

Interactive comment on “RTTOV-gb v1.0 – Updates on sensors, absorption models, uncertainty, and availability” by Domenico Cimini et al.

Anonymous Referee #2

Received and published: 25 March 2019

1 General comments

The authors describe the atmospheric radiative transfer code RTTOV adapted for ground-based sensors (RTTOV-gb) and present some updates compared to earlier studies (e.g. De Angelis et al., 2016), by adding two more sensors and presenting model uncertainties. They test the RTTOV-gb model by comparing simulated brightness temperatures (T_B) with a full line-by-line (LBL) model. Further, they compare T_B simulated from radiosonde data with measured T_B from co-located microwave radiometers. This approach provides a complete validation of the model, using both, the reference model and measured data as comparison. They justify the importance of the RTTOV-gb by its use to assimilate groundbased microwave radiometer data in NWP

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models.

The paper is well written and methods and results are presented in a concise way. It presents model advances with the aim to improve NWP and fits well in the scope of GMD. I recommend to publish the manuscript in GMD after consideration of my minor comments given below.

2 Specific comments

p. 1, l. 23: "... computes the bottom of atmosphere radiances". What do you mean with "bottom"? Do you mean that RTTOV-gb computes radiances and brightness temperatures of the lower atmosphere/troposphere?

p. 2, l. 4-6: Please put the first sentence of the introduction ("RTTOV-gb is the FORTRAN...") after the second sentence ("RTTOV-gb is a fast (i.e. radiances)"). The latter is a very nice introductory sentence, whereas the first gives additional information and should therefore not be the first sentence of the manuscript.

p.2, l.28: you mention that RTTOV-gb is one-dimensional: clarify which dimension is meant, e.g. add " profiles at a specific location".

p. 2, l. 36-37: "added as options" is not clear.

p. 2, l. 37: evaluation of what? Add e.g. "evaluation of RTTOV-gb against".

p. 3, l. 5: I suggest to place the second paragraph (p. 3, l. 15) after the first sentence in line 5. This would first generally describe the new sensors and thus provide a direct link to the title of the section (New sensors). Afterwards, it would describe the more specific information concerning the parametrization and the coefficients.

p. 3, l. 10: Reference to Sect. 2.2, where the regression coefficients are explained in more detail.

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p. 3, l. 18: Mention also the study of Stähli et al. 2013 (doi:10.5194/amt-6-2477-2013), which first described the TEMPERA instrument.

p. 3, l. 20: "LWP family": mention the sensors from p. 5, l. 23-24 already here, because this is the section where you describe the new sensors.

p. 3, l. 22: Please add some more information about the channels of the sensors used, or reference to Table 2 not only for the supported sensors, but also for their channels.

p. 4, l. 8: Clarify that it is not the first study that uses both models. E.g. "both ... models are now available and were first presented in Cimini et al. (2018). Extending the results ...".

p.4, l. 21-22: I suggest to move these 2 sentences to p.4, l. 8, where Cimini et al. and the broader frequency range of the present study has been mentioned first.

p. 4, l. 23-24: "water vapor self-broadened continuum temperature dependence exponent n_{cs} ": The long noun cluster is confusing. I prefer a description similar to Cimini et al. (2018), e.g. "... the temperature-dependence exponent n_{cs} of the water vapor self-broadened continuum ..."

p. 4, l. 32: Section 3 is rather long compared to the other sections. I suggest to divide the section into two subsections, one about the comparison with the reference LBL model (starting in p.4, l. 34) and the second one about the comparison with the real observations (starting in p. 5, l. 19).

p. 5, l. 4: What does "main differences" mean? Please remove "main".

p. 5, l. 5: Add "generally" before "decrease" and "increase", because this behaviour is not valid for all of the channels (e.g. Table 3, ch. 1 first increases, and Table 5, ch. 5 first decreases).

p. 5, l. 5: Add Table reference or sensor type for clarity, e.g. "..., the rms differences GENERALLY decrease for 50-57 GHz channels (TEMPERA, Table 3), while they in-

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crease for 23/31 and 70-150 GHz channels (LWP, Table 4)".

p. 5, l. 8: add "(RTTOV-gb)" to "fast model approximation" to clarify which model is meant.

p. 5, l. 5: Which angle is used for this "fast parametrization uncertainty" in Table 5?

p. 5, l. 19: Begin a new section (see comment above, p. 4, l. 32).

p. 5, l. 27: Please mention already here that these datasets cover two different meteorological conditions, namely midlatitude summer and midlatitude winter conditions.

p. 5, l. 34: Which altitude limits for the calculations do you generally use? Do the radiosondes cover this whole altitude range?

p. 6, l. 4: Why did you choose a threshold of 0.2K when reducing the 0.5K threshold from 1h to 10 minutes?

p. 6, l. 5: It would be nice to mark these identified cloudy periods in Figure 3 and Figure 5.

p. 6, l. 11: Could you provide some more details? What do you mean with conditions-dependent uncertainties?

p. 6, l. 18: It is interesting to mention here the meteorological conditions for the dataset. Please mention earlier also the conditions for the Milan dataset (see comment above, p. 5, l. 27).

p. 7, l. 5: Besides in the manuscript title and the Abstract, it is the first time here that you mention the version (v1.0) of RTTOV-gb, and you continue to do so during the whole summary section. Please mention the version earlier in the text and be consistent in the usage.

p. 7, l. 16: I think you can be more confident here. I suggest to change it to "This paper can provide ...".

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- p. 8, l. 20: For completeness, also state where RS98 is available.
- p. 17, Fig. 1: Adapt figure titles ("ros17" and "rosen") to R17 and R98 to be consistent with the text.
- p. 18, l. 3: K_p is not defined, do you mean **Cov(p)**?
- p. 19, Fig. 3: Add unit (GHz) to the legend. Also, it would be nice to mark cloudy periods (see comment p. 6, l. 5).
- p. 19, l. 3: add "radiosondes used for the simulations ...". Otherwise it is not clear why you mention radiosondes here in the caption.
- p. 20, Fig. 4: the x-labels of the first two panels are cut.
- p. 21, Fig. 5: Same comment as for Fig. 3, add unit to legend and mark cloudy periods.

3 Technical corrections

- p. 1, l. 33: Typo, according to the tables it should be 82.5.
- p. 2, l. 22: Data assimilation (DA): abbreviation not needed, because it is not used later on.
- p. 2, l. 31: "As hoped" is not appropriate here, state it as a fact.
- p. 2, l. 38: "Section 5 provideS"
- p. 3, l. 19: "Liquid Water Path (LWP)". Introduce the abbreviation LWP.
- p. 3, l. 35: Provide definition of AMSUTRAN.
- p.4, l. 7: remove blank space before ")".
- p. 4, l. 25: "the same approach AS described in ..."

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- p. 4, l. 27: bold typesetting of **Cov(...)** and **Cor(...)** for consistency.
- p. 6, l. 2: Missing space after T_B
- p. 6, l. 5: Missing space after T_B
- p. 6, l. 22: Missing space after T_B
- p. 6, l. 24: Missing space after T_B
- p. 12, l. 1: Add "with the corresponding sensor channels (sensor chans)."
- p. 13, Table 3: Add a digit to the Central frequencies to be consistent with the number of digits in the other columns and in Table 5.
- p. 14, Table 4: Same as for Table 3, add a digit to the channel frequencies.
- p. 15, Table 5: Add units for the uncertainties.
- p. 20, l. 7: add "and": AVG, STD, SDE, and RMS

Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2018-285>, 2019.

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