

## Responses to Review of Referee 2 (AMTD-8-1-2015)

We would like to acknowledge the anonymous referee for his/her useful remarks and comments which have helped to improve the manuscript. All comments have been addressed as detailed hereafter in blue.

This is a well written, interesting and important paper. The Zeeman effect on stratospheric O<sub>2</sub> is carefully observed and compared to simulations by the Atmospheric Radiative Transfer Simulator, ARTS. ARTS was recently upgraded to incorporate Zeeman splitting and this paper describe the first and successful test of this new ARTS module.

The other referees have commented on minor unclarities in the paper and I have nothing to add here. However I would like to see one more section in the paper.

To my knowledge this is the second paper about the TEMPERA instrument. Stähli et al. (2013) described the instrument and presented its first measurement of tropospheric and stratospheric temperature profiles.

In one of the final sentences in the present paper the authors (Navas-Guzmán et al.) claim that the successful inclusion of the Zeeman effect in ARTS will make it possible to extend the upper limit of temperature profiles, inverted from ground-based microwave measurements of O<sub>2</sub> (eg. at 53.06 GHz), beyond an altitude of 50 km.

I suggests that the authors add a section where they, with help from their new measurements and ARTS simulations, describe the optimal observation setup for the TEMPERA instrument to be able to get temperature profiles up to as high altitudes as possible.

This information would be very important for the microwave remote sensing community.

We would like to point out that the goal of this study was to measure the Zeeman effect using ground-based microwave radiometry. The temperature retrievals including the Zeeman effect is a topic which is outside the scope of this paper. At the present we are working on the temperature retrievals incorporating this Zeeman effect but our idea is to present these results in a separate paper where the retrieval setup will be described in detail and the results will be carefully validated.

Although we are in a preliminary phase of this study in the next plot (Fig. 1) we show the measurement response (MR) of two retrievals where the Zeeman effect was and not was incorporated in the forward model. We would like to point out that for the retrieval without considering the Zeeman effect the channels of the very narrow central region of the oxygen emission line are not included. From this plot we can observe that the MR reaches larger values for higher altitudes when the Zeeman effect is included in the retrievals (red line). In fact for this example the highest altitude where MR is larger than 0.8 correspond to 45 km for the retrievals without considering the Zeeman effect and around 54 km when the effect is included. The results look promising and point to a possible extension of the upper limit of the temperature profiles.

We have added some sentences in the manuscript indicating these results and the plan of presenting this new study in a different paper. The paragraph reads now as (lines 422-427):

**"The inclusion of the Zeeman effect in the ARTS model will allow to extend the upper limit of temperature profiles from ground-based microwave radiometers beyond 50 km. Preliminary results of the temperature retrievals including the Zeeman effect show higher values of the measurement response at higher altitudes, indicating a possible extension of several kilometers of the temperature profiles. This new retrieval setup and a detailed validation of**

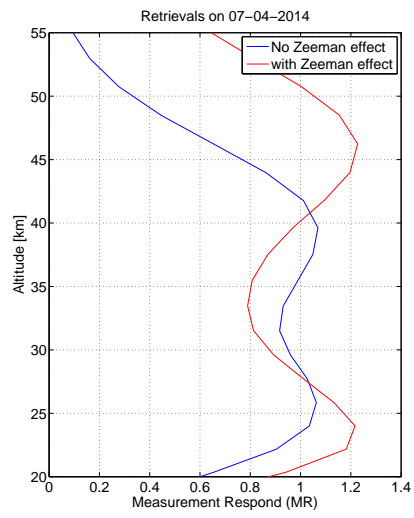


Fig. 1: Measurement responses for the retrievals including (blue line) and without including (red line) the Zeeman effect in the forward model.

**the temperature profiles will be presented in a separated paper."**