

Interactive comment on “Performance of the line-by-line radiative transfer model (LBLRTM) for temperature and species retrievals: IASI case studies from JAIVEx” by M. W. Shephard et al.

Anonymous Referee #1

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General comments:

This paper presents an evaluation of the limits of the Line-By-Line Radiative Transfer Model (LBLRTM) developed by part of the co-authors. This is performed by an inter-comparison of the spectral upward radiance measured with the Infrared Atmospheric Sounding Instrument (IASI) and the results of the LBLRTM forward calculations based upon an atmospheric state derived from other atmospheric soundings (aircraft, lidar) performed correlative to IASI. In so doing, significant residuals of the LBLRTM in various spectral regions are found which originate from different error sources. The high quality radiometric calibration of the IASI instrument allows the analysis and determi-

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nation of these sources, which is done here for different species (CO₂, H₂O, CH₄, and others) and spectral regions.

The authors conclude, that the uncertainties in the spectroscopic parameters (line widths, pressure shifts and line coupling) are dominating the errors from the LBLRTM while the measurement errors of the IASI instrument are comparatively small. However, the observed residuals are also impacted by i) errors in correlative measurements of the atmospheric state as an input for LBLRTM, and ii) the spatiotemporal mismatch between IASI and the correlative measurements. This is stated by the authors but the scientific discussion/quantification of these effects is somewhat weak.

Overall the paper gives a good overview of the actual LBLRTM performance. While it is somewhat weak in turning out original scientific results, it highlights possibilities for improvements. Therefore, I recommend publication after revision.

Specific comments:

- The introduction is too long. Some of the species-specific explanations should be moved to the relevant subsections.

- Introduction, page 9316: The fact, that airborne in-situ or remote sensing profiling does not sample the atmosphere in the same way as a satellite instrument, is pointed out. However, a quantification (or, at least a rough estimation) of this effect is missing. Currently, the spatiotemporal mismatch always appears as a daemon in the paper, when needed, but escapes from a well-founded quantification, which plays a key role here. This issue should be discussed in a quantitative way in an own section, which should be added.

- Introduction, page 9316, line 13: "While such in-situ ..." add "and remote sensing ..."

Page 9317, line 6: wording does not fit into a scientific paper: "Such issues raise the question, "What is truth?""

Page 9318, lines 8 – 22: the message of this lengthy passage can and should be said

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in one sentence.

- Splitting different species / spectral regions into different sections, in principle, is a good idea, but a synthesis of the basic results and the effects of the different error sources is missing. Also, reading the Summary it becomes not clear what the essential results are. This might be an inherent problem in the type of this study being an "Evaluation" rather than an active improvement of LBLRTM. As a remedy we repeat the recommendation of our ACPD access review to add a Table similar to Table 1 (or extend Table 1) where the wave number intervals of all identified model errors are listed together with a statement on the type/possible reason/recommended remedy.

- Section "Water vapor": This section is far too long for the relatively weak conclusion, that the "remaining residual features are associated mainly with the atmospheric variability of water vapor and with uncertainties in the line widths, pressure shifts and line coupling."

- Page 9330, lines 24 - 26: For meteorological reasons I would expect a lower water vapor variability in the ocean case compared to the land case. Explain why the opposite should be true.

- Section "Carbon dioxide", first paragraph: Lengthy unclear wording about mathematical issues: add appropriate mathematical formulae and shorten wording.

- Page 9325, line 3-6: What is the significance of this statement? Because of the very homogeneous distribution of CO₂ I would not expect this. Please quantify your statement.

- References: The reference list is still far too long. Reduce to key papers in the respective field.

Technical remarks:

- Some references do not show up in the reference list, e.g. P9331 Tobin et al. 2006a and Tobin 2006b. Only one Tobin reference shows up in the reference list. Please

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check for other errors like this.

- Page 9317, line 17: error in hyphenation
- Page 9327, lines 1-3: verb is missing in the first part of the sentence.
- Page 9329, line 6 and page 9330, line5: "v3"
- Page 9355, Fig. 9: legend / explanation missing
- Page 9356, Fig. 10: legend / explanation missing
- Page 9362, Fig. 16: legend / explanation missing

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