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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.

Anonymous Referee #1

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General Comments:

In this paper, the authors are trying to use three comparisons to reach the conclusion "GPS RO network can be used as a common reference for the comparison of sounder products from different sensors on different satellite platforms using different retrieval algorithms."

The three comparisons conducted by the authors are:

i) Use GPS RO data as common references to quantify the quality of temperature profile retrievals from AIRS v5.2 and AIRS v6.0: this is the case for the same sensor,

using the same samples, but using different inversion algorithm.

ii) Use different RO data that matching with AIRS, CrIMSS, and IASI separately to quantify the quality of AIRS, CrIMSS, and IASI retrievals: this is the case for different sensors, using the different samples, and different inversion algorithms.

iii) Use IASI as references and compare IASI temperature profile with co-located COSMIC data and GRAS data then to quantify the differences between GRAS and COSMIC temperature profiles.

To have a fair comparison between two satellite-derived profile retrievals, one will need to at least consider i) temporal and spatial sampling mismatching, ii) vertical resolution differences, and iii) possible errors due to different inversion methods and a priori in different lat zones.

Using a method introduced by Feltz et al. (2014), the authors largely eliminate the spatial and temporal sampling mismatches of RO-sounder pairs. However, the vertical resolution difference is in general ignored in this study. Although 1km smoothing is applied to RO data, large vertical oscillations (+/- 2K in some cases) still exist, which is most likely due to unresolved smoothing errors. For some comparisons (i.e., see Section 4.2 and 4.3), the temporal/spatial sampling errors are mixed with the vertical resolution errors.

In this study, the sounder errors defined as the bias and RMS error, which are used to quantify the "performance" of the sounder products from different sensors on different satellite platforms using different retrieval algorithms. Although the authors intend to use the proposed approach to "quantify" the sounder errors, most of the biases and RMS errors due to i) vertical resolution differences, ii) sampling differences, and iii) a priori differences are not isolated and are largely unexplained.

In general, the authors are intended to solve three very complicated inter-satellite comparison issues. However, the current results do not completely support the conclu-

sions. Main results are presented in three short sections and each section contains only one figure and a short paragraph to explain the complicated causes of the bias and RMS. More works are needed to isolate above errors so that the "performance" for different instruments can be truly quantified. More detail explanations and algorithm descriptions are needed too.

Specific comments:

1) Section 4.1: AIRS V5.2 – COSMIC vs. AIRS V6.0 – COSMIC

This is the case for the same sensor, using the same samples, but using different inversion algorithm. Again, the sounder error is defined as the bias and RMS error. The "improvement" is defined by smaller AIRS-COSMIC biases and RMS errors.

a. The sounding retrieval results are highly dependent on pre-defined a priori information, channel selection, underlying temperature contrast etc. The pattern of the large positive and negative biases (more obvious in 60S-90S zone) is showing the unresolved vertical resolution difference between RO and AIRS. Please consider using the method introduced by Rodgers and Connor 2003 to eliminate the vertical resolution and a priori effects (i.e., averaging kernels) then make the comparisons. Otherwise, please explain how the globally 1km smoothing of GPS RO data would affect the biases and RMS in different lat zones ? How will the results differ if you use 2 km smoothing ? Can the vertical smoothing explain a part of the larger biases in 60S-90S since the correlation length is too short in a colder environment ? This is a complicated issue and it is pity only simple but incomplete explanation is provided.

b. Not enough information of AIRS V5.2 and AIRS V6.0 in terms of the a priori information (averaging kernels and a priori profile) is presented. Are the same a priori profiles used in both V5.2 and V6.0 ? How does the averaging kernels different in different lat zones ? Please explain how is the different pre-defined a priori information, channel selection and different approaches in AIRS V5.2 and AIRS V6.0 contribute the biases ? These are complicated issues and will need to be addressed in depth before any

solid conclusions can be obtained.

c. P7, line 27, it is confused to state "COSMIC dry temperature profiles do not have these vertical oscillations" because COSMIC profiles are used as references. Please revise and provide the reason for "arguably larger in magnitude in the biases" in next sentence.

2) Section 4.2: for comparisons of AIRS V5.2 – COSMIC pairs; CrIMSS – COSMIC pairs; IASI-COSMIC pairs

This is the case for different sensors (with different weighting functions, a priori information, averaging kernels), using the different samples, and different inversion algorithms. Note that, no all profiles retrieved by using any different algorithms can be directly compared and the causes of the biases can be freely explained. Therefore, if possible, please state the difficulties for why it is not straightforward to directly compare, for example, IASI and AIRS ? Are there any studies for the AIRS vs. IASI comparisons ?

Although the retrieval results from these sounding data are reported in 101 vertical levels, AIRS, CrIMSS, and IASI measurements can only provide around 5 to 10 degree freedom of signals depending on locations and times. It is really unjustified to compare bias and RMS from different sampling pairs from AIRS-RO, CrIMSS-RO, and IASI-RO mathcups in the same plot. Is it possible to find a common RO pairs for AIRS, CrIMSS, and IASI ?

Is there is a way If it is not possible, then please at least consider quantifying bias and RMS due to i) temporal sampling errors, ii) spatial sampling errors, iii) vertical resolution errors, iv) errors due different a priori profiles separately.

Otherwise, please consider removing the whole section since all the i) temporal sampling errors, ii) spatial sampling errors, iii) vertical resolution errors, iv) errors due different a priori profiles, v) different inversion methods are all mixed and hard to be

explained. It is not justified to state which results are better and why.

3) Section 4.3

This is the case to use the mean bias of IASI-COSMIC matchups to minus the bias of IASI-GRAS to define COSMIC-GRAS bias.

Again, the mean bias and the RMS are used to quantify the quality of the retrievals. How justify to state that IASI data can be used as a common references ? Will the quality of IASI data vary with location and time ? How the quality of IASI data (i.e., averaging kernels) vary with locations and how to quantify that ? Again, since IASI-COSMIC and IASI-GRAS matchups are collected from different times and locations, how can you quantify the temporal and spatial sampling errors and how will that affect the results in Fig. 4 ?

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 5075, 2014.