aware RT model, yes? Please clarify either way.

— Page 10

No specific issues with anything on this page, but I'll just restate my request for some more discussion of radiometric calibration and gain compression non-linearities.

— Page 11

Line 331: Please clarify what is meant by "measurements" here. Is it the ATTOMS measurements or the ATMS etc. measurements? If ATTOMS is it an ATOMMS measurement of something other than opacity then? Again, I'm finding this discussion somewhat unclear.

— Page 12

Lines 347-357: Again, a recommendation to further consider gain compression would be valuable.

— Page 22

Line 582: Period needed after "legend" and start a new sentence with "The horizontal..."

— Page 23

Line 595: "captions" -> "legend"

— Page 24

What are the meanings of the different symbols? Either describe them in the caption (or a legend), or make them all the same.

Line 603: "... less than the size of the points".

Line 604: "for" -> "using the"?

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