Atmos. Meas. Tech. Discuss., 7, C2087–C2093, 2014
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Atmospheric Measurement Techniques Discussions

Interactive comment on "Application of GPS radio occultation to the assessment of temperature profile retrievals from microwave and infrared sounders" *by* M. Feltz et al.

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Received and published: 11 August 2014

General Comment Response:

"Discussion Comments: These are comments on the manuscript "Application of GPS radio occultation to the assessment of temperature profile retrievals from microwave and infrared sounders" by Feltz et al, manuscript amt-2014-74, submitted to Atmospheric Measurement Techniques. This study uses GPS radio occultation retrievals to validate temperature profiles from nadir sounding instruments. As noted in the study, information from GPS RO is a useful complement to information from radiosondes, es-

pecially the GPS RO unbiased sam- pling over land and ocean. The authors have compared the performance of multiple nadir sensing instruments using GPS as a transfer standard. These intercomparisons are a necessary step in creating merged records from all instruments, something especially challenging with sounders in different orbits. Also, the comparisons in this study are broken into separate latitude zones. The authors note some often-overlooked is- sues with the sounder data, including compensating biases in different zones and errors unique to one of the algorithms used to process data in this study. Finally, the manuscript is well organized and clearly written. For all these reasons, the results are appropriate for publication. As for weaknesses, my primary concern is the lack of information about the number of samples that go into the comparisons. While GPS RO may have thousands of profiles per day, how many are within the matching criteria used in this study? This issue needs to be discussed in the text, and appropriate information needs to be conveyed clearly, either by including the counts in each panel or by putting some sorts or error estimates (even crude ones) on the profiles plotted."

Author Response: The number of matchup cases was denoted in the legends of the manuscript figures 2 and 3, but never explicitly referenced in the text (a definite error that will be fixed). Additionally figures of sample count profiles (i.e. the number of samples used in the analysis after quality control) were created and though they would not be included in a revised manuscript version, they are shown below in Figures 1 and 2 for the manuscript figures 3 and 4 respectively.

Because the number of matchup cases were not included for Figure 4 of the manuscript (the GRAS/COSMIC comparison), a table could be added to the manuscript to summarize this information subject to editorial approval.

The following would be added to the manuscript in Section 4.1: "By using COSMIC dry temperature as the GPS RO reference, a comparison of sounder retrieval product version is presented in this section. Figure 2 compares the AIRS v5.2 and v6.0 statistics for the month of May 2012, with the number matchup cases noted in the legend.

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Feltz et al. (2014) concludes that the difference statistics become stable for a number of matchup cases greater than 200."

Section 4.2 "Figure 3 compares three different sounder temperature retrieval products, AIRS v5.2, NOAA IASI, and CrIMSS Mx5.3, using COSMIC as the reference GPS RO source. Statistics of the three sounder minus COSMIC profile sets for the month of May 2012 are overlaid, with the number of matchup cases for each latitude zone again noted in the legend."

Section 4.3 added ref. to possible table "The numbers of matchup cases for this comparison are shown in Table 2 by latitude zone. Though the number of matchups for COSMIC/NOAA IASI is less than half that of GRAS/NOAA IASI in the tropics (30N-30S), this region is known to have less variability than others. "

Discussion Comments: "Also, echoing an earlier reviewer's comments, some attempt should be made to in- corporate or approximate the averaging kernels in the comparisons. Doing so should reduce the vertical oscillations apparent in Figure 3. Given the much higher vertical resolution of the GPS RO, this does not need to be as involved as outlined in Rodgers and Connor. The sounder averaging kernels alone will suffice. However, I agree with the authors that the fundamental issue here is inter-sensor comparisons, especially biases, and that the instrument performance is usually defined for standard layers. One suggestion is to apply a smoothing filter of 2 km thickness, more consistent with the vertical resolution in Maddy and Barnet, 2008, TGARS. This may reduce some of the oscillation in the biases. The basic question to answer is: will some of the vertically oscillating bias be reduced by applying averaging kernels? The assumed 'no' answer may be wrong."

Author Response: In response the vertical resolution/degrading/averaging kernel issue, please see the author's response to anonymous referee's discussion comment #1.

