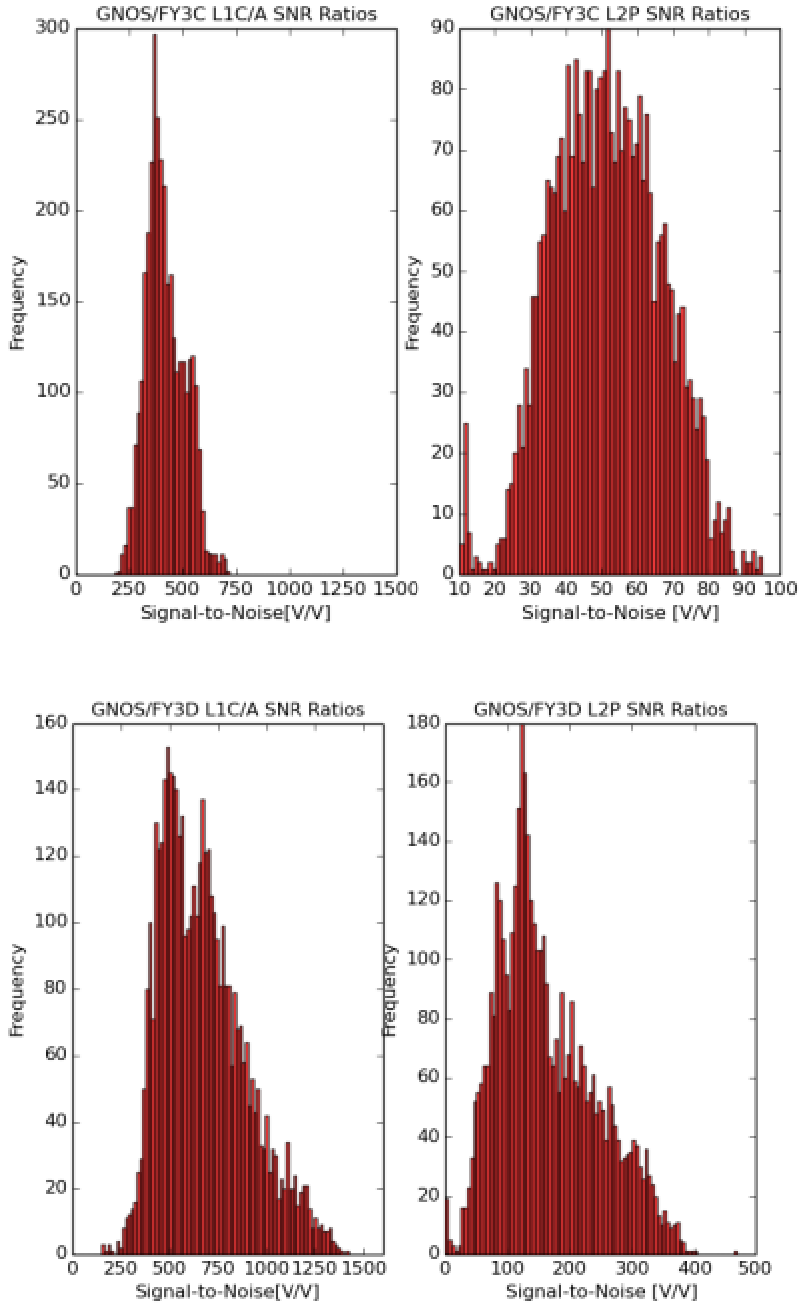
We thank reviewer for the comments.

Responses to the specific comments

1) Introduction. The manuscript lacks motivation. Since the authors present a new methodology to correct the L2 signal bending, the "old" ROPP L2 signal correction approach should be described. Additionally, the differences between the "old" and the "new" approaches should be emphasized and discussed in detail. Currently, the reader cannot understand why the current ROPP approach does not work for the GNOS retrievals and all relevant references are missing.
A: Thank you for pointing out the problem. We will add the relevant references about the old and approaches to clarify the GNOS retrievals in the revised manuscript.

