Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2020-114-RC2, 2020
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Atmospheric Measurement Techniques Discussions

Interactive comment on "The influence of the signal-to-noise ratio upon radio occultation inversion quality" *by* Michael Gorbunov et al.

Anonymous Referee #2

Received and published: 24 August 2020

The effect of SNR on GNSS-RO retrieval quality is an important topic. The author presented a study where white noise of various level is added to the phase of simulated data. Based on these results, the authors concluded that SNR had very little effect on RO retrieval as long as SNR is better than a certain threshold.

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.

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?

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.

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?

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?

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?

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Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2020-114, 2020.