

Response to Review#1

General comments

In general, I think the authors addressed a quite interesting and easy to implement approach for the correction of ionospheric residual errors in GNSS-RO data. They also provided a good literature overview, discussing the ongoing work and problems on this topic over the past years. Their style of writing was also good to follow, however, there are some technical errors/typos in this paper, which leave a bit of a sloppy impression. Furthermore, the paper is quite long and hence hard to read and concentrate on. I would prefer a clearer presentation of the main results, maybe providing some of the figures only as supplementary material.

We revised the paper considerably to take care typos and English. We added Appendix A to provide more discussions on 'bending delay and phase advance' for radio wave propagation in plasma.

Personally, I appreciate the extensive analysis the authors conducted, however some of the information might get lost due to the length of the paper. They also add as an additional study the impact of these RIEs on data assimilation. By itself, this is of course interesting and important to discuss, however, I also feel they could have split the study maybe in two papers.

To first introduce the method and precisely discuss the correction of RIEs on phase delays, and a second follow-up study with the data assimilation experiments. It reads more like a scientific report than a scientific publication, which should aim to concisely summarize and present the main/key findings. In that respect, I recommend the authors to improve the general style, structure, readability, and quality of the manuscript.

We moved a large part of the DA impact discussions to Appendix B, and keep the key results and summary in the main section.

Furthermore, I wanted to address, that to my knowledge a correction on phase delays was already discussed in previous literature years ago, leading to the conclusion that a correction on bending angle is to be preferred. The problem here is that the dispersion residual (different ray paths, L1 and L2) is the most dominant residual, compared to higher-order ionospheric effects. Thereby, a correction on bending angles provides better results, since profiles are studied already on a common impact parameter, instead of on excess phase (see also Syndergaard 2000). Please provide a good and high-quality discussion on this issue. Readers should be aware of that, and understand why you don't see this as an issue and recommend this correction approach based on phase delays.

From the review comments, we feel that one of the key points in this paper was not well communicated. Therefore, we added Appendix A to discuss how RIEs can arise in the case without bending. It's a misconception to attribute RIEs solely to the bending effect.

Appendix A provide more discussions on 'bending delay and phase advance' from radio wave propagation in plasma. Especially, the phase advance due to the faster-than-light phase velocity from propagation in plasma can be mistakenly interpreted as a bending. In fact, it is an independent effect from bending (due to group velocity) in the GNSS-RO excess phase measurement. This is also the major reason that this study argues to analyze the excess phase data, rather the bending data, of which the

latter would mislead what might cause the RIE. In Appendix A, we discuss the situation that RIEs can occur even without bending.

Summarized, I recommend a major revision in order to improve readability and a concise presentation of key results, and to get rid of most of the technical errors (I pointed out just a few, please re-check the complete paper carefully).

The manuscript has been revised to take these advices in consideration.