Interactive comment on "RTTOV-gb – Adapting the fast radiative transfer model RTTOV for the assimilation of ground-based microwave radiometer observations" *by* Francesco De Angelis et al.

Anonymous Referee #2

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Numerical weather prediction (NWP) uses input from a large number of observation systems, but ground-based microwave radiometers (MWRs) are not yet considered despite that these instrument should provide valuable additional information. The preferred manner to incorporate remote sensing data is to assimilate measured radiances (instead of making use of external retrievals) and this requires that a radiative transfer model for the observation system is at hand. The forward models used at NWP centres presently lack treatment of MWRs, and this manuscript presents an extension of the RTTOV model to remove this shortcoming. This is a valuable contribution that fits with the scope of the journal.

That said, the value of the manuscript depends critically on if the extension actually becomes part of future releases of RTTOV, or not. The manuscript is not clear on this point, the extension is just said to be "under discussion". My review below will be based on the assumption that the extension will be accepted. If this will not happen, I think the manuscript has to change focus. This is the case as the manuscript is of little interest for extending any other fast forward model, the discussion is quite specific for RTTOV. Further, the 1D-var examples shown (Sec 3.4) could have been performed with many other forward models, i.e. they could have been obtained without extending RTTOV. That is, I encourage the authors to confirm that the extension will be incorporated into the official RTTOV version.

Specific comments:

Page2, line 8: Why parenthesis around "in cloudy areas"? It causes confusion, is it from WMO, or your own comment?

Page 2, line 9: How do you define the acronym? It is below used to mean both one or several radiometers.

Page 3, line 33: What are the approximations? Make sure that what you write here is synced with the text in page 4, line 7.

Eq 2: It is highly confusing to use tau as symbol for transmittance. Tau is the standard symbol for optical depth (as you also noticed on page 4, line 34). Please consider to change notation. Maybe you follow the standard notation in RTTOV, but I don't see that as a sufficiently strong argument.

Page 3, line 37: To define a transmittance, you must give two points (here just TOA).

Page 4, line 22: The term describes the contribution of cosmic background radiation.

Page 5, line 8: For consistency, unit for CLW should be added.

Page 5, line 23: Don't see the logic behind "Thus" here. Is there not even a contradic-

tion between the sentence before and including "Thus"? Just remove the first sentence and "Thus" in the second one? Anyhow, I did not follow this part before reaching Eq 9.

Page 6, line 13: By using the word "optimally" you imply that you have considered all possible combinations. Is that really true?

Page 7, line 15: What is the transpose of software code?

Page 7, line 26: Should it be "employment"?

Sec 3.1: A lot of details (with low interest) in this section. Particularly, I don't see the point with all the tables. I don't argue about this further, just encourages the authors to consider a shortening of the section.

Page 8, line 13: Here you use V-band without introduction. Very few knows the definition of these "bands". Why not just use frequencies?

Comparison with ARTS: According to Fig 5 there is a significant deviation to ARTS already for "clear sky", but my understanding of the text is that the same absorption models are used for oxygen and water absorption. So why is the "bias" bigger here than in Fig 3? This seems to indicate a deviation already between LBL R98 and ARTS. Have you checked this?

Sec 3.4: When reading about OSSE in the abstract, I expected much more than this. The section shows some test retrievals (by 1d-var/OEM) with a priori taken from a model. I don't know if there exists an official definition of OSSE, but I expected to find a much more elaborated exercise (e.g. 4d-var) when OSSE was mentioned. That is, I recommend to not denote this as an OSSE.

Qpack + ARTS speed: As I did not understand the relation between Qpack2 and ARTS (that should be explained clearer in the manuscript), I asked a colleague that I had heard mention Qpack. He happened to notice the comment on calculation speed and then said that the speed of ARTS depends critically on several settings. Moreover, he also said that using ARTS through Qpack2 means a lot of overhead and if the

Jacobian calculation is clocked inside Qpack2 this does not necessarily reflect the true performance of ARTS. Without understanding the details here, I must still ask if these issues have been considered?

In addition, is the calculation speed of RTTOV-gb really the main contribution? Considering the relatively low number of MWRs and their relatively low number of channels, compared to all satellite data, I assume that NWP centre easily could afford a slow forward model to assimilate MWR data. However, they would still tend to ignore MWR data as long as those data require usage of an additional forward model. This another way to express why it is critical if this extension will be part of the official RTTOV or not.

Sec 6: Place this section before Conclusions.