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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Characterization of the Long-term Radiosonde Temperature Biases in the Lower Stratosphere using COSMIC and Metop-A/GRAS Data from 2006 to 2014" *by* Shu-Peng Ho et al.

Anonymous Referee #2

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This manuscript compares COSMIC and MetOP/GRAS GPS RO data with radiosonde temperatures in the interval 2006-2014. While this is not the first comparison of these data sets, the one presented here is an improvement due to the long time interval considered and because reprocessed COSMIC data have been used. The comparison is comprehensive and detailed. Accurate estimation of differences between radiosondes and GPS-RO is important since both are potentially used as "anchors" in reanalysis efforts. Other, less accurate data such as satellite radiances or aircraft temperatures are often bias-adjusted adaptively (Dee and Uppala 2009), whereas "anchors" are not.

Therefore I recommend eventual publication of the manuscript after undergoing the following major revisions: 1) Before the actual intercomparison, it should be specified what the structural uncertainties of the two measurement technologies are. These are mentioned for RO retrievals only in the supplement (+/-0.1 K in the 20-200 hPa range) For many modern radiosondes (RS92 in particular) they are specified as +/- 0.2 K below 100 hPa and somewhat higher at higher levels. RS-RO differences that fall within this range, especially if they are different in different regions of the world, should not be considered as "bias", as they may have other causes than systematic measurement errors. Small sample sizes or the different volumes sampled may be the reasons for the differences. 2) Modern radiosondes measure up to the 5hPa level, whereas this comparison stops at 20 hPa. Presumably this conservative choice is related to uncertainties in the inversion of the Abel integral necessary for the conversion of bending angles to refractivities. They lead to larger strucural uncertainties of the RO method. Could you elaborate on this, and also if the +/- 0.1K uncertainty specified for RO profiles applies to the 20 hPa level.

The other review points are minor: 3) The trend comparisons are difficult to interpret since the time interval is so short. Also the regional trend variability is much larger than the trend differences between RS and RO, at least for the more accurate radiosonde types.

4) When looking at the maps in Figure 2, it seems there is quite some heterogeneity even in countries with the same sensor, particularly at daytime, e.g. over China and Brasil. Can you give an explanation? It appears that the radiosonde type is not the only factor that determines the temperature biases. Do you think it is possible to estimate the biases also for each station individually? This has been done by several authors when homogenizing radiosonde time series. 5) The thresholds for daytime/nighttime (SZA < or > 90 deg) may not be optimal. Fig. 8c clearly shows positive biases at 90 deg, only at >95deg they are negative. Also the VIZ B2 and Shanghai sondes seem to reach their nighttime value at SZA clearly larger than 90 deg. I am also asking for

which times the SZA have been calculated? Nominal launch time of the radiosonde or time of collocation? Please clarify. 6) What is the reason for the strong decrease in measurement numbers already at 70 hPa over the US (Fig. 3a)? Did the reports from higher levels go missing? At most other places RS92 sondes consistently reach 20 hPa. 7) Fig. 3 onwards: You plot means and standard deviations. Instead you could plot means and the standard deviations of the MEAN (sigmaˆ2/sqrt(N)) or 95% confidence intervals. This would allow a smaller scale for the x-axes. 8) Figs 5,8: Please triple number scale so that there is less intersection between number line and departures. 9) Fig. 9: Are these differences significant? The samples are smaller here. If std is 1.5K and number is 1000 for both samples, then the std of the means is roughly +/-0.05. For a 95% confidence interval you have to multiply with 1.96. Thus a large fraction of the differences shown in Fig. 9 would be insignificant. 10) Figs 11-13: Are the trends or trend differences significant? Please give confidence intervals for slopes. 11) Layer mean 20-200 hPa bias values in tables 1,2 are of limited use, since the biases changes a lot over this range of pressure. 12) Tables 3,4: What do you think is the reason for the very different biases over Brasil at 150 hPa for RS92 sondes? This level is well below the tropopause. Is it possible that water vapor or cloud content could adversely affect the RO estimates there. These effects have been neglected in Formula 1. 13) l718: traceability, not tractability. 14) l1385: RAOB instead of ROAB 15) l653-655: Some words are missing, the sentence does not seem to be complete. 16) l558: non-trivial

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