2) Introduction: P. 3; Line 30. "These biases are not seen with other RO missions." Yes, the L2 signal is weaker than the L1 signal. However, other RO missions do not lose L2 signal tracking that much high up in the neutral atmosphere. The authors should explain why GNOS loses L2 signal tracking in the stratosphere at ~ 20 km, unlike all other RO missions. The authors state that the most prominent quality issue was the large departures biases, in the vertical range of 5 – 30 km. This altitude covers the middle troposphere up to the middle stratosphere. Then, within this context, if GNOS loses 30% of the profiles below 20 km (see P. 5; Line 11), then the authors should explain how does GNOS contribute to Numerical Weather Prediction (NWP) and specify the most effective altitude range of the GNOS RO profiles.

A: The reason for GNOS losing L2 signal tracking is that GNOS has a lower SNR compared to other missions. Additionally, the GNOS antenna is smaller and not well located on the satellite. Consequently, we have to use additional cables, which results in a larger decrease of SNR than expected. Scientists from EUMETSAT confirmed that GRAS can get down to 15 km for more than 90% of the cases, but it is not the case for GNOS. Only 70% of L2 can reach below 20km. However, note that GNOS on FY3C is just the first Chinese GPS-RO mission. For the second satellite, FY3D, GNOS has more antenna units and in turn, has higher SNR than FY3C. Thus, the L2 signal tracking gets better. The proportion of the large departures biases in FY3D is smaller than in FY3C as well.


GNOS/FY3C L1C/A SNR Ratios
Frequency
Signal-to-Noise[V/V]
GNOS/FY3C L2P SNR Ratios
Frequency
Signal-to-Noise [V/V]
GNOS/FY3D L1C/A SNR Ratios
Frequency
Signal-to-Noise[V/V]
GNOS/FY3D L2P SNR Ratios
Frequency
Signal-to-Noise [V/V]

