Author's Response to Referee #1

We would like to thank referee #1 for the positive review of our manuscript. We have answered all comments below (for easier comparison the referee comments are included in *italic*).

#1: Page 5462, lines 12-13: How is the interpolation from ECMWF levels to a 200 m grid performed? Generally it is questionable to interpolate from coarse vertical resolution (ECMWF) to a much lower grid (200 m).

#1: a) Temperature and humidity were linearly interpolated, while the logarithm of pressure and the logarithm of refractivity were spline interpolated.

b) Up to altitudes where there is a noteworthy difference between physical and dry parameters the resolution of the ECMWF fields is finer than the 200 m grid. Hence there was no problem to interpolate on a 200 m grid.

#2: Page 5465, Eq. 6: How did the authors initialize the integral on the upper bound (infinity)?

#2: While the physical pressure was extracted from the ECMWF fields, the hydrostatic integration was performed to obtain dry pressure. The pressure integration is started at that altitude where the humidity exceeds a value of q= 5 * 10^-6 kg/kg, where q is the specific humidity from the ECMWF fields. Above this value a transition from pressure to dry pressure is performed in a first order approximation for low humidity. The initialization of the hydrostatic integral at this altitude was obtained by calculating dry pressure depending on pressure and specific humidity. This approximation has been introduced since the numerical integration of dry pressure for humidity values below q= 5 * 10^-6 kg/kg led to unphysical dry pressure. This method was found to be robust.

#3: Page 5471, lines 6ff: How did the authors calculate the trends and how is natural variability (QBO, ENSO, volcanic eruptions, solar cycle) considered? Please describe this point in more detail.

#3: In this specific study, performed with climate models, linear regression was used for the trend analysis (see p. 5466, line 18 to 22). While for observational data a multiple regression is commonly applied, for models on a long time period a linear regression analysis is suitable. First of all, there are no volcanic eruptions simulated in this specific set of models. Secondly, solar forcing is commonly used for historic runs and not for future projections. And thirdly, models show the QBO signal (~ 2 years) and ENSO signal (~ 6 years) at different times, playing a not significant role in the linear regression analysis on this long time period of 45 years. However, the start and the end year can have an effect on the linear trend analysis. Hence, we tested the sensitivity of the start and the end year. We started the trend analysis in the year 2006, analyzing 40 years, and moved then the linear regression analysis ahead for one year, testing it until the starting year 2010. The trend results showed to be stable when moving the start and end year, leading to very consistent results.

However, since this a very important point we will include the following text in the manuscript:

p. 5466, line 21: The trends were evaluated for 10° zonal-mean climatological fields for a period from 2006 to 2050. In general, natural effects such as ENSO (El Niño-Southern Oscillation), or QBO (Quasi-Biennial Oscillation), only play a negligible role in such long term trend studies. However, natural variability can have an impact in the linear regression analysis through the starting year and the end year. Hence, we tested the sensitivity of the start and the end year by analyzing the trends in a period of 40 years, starting 2006, and moving ahead for one year, until 2010. Results showed to be insensitive among this test, and also when comparing the trend results to the trend results for the complete period of 45 years. In this analysis the following two different kinds of trends were analyzed: ...

#4: Page 5480, Fig. 1: Would be nice to see where the lines cross the surface? In contrast to most radio occultation measurements model data are available down to the surface.

#4: Since the focus of this study was to see down to which altitude dry temperature can be safely used as proxy for physical temperature, we did not focus on its difference down to the surface. Dry temperature is a useful quantity in studies with RO data, since it does not need additional background information in its retrieval, but it only makes sense to use it in regions were water vapor is essentially zero. Hence, the focus was at altitude regions between about 6 km to 16 km.