

## Author's Response to Referee #2

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

*#1: Throughout the paper, statements were made that the new approach was better because it agrees better with ECMWF. Also it was stated that “the slightly increased bias of the new approach relative to ECMWF data. . . point to some remaining problems with the averaging approach.” (P7825,L9-11) What is the expected accuracy of ECMWF at large altitudes? Can it be really used as a basis of truth here?*

#1: Thank you very much for your comment. We agree with the referee that any judgment about better agreement with ECMWF means better approach, is not appropriate. We will look through the complete manuscript and revise the text if necessary. Sentences like e.g., p. 7825, L5-L6 will get cut.

*#2: Figs 3-5: The plots lack detailed structure of the differences. Is there any reason not to show the smaller differences? 0.2% in refractivity scales to ~ 0.5 K in temperature, which is not negligible for climate studies, so I think it is important to show the climatological differences at these levels. In addition, besides showing an example from a particular month, it would be instructive to show mean and standard deviation of the differences when averaging over all the months so we can get some sense of the month-to-month variabilities.*

#2: According to your suggestion we changed the scale, showing now a smallest difference of 0.1 % in Fig. 3 to Fig. 5. This way more structure is visible. Furthermore, we will revise the text in the manuscript (Sec. 4.1) according to the new scale.

Regarding your suggestion to show a month-to-month variability of the new and standard inversion: While Sec. 4.1 only gives an initial analysis of the new inversion when using CHAMP data, Sec. 4.2 gives a more detailed analysis of the new approach, covering also your suggestion. Fig. 6 and Fig. 7 show a comparison of the month-to-month variability of the new and standard inversion relative to ECMWF, for high latitudes and down to low latitudes.

#3: P7817,L6: *“Furthermore the measurement noise grows in magnitude with increasing altitude.” I think you meant the measurement noise grew fractionally with altitude.*

#3: Thank you for noticing. We will write: *“Furthermore the signal-to-noise ratio increases with decreasing altitude.”*

#4: P7817,L10-11: *“Furthermore, the sensitivity at the assumed scale height was tested, and it had little impact below 40 km.” Could you quantify what “little impact” mean?*

#4: Different scale heights were tested in the processing, and the impact was less than about 0.02% below altitudes of 40 km.

We will change the manuscript accordingly: *“Furthermore, the sensitivity at the assumed scale height was tested, using scale heights of 6 km and 9 km. The impact on the refractivity below values of 40 km was found to be less than about 0.02 %.”*

#5: L7818,L18-20: *“Below 50 km, errors resulting from . . .” should be changed to “Below 50 km, random errors resulting from . . .” since systematic errors would not average out.*

#5: Thank you very much. We will change the text in the manuscript.

Minor comments:

#6: P7813,L12: *“GNSS-RO it is likely. . .” -> “GNSS-RO is likely. . .”*

#7: P7813,L18: *“the primary observable is. . .” -> “the primary observables are. . .”*

#8: P7814,L21: *“e.g zonally. . .” -> “e.g., zonally. . .”*

#9: P7820,L13: *“medians” -> “median”*

#10: P7821,L22: *“always to apply” -> “to always apply” (or simply “to apply”)*

#6 to #10: We have changed the text according to your suggestions.