

# ***Interactive comment on* “Quantification of structural uncertainty in climate data records from GPS radio occultation” by A. K. Steiner et al.**

## **Anonymous Referee #2**

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Review of "Quantification of structural uncertainty in climate data records from GPS radio occultation" by Steiner et al., 2012, Atmospheric Chemistry and Physics

### GENERAL COMMENTS

This is a well written paper that describes a statistical analysis of radio occultation (RO) data resulting from processing by 6 different processing centres. The paper is relatively straightforward and the statistics required for the interpretation of the data are not sophisticated (nor do they need to be). The paper will be suitable for publication in ACP subject to the minor corrections detailed below.

One thought was whether this paper was more suitable for Atmospheric Measurement

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Techniques (AMT) rather than ACP. Well, then again, I suspect that the authors want to target the broader climate science community and not just measurement scientists. Anyway, they should just give some thought to this.

The figures in this paper need work. There are only 4 figures in the paper and they each consist of 20 panels or more. The panels are way too small to see much detail. For example, I would suggest splitting Figure 1 into 5 figures, one for bending angle, one for refractivity, one for pressure, one for geopotential height and one for temperature.

### SPECIFIC COMMENTS

Page 2, line 17: I am not sure how to interpret this " $<0.06$  K for temperature". Do you mean a temperature trend of 0.06K over 7 years i.e. around 0.1K/decade?

Page 2, line 19: But surely this depends on the expected temperature trend. Chemistry-climate models suggest expected trends in stratospheric temperature on the order of 0 to 1K/decade.

Page 3, line 2: I think that you need to be more specific here. For example I suspect that the newly revised SSU time series (Wang, L.; Zou, C.-H. and Qian, H., Construction of Stratospheric Temperature Data Records from Stratospheric Sounding Units, *J. Climate*, 25, 2931-2946, 2012) could be considered as coming close to providing an upper atmosphere climate data record for temperature. Maybe you should just say that the radiosonde record is not sufficient? But at the very least you should state what the requirements are for a climate data record before saying that none of the existing data sets (other than RO) meet that standard.

Page 3, line 28: I don't think that you have expanded the CHAMP acronym anywhere?

Page 6, line 11: Even after reading this line a couple of times I still could not understand what the 'impact altitude' is. Maybe it's because I don't know what the 'impact parameter' is. I think that this needs to be explained for people such as myself who are not experts in RO.

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Page 6, line 14: I am very confused by this. The native vertical coordinate for RO is geometric height about the ground. Now you say you calculate geopotential height, assuming a scale height of 7km which is only appropriate when the atmospheric temperature is 239K, from pressure, but where does the pressure come from?

Page 6, line 31: I don't know what you mean by 'suitably available'.

Page 8, line 1: While I could unscramble all of the equations listed in the paper, I thought that in many cases it would be much easier for the reader if they were just replaced with narrative e.g. equation 5 could be replaced with something like "Time series were deseasonalized by subtracting the mean annual cycle from the data".

Page 8, line 13: I think that you need to say a bit more about the regression model that you used to calculate trends. For example, what basis functions, other a trend basis function, were included in the model? How were uncertainties on the trends derived? This, for example, would be important if you are using trend differences to say something about the structural uncertainty in the different data sets. If they do not differ within their uncertainties then that's quite a different matter to if they do. That uncertainty will be affected by how you dealt with auto-correlation in the residuals when running the regression model. This is why I would like to see more details about the regression model.

Page 9, line 4: I really don't like the use of parentheses to create 'parallel sentences'. When I read 'Mean pressure (geopotential height)' I read this as geopotential height being another form of mean pressure which is certainly not the case.

Figure 2 caption: The figure caption is incorrect. It refers to panels (a) through (e) but there are only columns (a) and (b) on the figure. The caption needs to say rather that (a) is for the sampling error not removed and (b) is for the sampling error removed.

Page 9, line 16: I would suggest that rather than showing all of the panels without the sampling error removed, just show e.g. two pairs of panels with and without sampling

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error removed, as a completely separate and new figure, to demonstrate the value of removing the sampling error and then say that similar gains in noise reduction are achieved across all other regions. In the end, it is the two rightmost columns of Figures 2 and 3 that convey the key messages to the reader. If you drop the two leftmost columns the figures will be less cramped and also you can then expand the vertical axes to show more of the detail. I think that doing this would significantly improve Figures 2 and 3. On line 19 you even say 'In the following we discuss the results after sampling error subtraction' so why spend half of Figure 2 and 3 showing results without sampling error subtraction?

Page 9, line 30: Wouldn't it be more precise to say that these results indicate the advantages of the use of bending angle climatologies in the retrievals for climate trend studies?

Figure 4: I would suggest splitting this into 5 separate figures, one for each variable.

Page 11, line 8: It doesn't appear that the MSIS acronym has been expanded anywhere?

Page 11, line 31: But surely temperature changes are also a factor here since the scale height depends on temperature? I really think that you need to explain more carefully in this paper your use of geopotential height as a stability metric.

Page 12, line 21: I don't understand what you mean by 'allows isolating the above trends'. Can you please explain this more clearly.

Page 13, line 13: I don't understand what you mean by 'including different high altitude background information'. Can you please explain this more clearly.

#### GRAMMAR AND TYPOGRAPHICAL ERRORS

Page 2, line 4: Replace 'provides' with 'has provided'. Likewise on page 3, line 6.

Page 3, line 22: Replace 'has been' with 'was'.

Page 5, line 30: Replace 'An overview on' with 'An overview of'.

Page 7, line 22: Replace 'center as function of' with 'center as a function of'

Page 8, line 13: Replace 'Trends of the' with 'Trends in the' and replace 'using standard' with 'using a standard'.

Page 8, line 22: Replace 'Figure 1 pictures' with 'Figure 1 shows'.

Page 9, line 8: Replace 'Fig. 1 pictures' with 'Fig. 1 demonstrates'.

Page 9, line 21: Delete 'basically'.

Page 11, line 9: Replace 'strato-' with 'stratosphere'.

Page 11, line 23: Replace 'program' with 'programme'.

Page 13, line 16: Replace 'were found consistent' with 'were found to be consistent'.

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