Response to the Reviewer #1

We thank the Reviewer for the constructive review and the valuable comments. We carefully considered all suggestions and made improvements related to all of them. In the following we address the comments point by point. *The reviewer's comments are in italics.* Changes in the text are highlighted.

General discussion points

"Structural uncertainty" does not appear to be clearly defined early in the paper. Thorne et al (BAMS, 2005, vol 86, 1437-1442) define it terms of a subjective choices in the processing.

We included a definition of structural uncertainty in the introduction section (paragraph#2) and added Thorne et al. (2005) to the reference list:

"For a specific observational record, structural uncertainty arises due to different choices in processing and methodological approaches for constructing a data set from the same raw data [*Thorne et al*., 2005]. Structural uncertainty for the upper-air temperature record decreases by increasing the number of independent observational data sets. Thus, multiple independent efforts should be undertaken to create climate data sets."

In the context of this paper, could we just relate many of the results more clearly to the need for a priori information to retrieve geophysical information from the measurements. Deriving geophysical information from GPS-RO is an ill-posed problem, and a priori is required to make it well-posed. Different centres make different choices about the a priori information used, and how much weight it is given in their retrievals. On page 26976 it is noted that "structural uncertainty increases with increasing altitude ..." and the differences mainly stem from "different bending angle initialization ...". Alternatively we could simply say the processing centres use different a priori information. In this context, a simple statement saying that GPS-RO geophysical products become increasingly sensitive to a priori as the height increases might be useful to a non expert.

The results shown here also show that structural uncertainty is lowest where the measurement information content is highest. This point should be emphasised.

EG, perhaps point out that the bending angle falls exponentially with height, but the measurement noise in the stratosphere is relatively constant, and this leads to an exponential fall in signal to noise with height.

We included the following explanation on the exponential behaviour of the bending angle and the signal-to-noise ratio in section 2 at the retrieval description (paragraph#4):

"The bending angle decreases exponentially with altitude but the measurement noise stays relatively constant in the stratosphere, which leads to an exponential decrease in signal-to-noise ratio with altitude. In order to calculate refractivity, an initialization of bending angles with a priori information is performed at high altitudes to reduce the effect of error propagation downward."

We furthermore reformulated the respective paragraph on page 26976 (section 4.3, paragraph#3) along your suggestions. It now reads:

"Overall, structural uncertainty is lowest where the measurement information content is highest. Structural uncertainty increases with increasing altitude and at high latitudes. The larger differences between centers are regarded to mainly stem from increased sensitivity to the different bending angle initialization at high altitudes in the centers' processing schemes. Different centers use different a priori information, i.e. climatology models (DMI, GFZ, UCAR), exponential extrapolation (JPL), or numerical weather prediction forecasts (WEGC). The initialization approach affects uncertainty from about 25 km upwards and the atmospheric products become increasingly sensitive to a priori information as the altitude increases."

Figure 1 shows convincingly that the consistency is best at the bending angle level. It might be worth noting the NWP users are increasingly moving towards the direct assimilation of bending angles to reduce the sensitivity to a priori information introduced at the data processing centres.
We carefully considered adding a sentence or two on NWP applications. However, since the paper deals with RO climatological products it did not fit well. We therefore prefer not to comment on the assimilation and use (of individual profiles) in NWP applications.

The authors might consider referencing recent papers on the importance of the statistical optimization processing step in the generation of monthly mean climatologies.
Ao, C. O., A. J. Mannucci, and E. R. Kursinski (2012), Improving GPS Radio occultation stratospheric refractivity retrievals for climate benchmarking, Geophys. Res. Lett., 39, L12701, doi:10.1029/2012GL051720.
Gleisner, H. and Healy, S. B.: A simplified approach for generating GNSS radio occultation refractivity climatologies, Atmos. Meas. Tech. Discuss., 5, 5245-5269, doi:10.5194/amtd-5-5245-2012, 2012.
We added the following sentence in section 4.3 (paragraph#3) and included the references.
"Current efforts on improving this optimization processing step involve the use of monthly mean RO climatologies (Ao et al., 2012; Gleisner and Healy, 2012)."

Minor point
Table 1 "EUM" Initialisation of bending angles. This is a strange entry because there are no refractivity, temperature etc results shown for EUMETSAT.
Thank you, we removed this entry in Table 1.