

## Short Comment 1 (SC1) by Emma Turner

This is an important piece of work that quantifies the total effect of spectroscopic uncertainties on ground based radiances, and vitally includes their covariance. As most spectroscopic parameters are not derived in isolation from each other this is very important to include, and to my knowledge is not, and has not been published by any other authors prior. The review of the absorption model equations with up-to-date material is particularly useful to have documented.

We are very grateful for this comment, which confirms our expectations that the interest on the presented analysis goes beyond the ground-based microwave radiometry community.

As it is a general approach it would be really good to see how this looks for top of atmosphere geometry, though I am not suggesting the authors do this for this publication. I think it would look quite different, probably have a lot more impact, and the 55-60 GHz impacts would not be negligible in this case. Also, it would be good to see how this looks for the whole 0-200 GHz range where I suspect in some bands the order of parameters that dominate would change. This might be limited computationally, again I don't suggest the authors do this.

The extension to upwelling  $T_B$  (top-of-atmosphere geometry) and higher frequencies is currently ongoing and it will be reported in the near future.

To make sure it is clear that the same analysis would give different results at higher frequency and for upwelling  $T_B$ , we add the following sentence to Summary and conclusions:

“Note that the presented uncertainty covariances of spectroscopic parameters are generally valid, while the  $T_B$  sensitivity analysis and uncertainty quantification are strictly valid only for the ground-based geometry and the considered frequency range”

One minor point is the use of the MWR to describe ground-based MW radiometers is a bit confusing, as some have already adopted the acronym for their own space-based instruments.

Indeed, the acronym MWR is used for space-based instruments (e.g. on board Envisat and Aquarius/SAC-D) but also for ground-based instruments (e.g. ARM units<sup>1</sup>, MWRnet<sup>2</sup>). We believe that MWR should be used as the acronym for “Microwave Radiometer”, with no reference to any particular type or observation geometry.

To avoid confusion with space-based instruments, we added “ground-based” and/or “downwelling” to sentences where it could have been not evident.

<sup>1</sup><https://www.arm.gov/capabilities/instruments/mwr>

<sup>2</sup><http://cetemps.aquila.infn.it/mwrnet/>