Dear Reviewer,

Thank you very much for providing the valuable comments and suggestions. We do appreciate it. After checked all the comments and suggestions carefully, we'd like to respond them item by item as well.

List of Responses

As to the general comments:

1. We are willing to have a comparison of GNOS rBAs both with GRAS and COSMIC, and ensure the same units and time ranges.
2. That's a good suggestion to check the performance of GNOS-GPS. We had intended to examine the noise at the impact height of 60-80 km. However, the GRAS and COSMIC rBAs data we obtained from CDAAC only capped at 60km (don't know why). In light of this, we can only get the result of GNOS-GPS at 60-80km, but no GRAS and COSMIC.

As to the specific comments:

1. - p9011/L6: **Thanks for providing the more reasonable quote citations. We will replace or add the corresponding references you suggested. Likewise for the p9011/L7, p9011/L21, p9013/L13.**

   - p9011/L16: **thanks for pointing out this, we will correct the corresponding contents.**
2. As to the "p9014/L9: Multipath effects are a phenomenon of the troposphere, why is wave optics applied up to 25km?"

   I thought this separation has been a common view. From my understanding, 25km is the maximum height for wave optics processing. Although multipath effects are a phenomenon of the troposphere, an extended height is kept for transition from WO to GO processing. SAF ROPP also sets the 25km as the maximum height for wave optics.
3. As to the question of "- p9015/L14: Profiles are rejected, if larger than 0.06 rad. Is this applied at a certain altitude range, or to the entire profile? If applied to the entire profile, rejections will probably happen mostly below the boundary layer, and could randomly reject (also high quality) profiles. The measure might also introduce a bias, by constantly rejecting profiles with larger bending angles/refractivities at low altitudes. Has this been tested?"

   This QC is applied above a specific impact height and straight line tangent height. Data are cutoff where the estimated bending angle exceeds 0.06 rad at an impact height above -2km and where the straight-line tangent height is above -250km. The threshold value 0.06 is drawn on the experience of SAF ROPP, which set 0.1 rad, and considered the characteristics of GNOS.
4. As to the "- p9016/L5: "BDS B1 has not implemented open-loop tracking". Does the implementation of open-loop tracking really require changing the transmitted signal (and not just changes to receiver and processing)? Or is it merely a language issue: "Open-loop tracking has not been implemented for BDS B1 signals yet."

Indeed it is a language issue, we are sorry for the unapt expression.

5. "- p9015/L25: "This penetration is comparable to the GPS occultation." The whole paragraph is about GPS occultations. Do you mean comparable to GRAS/COSMIC? "

   Yes

6. "- p9017/L1: are the products open for the public, the entire scientific community, or just parts of it?"

   The products have been uploaded on the data service website of NSMC. Anyone who can access to the internet can download the products through a user account.

7. "- p9017/L13: Instead of using "cosmic2013" I suggest to search for and provide the ID of the reprocessing, do the same for MetOp/GRAS, and then call the datasets just "COSMIC" and "GRAS"."

   Thanks for the suggestions.

8. "- p9017/L16: I doubt that COSMIC and GRAS use/are the identical type of sounders as GNOS."

   Sorry, actually, I mean they are all occultation sounders.

9. As to the different time-ranges, we will stick to the same range in the next revise.
10. "I suggest to add a table after the introduction of the time-range (p9017/L24), where all the numbers of profiles and profile-pairs used for calculations or plots are listed."

    Thanks for the suggestion; we will adopt it in the revise.

11. "Add a sentence clarifying that the same procedure as for refractivity is used for the rBAs." **Thanks for the suggestion; we will adopt it in the revise.**
12. "p9019/L9: The bias from 5-30km is -0.09% and therefore larger than the bias above 45km (-0.05%)".

    After another check of the data, a mistake is found when descripting the value. It is up to -0. 5% above 45km, its average should be -0.25%. We are sorry for the mistake.

13. **As to the suggestion of cutting the plots off at 45km, does it mean all the plots?**
14. "p9020/L1: "This shows better performance than GNOS GPS. We attribute this to the B2."

    This kind of expression may be slightly arbitrary.

15. "p9020/L7: "the "good" performance of BDS below 5 km may be an illusory phenomenon. The sample size [shown] on the right panel of Fig. 5 [decreases] rapidly below 5 km." Besides the language points, I have two remarks: 1. the sample size starts to decrease at 10 or 8km, rather than 5km. 2. The sample size at 5km is still ~1000 profiles, definitely sufficient to calculate mean and std.dev. The Beidu performance appears to be very good…".

    Thank you very much to point out this. Some peers doubt this result due to its fewer samples. I am also wondering that whether the good performance of BDS can be founded just only by comparing in terms of refractivity?

16. "- p9022/L15: "range of +/- 0.05". Why do you use fractions, not %?"

    We thought 0.05 is the same value as 5%, therefore, not using %.

17. “- p9022/L18: “representativity error due to time and space gaps”. See general comments. Your own test of time intervals (p9023/L2) showed that outliers are not sensitive to these (time) gaps.”
    The higher altitude gets larger discrepancies, not only related to random errors, but also systematic or representative errors coming from time and space gaps. Nevertheless, from the test of time intervals, those outliners have a fixed proportion, not sensitive to the time gaps. Therefore, the discrepancies probably related with random errors.
18. “p9022/L24: at which altitude do you apply the 10murad quality check?”
    During the impact height of 30 – 60 km, difference between GNOS and GRAS at any level exceeded 10 urad is excluded.
19. “9023/L20: in Figure 9, consider merging rising and setting occultations (using different colors/linestyle) to one plot for GPS and one plot for BDS”.
    Thank you, we will merge the rising and setting occultations in the new version of plot.
20. “p9023/L21: delete lower (you show 0-12km)”.
    We will do that, thank you.
21. “p9024/L17-22: It would improve the structure of the paper to include a slightly more detailed description of the Beidou-Satellites active in RO soundings in one of the first sections (e.g. in “2.2 The status of the GNOS products”).”
    Thank you for the suggestion, we will consider it carefully, and try to enrich the contents.
22. “Consider replacing Figure 10 by a figure similar to Figure 3 (but for BDS instead of GPS), including penetration depth in color. These two Figures could then be named 3a (GPS) and 3b (BDS), using the same time-frame (e.g. October 1st – November 30th 2013) for both figures. You could then eventually even delete Figures 2a and 2b.”
    Thanks for re-constructing the plots, we will adopt it.

As to the technical corrections:

We will keep in mind to avoid these basic issues. For my first foreign language paper, your suggestions really help me a lot to improving the writing.

As to the language:

As I am not a native English speaker, the language gaps remain, although I have used the copy-editing service for improving the language. In the next revise, we will use another language service to avoid those problems.

“- p9015/L7: probably missing “ECMWF” before T639”: T639 is the forecast field of CMA

At last, really appreciate your kind work.