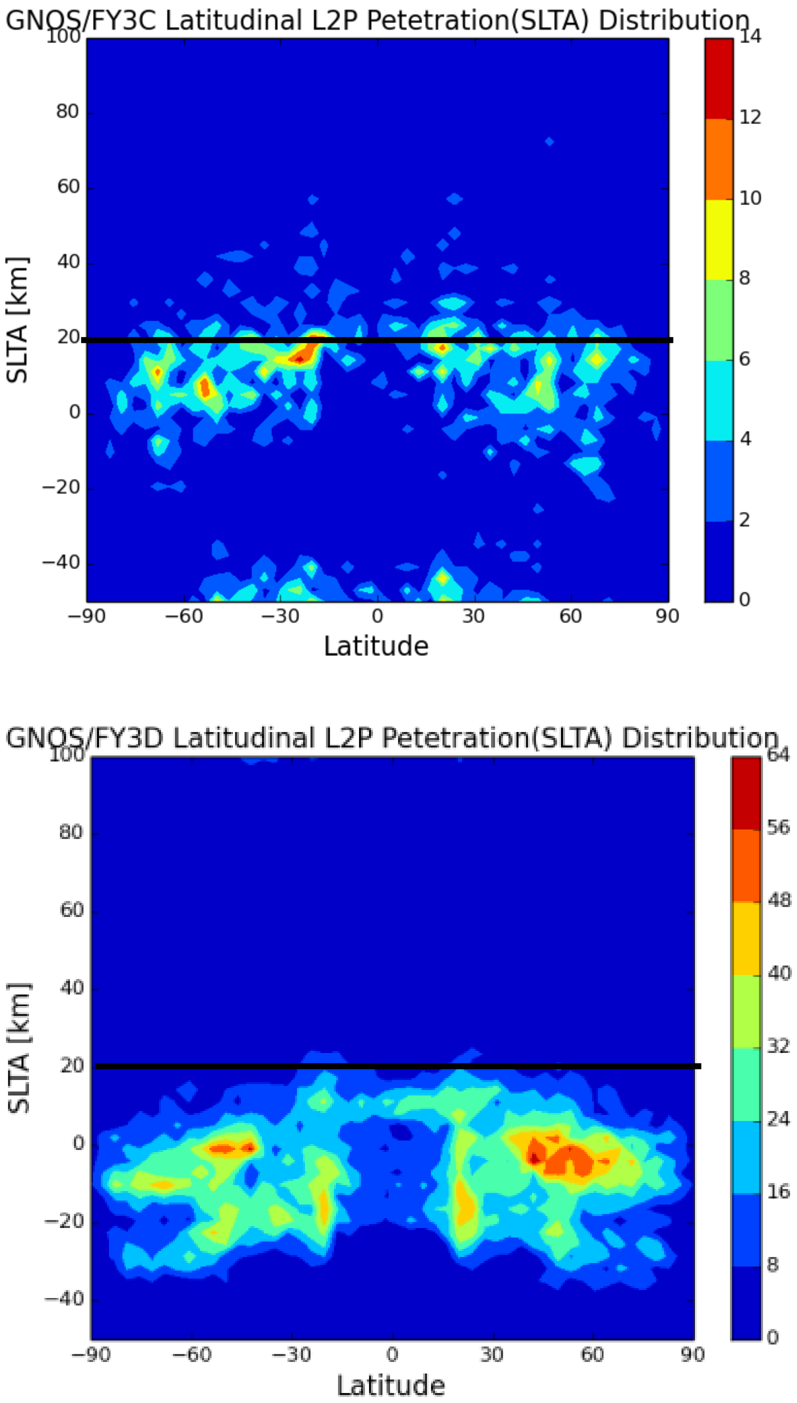


Figure 1

It is true that GNOS initially lost 30% of the profiles below 20 km, but that was before applying the new L2 extrapolation method outlined in the paper. After adopting the new method, we can process more GNOS profiles successfully. .

Regarding the impact on numerical weather prediction, GNOS was tested in the ECMWF assimilation system for the period November 23, 2017 to March 5,2018, prior to operational assimilation in the ECMWF system in March 2018. GNOS is assimilated operationally in the impact height interval from 8 km to 50 km in the extra-tropics, and from 10 km to 50 km in the tropics. Although the medium-range forecast scores were generally neutral, in the short-range, the assimilation of GNOS data clearly improved the fit to other GPS-RO data, such as Metop GRAS A,B GRAS, COSMIC-6 etc. Figure 2 shows the improvement in the GPS-RO departure statistics for short-range forecasts when GNOS data is assimilated. This Figure could be added the final manuscript, but the main focus of the paper is how the current operational FY3C GNOS data is processed, rather than the impact in NWP systems.

