Review of "An assessment of the accuracy of the RTTOV fast radiative transfer model using IASI data" by Marco Matricardi.

As I stated in my original, brief, review I believe this work should be published – it documents analysis of updates to a fast radiative transfer model in use by many researchers around the world. Additional, it addresses issues with the line-by-line modeling that is the basis for fast RT modeling everywhere.

However, the article requires significant work to get it into a condition suitable for publishing. The text desperately needs to be edited to improve the layout. There are insufficient paragraph breaks which greatly impede the reading and comprehension of the text. The paragraph sizes seem to increase towards the end of the article.

Specific issues with the article are listed below.

Introduction

Second paragraph starting

> "In fact, LBL models are…"

should read

> "Since LBL models are…"

The RTTOV model

The last sentence of the 4th paragraph: "For instance the inaccurate knowledge of molecular line strengths alone can result in TOA radiance as large as 0.3-0.4K." A reference is needed to support this statement.

The line-by-line models

The first paragraph cites Rizzi et al. (2001), but there is no corresponding reference in the References section.

Also in the first paragraph, the sentence:

> "These channels have weighting functions that are sharper than the weighting functions that characterize the channels placed on top of the spectral lines and consequently particular attention must be paid to the spectral line shape of species like H_2O and CO_2 for which optical depths in the atmosphere can reach very large values."

is very confusing and needs rewriting. A suggestion is:

> "These off-line channels have weighting functions that are sharper than those for on-line channels and consequently particular attention must be paid to the spectral line shape of species like H_2O and CO_2 which have a large dynamic range of atmospheric optical depths."

I'm not sure if the dynamic range of optical depths is what should be used here.

Also in the same paragraph, a reference is needed to support the statement,

> "The effect of line mixing [elided parenthetic explanation] in the CO_2 Q-branches is now routinely incorporated in LBL algorithms and in the recent

> past progress has been made in the development of improved CO_2 line shapes by taking into account the effect of line mixing in CO_2 P/R-branches."

particularly since the phrase "recent past progress" is used.

The second last sentence of the same paragraph refers to the "MT_CKD model". A citation is needed to accompany that reference.

GENLN2_v4

Citations are required for the references to CKD_2.1 and CKD_2.4.

The paragraph also needs to be restructured and broken up into more manageable pieces.

kCARTA_v1.11

The version number in the section title (1.11) is different from that in the text (v11.1).

A citation is required for the reference to the MT_CKD_1.0 model (is it different from the previous reference to the "MT_CKD model"?

LBLRTM_v11.1

In the first paragraph, the citation "Niro et al. (2055)" is incorrect.

The subsequent paragraphs in this section should be in their own section since they detail the LBL computations for all the different models just discussed.

In the second paragraph there is a sentence that starts "For the LBLRTM computations we have envisaged…" Is "envisaged" the correct word to use here? I think a more pedestrian word like "created" is more appropriate.

Also in the second paragraph, for the Matricardi (2006) citation (there are two), there is no corresponding reference in the References section.

Still in the second paragraph, the word "envisaged" in the sentence that starts "Although Matricardi (2006) suggests…" needs to be replaced with something simpler, like "used".

In the third paragraph of this section, the discussion of figures 1 and 2 includes:

> "These figures show that in the 10 micron window region MTK_CKD_UMBC self broadening coefficients are smaller than CKD_2.4 and MTK_CKD_v1.4 coefficients."

This is not very clear from figure 1 unless one really looks closely at the $1000cm^{-1}$ region of the plot. If the point is to be made, then a separate plot should be used to emphasize the differences.

The next sentence states,

> "In the centre of the water vapour band around $1600\ cm^{-1}$ the CKD_2.4 foreign broadening coefficients are smaller that MTK_CKD_UMBC and MTK_CKD_v1.4 coefficients whereas for *larger* [emphasis mine] wave numbers MTK_CKD_UMBC foreign broadening coefficients are larger than CKD_2.4 and MTK_CKD_v1.4 coefficients."

How much larger wavenumbers? What about the artifacts in the $2200\text{-}2700cm^{-1}$ region?

The monitoring experiments

In the first paragraph, the meaning of the terms "cycle 33R1" and "IFS" should be defined/explained.

Also in the first paragraph, I think the water vapour stddev amounts, 0.5 and 1.5g/kg, should also be stated in terms of a percentage as well.

