Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2019-504-RC2, 2020

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 #2

Received and published: 11 March 2020

The manuscript introduces and discusses important methodology and results to the suitability and utilisation of AIRS for climate applications, showing also a way for other hyperspectral sounder products (e.g. IASI, CrIS...). Based on a 16-year series, it indicates that AIRS radiance measurements and retrieved quantities match stability and sensitivity requirements for climate trend studies, as evaluated indirectly by Obs fit computations and direct intercomparisons to external reference measurements. This is found in line wit the scope of the journal and expected scientific novelty.

I find the manuscript overall very well structured and written, providing sufficient results

and discussions, with clear illustrations and appropriate references.

I recommend the publication of the manuscript pending few clarifications listed below.

—— General: "However, ERA-I is so accurate, that is not necessary" and similar other statement, sounds too absolute statement. The "so accurate" sould be elaborated a bit more, especially in view of some non-negligible biases seen in Fig.2.

L38: has it ever been considered to use AMSU in combination to disentangle T/CO2 signals? Like e.g. in Crevoisier et al. 2011 (TBC). would independence be more useful to climate studies, as oppoosed to using climatological CO2?

L56: not sure what the retrieval residuals can tell us really. The fit, if minimisation well programmed, will always come down to about the observation error in the end.

L65: how about any bias correction prior to the 1D-Var? NWP DA for instance need BC in variational minimisation to fit OBS with CALC. Has it been ever considered in AIRS L2 retrieval?

L115: over year+ ? clarify editorial

L161: by by (or bye bye typo)

L162: stddev in window may be due also to uncertainties in the forward modelling, including RTM/spectro as well as input SST/H2O profiles.

eq(5): explicit L?

L191: why are forward model uncertainties not included? The rationale (and consequences) should be discussed. Any bias correction?

L194: typo "more layers thAn"

L206: needs a little more explanation how the 0.004K and even 0.001K extremely low noise values were found. I assumed simple signal/noise enhancements resulting from massive averaging. However it is difficult to believe that one can fit the observation

down to that level, usually the RTM uncertainties combined with the effect of state vector not varied in the retrieval are larger than the instrument noise.

238, 264: incomplete ref (Aumann)

240-242: the DoF for O3 and H2O appears quite large compared to what is commonly accepted, as pointed out (usually $\sim$3 for O3 and 6-8 for H2O). I think this is more directly due to the massive averaging which effectively results in lowered instrument noise. 321 H20 channels on a single pixel would not bring such a high DoF, would it? Temeprature is a little under what is commonly expected of hyperspectral sounders $\sim$10-12 DoFs. But in this case, the channel pruning might be responsible for the signal loss.

254: typo to to (two to)

271: complete ref (Tans and Keeling)

L312: section reference broken

Fig.11: isn't it possible to plot break-down of ESRL components in their different latitudes location?

Explain Lag-1 autocorrelations

§5.5 For clarity, move Table 4 and Fig. 12 in section 5.5.

The larger departure AIRS - ESRL for CH4 and N2O over time is interesting, yet unexplained. Seems noticeable enough in Climate app context.

5.7: I understand that OSTIA provides the foundation SST (Merchant et al. 2014, Corlette et al., GHRSST website...), which is physically different to the radiative skin SST which is accessible to AIRS. In that respect, I find the agreement rather impressive with nearly no biases, while one could expect some given the different SST quantities. The authors should confirm the respective intrinsic nature of the SST datasets (model and retrieved) and possibly discuss the agreement accordingly. A correction of e.g.

skin-to-bulb bias of 0.17K may be necesssary in absolute term, it would however not impact the relative variation over time.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2019-504, 2020.