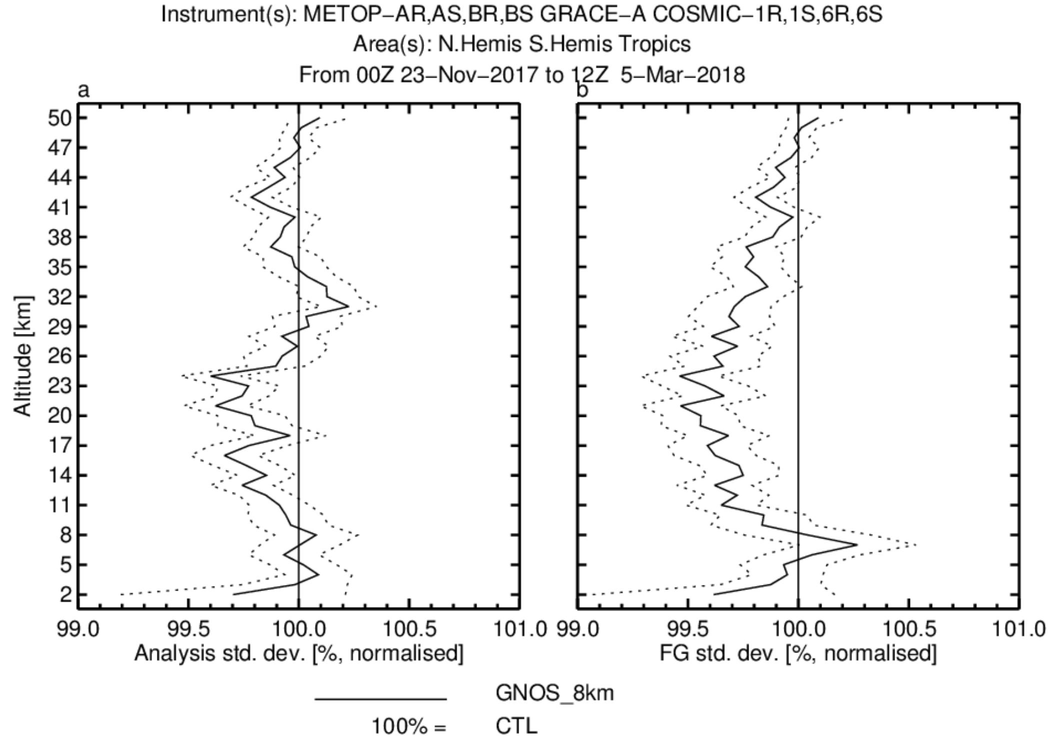


Figure 2: The percentage change in the GPS-RO departure statistics as a result of assimilating the GNOS measurements. The change in the standard deviation of the background (o-b) departures are on the right, and the analysis (o-a) departures are on the left. The statistics are globally averaged, and the dotted lines indicated 95 % statistical significance. Values less than 100 % on the left hand side indicate that the short-range forecasts fit the other GPS-RO data more closely as a result of assimilating GNOS.

5) Section 4.2: The authors do not explain why is it necessary to monitor the performance of GNOS mean L1 and L2 phase delays in the height interval of 60 to 80 km. Also, why the mean phase and not the phase variation with altitude within this height range? What GNOS product is assimilated in NWP models and how does monitoring the 60-80 km phase delays help us to QC the profile below?

A: We take these phase delays as one of QC factors because empirically it was found to determine the performance of GNOS when compared with reanalysis data. When encountering the bad profiles, the rising L1 and L2 mean phase delays have small values. The result is only based on FY3C. Subsequently, when we look at FY3D, this phenomenon disappears. Thus this factor is not a general one. We are considering cutting this part of from the manuscript.

6) P. 10; Line 21: "...these have been tested with one day of data..." The statistical sampling used in the determination of the statistical performance of the QC methods is low and does not represent the statistical performance of the GNOS profiles around the globe and under different seasons.

A: One day of data was used to initially estimate the various QC parameters and then these were tested over longer periods. Clearly, the new L2 extrapolation method is rather effective at eliminating the large errors for the longer period, globally (See Figure 13,14)The plot shown here is just an example.

Minor comments:

a) P. 2; Line 16: "...velocity and anti-velocity antennas..." Do you mean fore and aft antennas?

A: Yes

b) P. 2; Line 19: What is the GNOS inclination in Table 1?

A: The inclination of FY3C/GNOS is 98.75 °

c) P. 2; Line 17: Is BDS global or region constellation. Mention geographic restrictions of RO.

A: BDS both has global and region constellation. The distribution of BDS RO can be shown as follows, also it can be refered to Mi Liao et al.,2016