Again in the first paragraph, the year in the citation for Kara et al., 2006 does not agree with the year given in the References section.

In the last paragraph of this section, it needs to be clearly stated exactly what "RTTOV coefficients based on GENLN2 and LBLRTM" means. That is, state that

- "LBLRTM experiment" refers to RTTOV calcs using LBLRTM-derived coefficients
- "GENLN2 experiment" refers to etc.

This may seem obvious, but this is the first time where the monitoring experiments are referred to by the LBL model used to derive the RTTOV coefficients.

Discussion of the Results

IASI band 1

The first paragraph in this section is monolithic! For example, new paragraphs could be started at the sentence "Figure 4 shows that…", as well as "A feature of the LBLRTM and GENLN2 spectra…", and also "As discussed above, the performance of…".

The second paragraph in this section is actually longer than the first! Argh! New paragraphs can be started as the sentences "Also noticeable is the feature…", "Errors in the SST analysis…", "Results for the tropical band…", "This is all the more evident…", and "Finally, we want to comment…". It is exceedingly difficult to read and comprehend the results from a paragraph this long. But, having said that…

Why is figure 6 referred to before figure 5? When a reader comes upon a reference to "fig.6" after previously encountering "fig.4" they get confused. Why not simply make figure 6 be figure 5 and vice versa?

The sentence "Also noticeable is the feature (a kink) in the GENLN2 spectrum around 1000 cm^{-1}." This feature is not *that* noticeable given all the other features in that plot.

More explanation should be given as to why "Errors in the SST analysis Errors in the SST analysis should also be taken into account in that they can contribute to the biases."

A definition or explanation (with citation) for ISEM should be provided.

The author should consider removing the second and third "channels" from the sentence

"It is also possible that channels identified by the cloud detection scheme as clear channels are in fact channels affected by clouds."

to give

"It is also possible that channels identified by the cloud detection scheme as clear are, in fact, affected by clouds."

Still on the same paragraph, but now on page 9, we see a sentence:

> "Results shown in the bottom panel of Fig.7 corroborate this hypothesis in that GENLN2 and kCARTA biases are in very good agreement"

Figure 7 has no GENLN2 data plotted in it. Does the author mean figure 6 here? This is doubly confusing because the next sentence refers to a feature at "…1000cm^{-1} in the GENLN2 spectra for the tropical and southern latitude band." I presume this sentence refers to figures 5 and 6 respectively? If so, it should be stated.

In the last sentence of this paragraph, the text "…but it is difficult to argument in favour of a possible impact…" should be replaced with "…but it is difficult to argue in favour of a possible impact…".

IASI band 2

This section is all one massive paragraph. My suggestions for new paragraph breaks would be at the sentences: "LBLRTM and kCARTA spectra exhibit…", "The GENLN2 spectrum in the lower panel…", "In terms of absolute biases…", Results for the tropical band…", "Since GENLN2 and kCARTA use…", "It could be argued that the kCARTA…", "Finally in the lower panel of fig. 11…".

Similar to the previous section, a later figure (figure 10) is referenced before an earlier one (figure 9). Why not swap the figures?

The range of 1980-2000cm^{-1} mentioned in the sentence beginning "In terms of absolute biases…" is a very small spectral width to focus on given the entire plot is 1200-2000cm^{-1}. Why not plot that section of the residual separately?

In the sentence (referring to figure 9),

> "Differences between the spectra are now larger and the structure of the spectra is more articulate."

I think the word articulate should be replaced, or the sentence rearranged. What about,

> "The spectrum differences are now larger and with more spectral structure."

?

In discussing figure 11, there is a reference to kCARTA spectra using the LBLRTM continuum (kCARTA_LBL). This was also used in the caption for fig.7 (for band 1) but was never defined in the text. This must be corrected.

IASI band3

I didn't review this section due to the single paragraph. The structure of the article really needs to be resolved.

Conclusions

Ditto. Again, one single paragraph.

Tables

The title for table 1 needs more information. What about "Basis of LBL data used for regression fitting" ?

Figures

In all the latitude band plots, figures4-15, label the plot captions with the same information as figure 3 for the latitude band, i.e. 30N-90N, 30N-30S, and 30S-90S. There is no explanation in the text of what latitude range corresponds to northern hemisphere, tropical, and southern hemisphere.

Also, I mentioned in my notes that there are several references in the article that call for additional figures – the plot ranges of the figures that are present don't scale well to some of the features mentioned in the text.