

## REPLY TO REFEREE #1

The authors are grateful to the referee for the positive feedback and the constructive comments. We accept them all and acknowledge the help in improving the manuscript. Our point by point replies are highlighted in red below as well as in the revised manuscript (to be submitted after the comments from Referee #2 will become available).

### Specific comments:

**P4/I14:** not clear if fixed pressure levels are used. I suggest to write "...are pressures of the fixed pressure levels. . ."

**Agreed. Text has been changed according to the referee comment in the revised manuscript.**

**P5/I24:** this is better referred to as "linear combination" than "polynomial".

**Agreed. Text has been changed according to the referee comment in the revised manuscript.**

**P6/I10:** say here which LBL model has been used.

**Agreed. Text concerning LBL model has been moved earlier in the revised manuscript, according to the referee comment.**

**P6/I10:** is it justified to say that only 83 profiles cover the variability of humidity and temperature?

**This profile set has been assembled at ECMWF to represent the range of variations in temperature and absorber amount found in the real atmosphere. This set was sampled from a large profile dataset containing 121,462,560 profiles generated using the experimental suite of the ECMWF forecasting system. To make this point clear, we added a new reference and the following sentence in the revised manuscript:**

**"It is important to emphasise that this profile set was carefully chosen from a set of more than 100 million profiles to represent a wide range of physically realistic atmospheric states (Matricardi, 2008)."**

**P6/I34:** use "state vector" instead of "profile vector".

**Agreed. Text has been changed according to the referee comment in the revised manuscript.**

**P7/I10:**  $\gamma$  should be bold in the denominator.

**Thanks much for spotting this typo. It has been modified in the revised manuscript.**

**P8/I5:** refer to table 2.

**At P8/I5 we refer to Table 1, which presents the results for the dependent profile set. We refer to Table 2 at P9/I24, where the results for the independent profile set are discussed. Hope this clarifies, otherwise don't hesitate to let us know.**

**P8/I31:** in this and the following sentence you use twice "underestimate" which does not seem to make sense. Please check.

Agreed. We checked and confirm that “underestimate” is correct in both sentences. However, to make it more clear we modified the sentence as follows:

“However, in such a case where the optical depths are underestimated, then the atmosphere as a whole is too transparent”.

P10/l8: why does it make sense to compare RTTOV-gb to two other implementations of R98? Would it not be more sensible to use different absorption models. For ARTS one could use individual LBL calculation rather than the predefined models. Please comment.

As stated in P9/l40 of the original manuscript, “In this analysis, ARTS settings for absorption model have been selected to adopt as much as possible the same absorption model as RTTOV-gb”. Indeed, the goal of that analysis is to test the fast RT modeling (RTTOV-gb) with respect to accurate but slower LBL calculation, all the other settings (including gas absorption model) being equal. To make this point more clear the following sentence has been added:

“Since the goal of this analysis is to test the fast RT modeling (RTTOV-gb) with respect to accurate LBL calculation, all other settings being equal, ARTS settings for absorption model have been selected to adopt as much as possible the same absorption model as RTTOV-gb”.