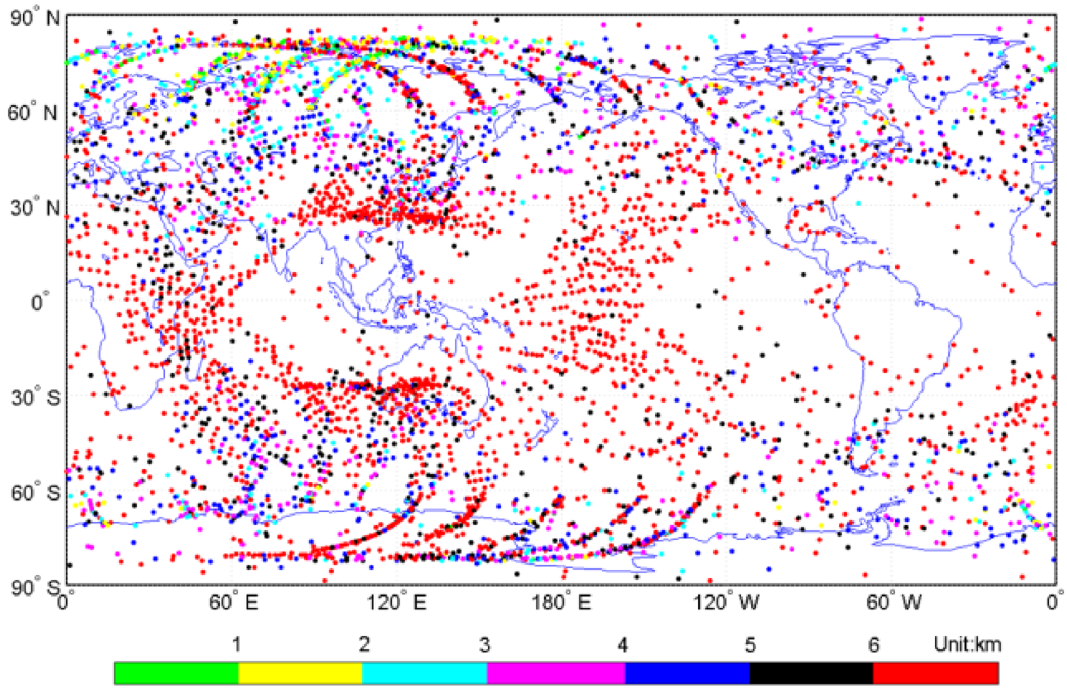


Figure 3. Map of the GNOS BDS occultation coverage from
1 November to 31 December 2013, with a total of 4648 samples.
Different colours indicate different penetration depths.

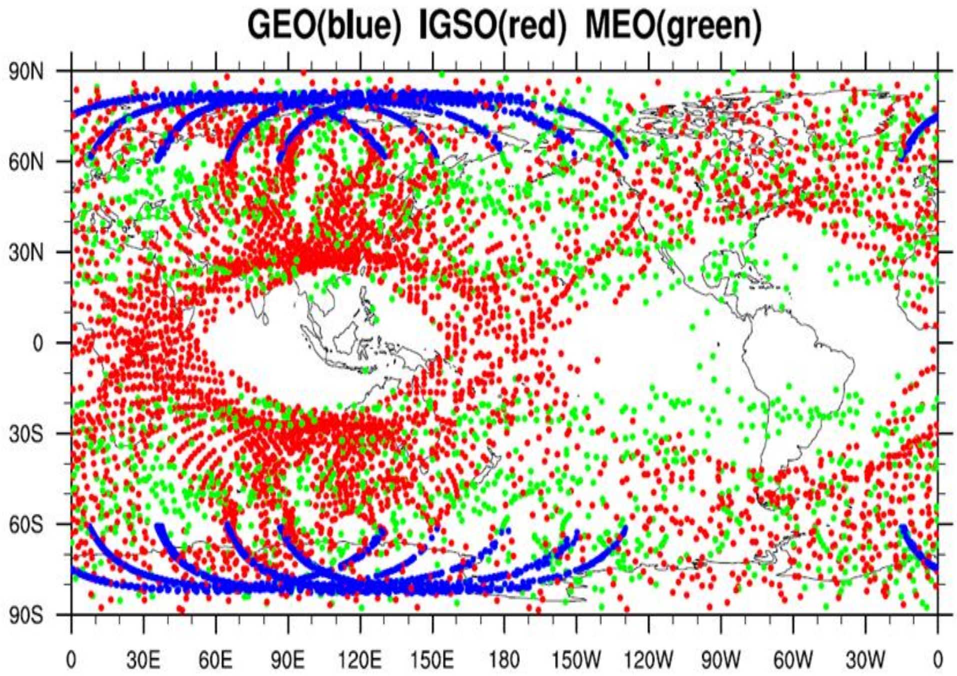


Figure 4. Map of the GNOS BDS occultation coverage
Different colours indicate different constellations. MEO have the same altitude as GPS.

d) P. 3; Line 22: "...departure statistics..." From what?

A: From background data, such as forecast data.

e) P. 3; Line 25: Why more than 20% levels of the profile? How was this threshold selected? Explain.

A: Compared with background data, the bad profiles are defined as the mean biases greater than 10% (100*(O-B)/B) from 5km to 30 km. As we know that the bias of RO at that height is about 1% in normal case. If the threshold is set as 10%, the large departure profiles can be identified.

f) P. 4; Line 10: What is the most effective altitude range that GNOS provides the best RO profiles and explain how this information is used in NWP and how does it improve NWP. Include references to support claims.

A: Currently, there are no published papers talking about the GNOS in NWP. Only some technical reports from personal communications. However, see Figure 2 above.

g) P. 4; Line 14: "...may..." replace with "...could be..."

A: Fine.

h) P. 5; Line 11: Is this L2 signal loss at 20 km normal? Usually L2 signal is lost in the middle troposphere which is about 5 km. Explain.

A: This can be seen from my reply to your second major comment.

i) P. 5; Line 27: "...consistency..." replace with "...agreement..."

A: Fine.

j) P. 6; Line 5: Define "obvious errors".

A: Fine.

k) P. 6; Line 9: Define "other profiles".

A: Fine.