Referee #2

From the abstract, the author seemed to suggest that this statement holds under all situations. However, at the very end of the paper, the author qualified the results by saying that the effects of noise on "deep, PBL RO signals… requires an additional study." I find this misleading, especially given that high SNRs are generally designed to get better retrievals within the PBL.
The fact that it does not address to RO quality near the surface also means that this paper is not very impactful. I would argue that the effects of SNR at higher altitudes are fairly well understood [e.g., Kursinski et al., 1997]. When the signal is weak, the effects of tracking must be taken into account. The receiver does not output a connected phase [e.g., Sokolovskiy et al. 2006], and effects of uncorrected cycle slips must be considered. This study did not address any of that.

I performed very simple numerical simulations, which were aimed at the study of the influence of SNR (and only SNR) upon the RO retrieval quality. The idea of the study is to isolate just one factor. It is true that the signal tracking is an important issue that has not been addressed by the study. From this view point, the final statement of the abstract does not take into account possible problems with signal tracking. Still, from this study, as well as from the analysis of RO data with lower SNRs (like Spire CubeSats) we can conclude that it is not SNR itself that is of primary importance for good retrievals. On the other hand, our noise model does include a minimum model of signal tracking, because the noise is formulated in terms of complex field, and the accumulated (connected) is re-evaluated after superimposing the noise. This is discussed below.

In addition, this paper did not provide sufficient details of the methodology nor adequate explanations of the results that were presented. For example, what is the sample rate of the simulated phase? Are these results based on a single realization of random noise? Or are multiple realizations used? Are the simulations dual-frequency, and if so, are noise added to both L1 and L2?

I used the standard 50 Hz sampling rate in our simulations. Using a single realization of white noise does not make any sense. I used random independent realizations. The artificial data had two frequencies, L1 and L2, and the noise realizations were independent for the two channels. I added a Section "Data Processing Setup" providing more explanations, including the above ones.

What is the vertical resolution of the refractivity retrievals? The effect of noise on refractivity retrieval must surely depend on vertical resolution, which is tied to the time interval used to reduce the noise in the phase [e.g., Hajj et al., 2002]; however, there is no mention of the vertical resolution anywhere in the paper.

The resolution is now explained. We use the resolution (or filter width) optimized for NWP purposes. More details in the updated text.

Results from Figs 1 and 2 are not explained. For example, in Fig. 1, why are there systematic bias at about 15 km across most of the globe, given the simulations are performed using same ECMWF profiles with only random noise added. In Fig. 2, why is the refractivity RMS so small at high altitudes? What's responsible for the large refractivity RMS near the surface?

The small bias with a magnitude of about 0.1% at 15 km is probably caused by some numerical issues. The RMS at high altitudes is small because we employ the statistical optimization (SO). Note, the paper studies the influence of SNR upon RO inversions, and SO is their imminent part. The explanation of the use of SO has been added.

Fig 3: I assume "ndata" is the data that pass QC? Please explain. Why are the drop-offs for 5 and 20 km altitudes occurring at the same C/N0 given that their degradations occurred at different C/N0?

Yes, Ndata is the number of data that passed QC. This explanation is added to the figure caption.
It is correct that WOP and COSMIC data indicate different properties and with an increasing noise they break down in different ways. Most sensitive is the wave optical (WO) processing applied below 25 km. For WOP data, at 27 dB-Hz there is a small decrease of data, while for 17 dB-Hz the number of data below 25 km drops almost to 0. I think that most probable explanation is the fact the COSMIC data are influence by small-scale atmospheric inhomogeneities not represented by the NWP models. This must result in a higher sensitivity to noise in the troposphere, where small scale structures are stronger. We added an explanation along these line to the discussion of Figure 8, which shows similar results for COSMIC data.

Sec 3.2: It's not clear how noise is superimposed on COSMIC data. Are these added on top of the phase measurement noise that is already present at COSMIC? Do you do it for both L1 and L2 signals? Please clarify. Again, why is it that the added noise has no effects at high altitudes?

This is partly explained in the beginning of Section "Noise Model". The procedure for the COSMIC data is the same as for the artificial data. The original RO data represented by their amplitudes and excess phase for the two frequency channels, were first transformed to the complex field, upon which the white noise realizations were added. Then the noisy wave field was transformed back to the amplitude and accumulated (connected) excess phase. This provided a minimum signal tracking model. An explanation along these lines has been added to the revised text.

References:
Hajj, G. A., E. R. Kursinski, L. J. Romans,W. I. Bertiger, and S. S. Leroy (2002), A technical description of atmospheric sounding by GPS occultation. J. Atmospheric and Solar-Terrestrial Phys., 64(4):451–469.
Kursinski, E. R., G. A. Hajj, J. T. Schofield, R. P. Linfield, and K. R. Hardy (1997), Observing Earth's atmosphere with radio occultation measurements using the Global Positioning System, J. Geophys. Res., 102(D19), 23429-23465, 10.1029/97jd01569.
Sokolovskiy, S. V., C. Rocken, D. Hunt, W. Schreiner, J. Johnson, D. Masters, and S. Esterhuizen (2006), GPS profiling of the lower troposphere from space: Inversion and demodulation of the open-loop radio occultation signals, Geophys. Res. Lett., 33, L14816, doi:10.1029/2006GL026112.

These references have been added.