Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2017-261-RC2, 2017

Atmospheric Measurement Techniques Discussions

Interactive comment on "Single Footprint Retrievals for AIRS using a Fast TwoSlab Cloud-Representation Model and All-Sky Radiative Transfer Algorithm" *by* Sergio DeSouza-Machado et al.

Anonymous Referee #2

Received and published: 29 September 2017

The manuscript ÂńSingle Footprint Retrievals for AIRS using a Fast TwoSlab Cloud-Representation Model and All Sky Radiative Transfer AlgorithmÂż of DeSouza-Machado et al., submitted to Atmopsheric Measurement Techniques presents a study in two parts. The first one compares two infrared cloudy radiative transfer models (RTM), a fast and complex cloudy RTM and a fast and simplified cloudy RTM. Based on their results they used in the second part the fast and simplified cloudy RTM model to improve water vapor and temperature profile retrievals from AIRS cloudy observations. The results presented here are very encouraging and comparison with other

independent product such as NUCAPS will be interesting in the future. Overall, the paper is well written and well structured. I do recommend this manuscript for publication in AMT but after minor revisions.

General comments:

1) It should be mentioned in the title that the All-sky radiative transfer algorithm cover the infrared spectral range.

2) The last sentence of the second paragraph of the introduction seems a bit too simplistic considering the large amount of works done by national weather services to assimilate infrared cloudy radiances in NWP. If the cloud-clearing method is operationally used by NOAA and NASA, other methods such as CO2-slicing, Maximum residual method and 1DVAR are used to characterize single layer cloud for operational application. I suggest the author to provide at least some references to these works.

3) I do not see the utility of Figures 13 and 14. Does the authors want to explain why ECMWF is better than climatology for the retrieval ? If yes, then it must be stated in the text.

Specific comments:

Page 4, line 31: What is the spectral resolution of AIRS? Is the typical 0.2 K noise for cold or hot scenes?

Page 5, line 10: replace 00.00 by 00:00

Page 5, line 12: (latitude,longitudes) can be remove if the unit of 0.25+/-0.05 is given.

Page 6, line 8: The sentence is not precise enough. Do you mean gamma size distribution? If yes then the unit of the effective variance should be added as well as the effective radius or diameter.

Page 6, line 16: Does SARTA use the same refractive indices as PCRTM ?

Page 6, line 26: A space is missing before the reference.

Page 7, line 11: Why cloud content profile are smoothed?

Page 7, line 23: Are case 2 often happen?

Page 7, line 30: What is the justification of adding a random offset to the effective diameter?

Page 9, line 6: I think the word types should replaced by layers if case 2 happen.

Page 11, line 17: What are the standard deviation or RMS of the difference Observation minus simulation? Are they comparable between SARTA and PCRTM?

Page 13, line 15: The first bracket of the second reference is not at the right place.

Page 14, line 3: replace 1 1/2 by 1.5 for consistency

Page 15, line 1: I do not see difference in the slab position between blue and cyan. Can you explain it better?

Page 15, line 5: The first bracket of the reference is not at the right place. I also suggest to refer the listing (1), (2), (3) and (4) to the figure.

Page 16, line 3: Positions (1), (2) and (3) are not represented on the right panel of Figure 6.

Page 17, line 1: Are pdfs normalized? If yes it should be mentioned both in the text and in the figure caption.

Page 17, line 19: Is these interpretations have been already shown by other studies?

Page 17, line 22: I suppose ice contamination is sea-ice?

Page 17, line 28: This sentence seems to repeat the sentence before, please reformulate.

Page 19, line 5: There is again a bracket problem with this reference.

Page 20, line 11: Replace Tikonov by Tikhonov.

Page 20, line 13: Put the references before the dot.

Page 20, line 16: The forward model error has been set to be < 0.2K. This is very optimistic for infrared cloudy simulations. As comparison in figure 5, you found a standard deviation of 20 K when comparing observation with RTM. How do you justify that?

Page 20, line 21: What do you mean with logarithmic multiplier for ozone? What is the unit of the cloud amount?

Page 20, line 25: Please, correct Tikhonov.

Page 20, line 29: How the 10% cloud amount uncertainty has been chosen?

Page 21, line 3: Correct physically-based

Page 21, line 5: Appendix II instead of 10

Page 21, line 9: remove file.

Page 21, line 26: the value of the surface temperature uncertainty is not consistent with line 28 of page 20.

Page 24, line 13: Please explain what is Âńfinal UMBCÂż in the legend of Figure 11?

Page 27, line 4: the DOFS and FOVs numbers are not consistent with those of the figures 13 and 14 labels. Please clarify.

Page 27, line 7: I do not see on the figure where is the little difference between the retrieved profile temperature and the a-priori. If it was the case then the red full line would be close to the 0 line ?

Page 29: please indicates the units of relative humidity both in the figure and in the label

Page 30, line 1: please correct “deg”

Page 30, line 20: this paragraph is difficult to understand since there is no figure to help to reader. Is this a general feature of the retrieval or is this a feature of the track B ?

Page 30, line 30: This result is very interesting and I suggest the author to compare this results with other works (for example the work of Heymsfield, A.J., S. Matrosov, and B. Baum, 2003: Ice Water Path–Optical Depth Relationships for Cirrus and Deep Stratiform Ice Cloud Layers. J. Appl. Meteor., 42, 1369–1390, https://doi.org/10.1175/1520-0450(2003)042<1369:IWPDRF>2.0.CO;2)

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