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Atmospheric Measurement Techniques Discussions

Interactive comment on "Establishment of AIRS Climate-Level Radiometric Stability using Radiance Anomaly Retrievals of Minor Gases and SST" *by* L. Larrabee Strow and Sergio DeSouza-Machado

Anonymous Referee #1

Received and published: 10 March 2020

This paper quantitatively evaluates the radiometric stability of AIRS observation. It provides an important guideline for future studies on climate-trend monitoring using AIRS and other infrared hyper-spectrometers. I believe it qualifies very well for this journal. It is well written and organized. I recommend this manuscript to be published after minor revision.

Main Comments:

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Discussion paper

Generally, I appreciate the logically organized approach present in this paper. Improvement can be made on the coherency of terms, explanation of figures, and other technical details. Further quantitative evaluation of this approach in the following aspects might be helpful:

1. Section 3.2 4.1: the Jacobian used in later retrieval could be sensitive to the temperature and water vapor amount, which is derived from the ERA-I dataset in the article [Line 217 to Line 223]. However, in Figure 2, besides a clear pattern in CO2 channels, the bias in O3 and H2O channels is large as well. This may imply biases in temperature/humidity profile in the ERA-I datasets, even for those channels clearly insensitive to the upper troposphere and stratosphere, which is not totally in agreement with the statement in Line 219 '. . .**ERA-I is so accurate we do not believe this is needed...** ".

I think it is important for the author to demonstrate, or at least mentioning in the text, whether Jacobian values of minor gases are sensitive to temperature and humidity, and whether updating them (besides gas amounts itself) is necessary.

2. Section 4.2: Can you clarify how Fig. 7 helps to evaluate the effect of Jacobian co-linearities?

3. Eq. 1: please define $r(t)$, r_0, and Φ in the text.

4. Can you add an equation to describe how a1 in Eq.1 and Eq. 2, and the directly retrieved quantity, x, is linked? In the Eq.1 and Eq.2, a1 terms are the linear trends of BT anomaly with time, but Fig. 11 and Line 340 treat it as the linear trend of individual gas amounts. I think it can be defined more carefully to avoid misunderstanding.

5. Section 5.7: Considering SST has a large diurnal fluctuation and a sun-synchronized orbit overpasses one geolocation approximately every 12 hours. Such temporal sampling may result in large bias in SST if directly compared it to a multi-day mean product. When compare AIRS retrieved SST and other products, have you considered the effect of this sampling difference?

6. It will be very interesting to see how the spectral anomaly at selected channels looks like and how it can be decomposed to spectral anomaly signal due to each retrieved anomaly (especially those discussed in the paper), compared to Fig.18.

Can you make a figure illustrating it? If possible, showing the standard deviation and linear trends of such spectral anomaly may be helpful to understand, besides the discussion showing in Fig.19, whether some channels are behaving no physically.

Technical comments:

1. Figure 2: . . . near 700-760 cm^{-1} is due 'to' . . .

2. Line 161: delete extra 'by'.

3. Line 165: change 'influence' to 'influenced'.

4. Figure 5: . . . differences in the AIRS and ERA-I anomalies 'are'. . .

5. Line 248: change 'this' to 'these'.

6. Line 253: 'RTA' is never spelled out.

7. Line 266 to 267: considering rephrasing: ‘ because viewing angles to the Earth and cold scenes might change every so slightly’.

8. Line 294: delete ‘in’ located below . . .

9. Line 396: change ‘use avoid . . .’ to ‘avoid using . . .’ or consider rephrasing.

10. Line 412: change ‘on’ to ‘one’.

11. Line 418: delete extra ‘two’.

12. Line 450: change ‘an’ to ‘a’.

13. Line 493: delete extra ‘the’.

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