Discussion Comments: "Finally, what about land-ocean differences? While the results

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in this study stand alone, conditioning by the underlying surface may reveal more biases (which probably cancel in the global mean). However, looking into land / sea differences is more a suggestion than a necessity for making the paper ready for publication."

Author Response: An investigation into land and ocean differences would definitely be interesting and the suggestion is appreciated, however, the topic was decided to be left out of this paper and saved for a later study.

Specific Comments:

Discussion Comments: "Here are a few other comments (few because of the quality of writing in the manuscript): p. 5077, line 12. Here the 'select' can be expanded to note strictly cloud-free radiances, as compared to cloud-affected radiance used in the retrievals. Many in the community assume they are the same radiances. p. 5079, line 11. Are the orbits all in the same inclination? In any case, different –or the same orbital inclinations should be noted. p. 5085, last sentence. Suggest changing 'zonal' to 'regional'. Also, to be very clear about what is going on, suggest changing 'not just . . . as is common practice' to 'because global comparisons will hide compensating local biases'.?"

Author Response: p. 5077 line 12 - Thank you for the comment. This would be changed in the manuscript.

p. 5079 line 11 All orbits are in the same 72 degree inclination (Anthes 2008). The manuscript could be changed to "COSMIC, also known as Taiwan's Formosa Satellite Mission #3 (FORMOSAT-3), is a mission consisting of six radio receivers in circular 72 degree inclination orbits, (Anthes et al., 2008)."

p. 5085 last sentence We have not studied regional scales yet, but hope to do so in the future. (With regional implying a smaller scale such as 15 x 30 degrees.) The last phrase could be restated more explicitly to "as global comparisons will hide compen-

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sating local biases”

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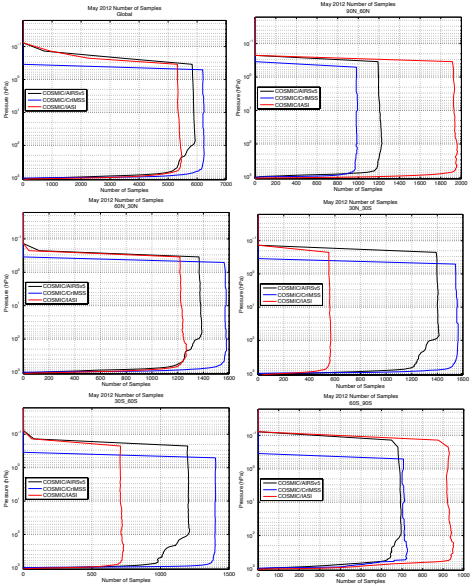

Figure 1. Number of samples (matchup cases with valid data) as a function of pressure for the COSMIC and AIRSv5 (black), CrIMSS (blue), NOAA IASI (red) May 2012 comparisons by latitude zone. Note the change in x-axes between subplots.

Fig. 1. Figure 1. Number of samples (matchup cases with valid data) as a function of pressure for the COSMIC and AIRSv5 (black), CrIMSS (blue), NOAA IASI (red) May 2012 comparisons by latitude zone.

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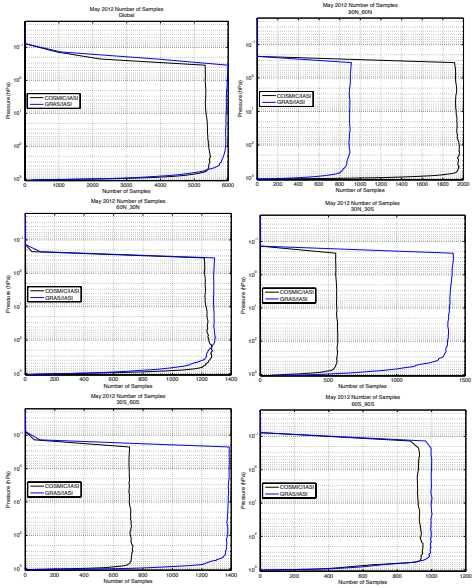

Figure 2. Number of samples (matchup cases with valid data) as a function of pressure for the IASI and COSMIC (black), GRAS (blue) May 2012 comparisons by latitude zone. Note the change in x-axes between subplots.

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