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Discussions

Interactive comment on "Evaluation of MUSICA MetOp/IASI tropospheric water vapour profiles by theoretical error assessments and comparisons to GRUAN Vaisala RS92 measurements" *by* Christian Borger et al.

Anonymous Referee #2

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This paper describes in detail an evaluation and error analysis of a water vapour profile retrieval algorithm (Multi-platform remote Sensing of Isotopologues for investigating the Cycle of Atmospheric water, MUSICA) that has been applied to the Infrared Atmospheric Soundings Interferometer (IASI) sensor flown onboard the EUMETSAT MetOp satellites. The algorithm is an optimal estimation (OE) algorithm after Rodgers (1990). The paper is well organized, thorough, precise and well written. As such, I recommend publication, but only after my comments/suggestions are addressed below:

General Comments

1. The Authors have neglected to reference any of the previous work regarding satellite sounder validation as detailed in numerous publications, especially those pertaining to the NASA Atmospheric Infrared Sounder (AIRS). In fact, I don't even recall that the AIRS sounder was even given a mention in this paper. As the Authors must know, acknowledgement of previous related work is a very important aspect of science publications. I can provide example publications, but I'm sure the Authors are already aware of them. It is important that this previous work be acknowledged in the revision.

2. On Page 7 the Authors indicate that they are using Level 2 IASI products as components in their a priori state. Unless the Authors are using independent channels from those used in the EUMETSAT L2 product, then this technically speaking would not be an a priori, which by definition is a "virtual measurement" not used prior to the retrieval. Also, this begs the question: Why not simply use the L2 H2O product? The Authors should acknowledge and clarify these considerations, and it is particularly important that they explain the latter question — else the paper's novelty and/or utility comes into question.

Specific Comments

- Page 2, Line 26: "MUSICA" — acronym should also be defined here.

- Section 2.1: Nicely written introduction to the OE methodology — this is greatly appreciated.

- Page 3, Lines 3–4: This statement needs to be qualified with adequate references. As the authors probably know, the NASA AIRS sounding algorithm (which is the pathfinder high spectral resolution infrared sounder) does not use the Rogers version of OE.

- Page 3, Equation (2): recommend that this be expressed as a formal equation — the "cost" term can be explicitly featured on the left side (a standard variable is J, but the authors are free to use whichever they choose).

- Page 4, Lines 19–20: Acronym should be defined above at first occurrence.

- Page 4, Line 24: "HDO" — this chemical formula is not something I've encountered — although I (and astute readers) may deduce that it has something to do with the isotope formulas, the Authors should nevertheless define it and describe why it's relevant and/or important to this paper.

- Page 5, Lines 2–3: By "single a priori" do you mean a single a priori profile globally? If so, where do you obtain this?

- Page 5, Line 5: "there is no constraint on the surface temperature" — What is meant by this? What is the a priori for surface temperature?

- Page 5, Lines 14–15: Although not critical to the current paper, the Authors may wish to consider more recent models in future work, such as Watts et al. (1996), Masuda (2006), or the JCSDA CRTM model (Nalli et al., 2008), and perhaps acknowledge this in the text. The Masuda et al. (1988) model is known to have significant biases at larger scan angles. Also, what is being used as the surface wind speed?

- Page 6, Lines 19–20: The meaning of this sentence is not clear — I'm not sure how different time periods at the different locations means that the the dataset is not uniform.

- Page 6, Section 3.1: What is the source for the Vaisala sensor information? This should also be included in the references.

- Page 7, Line 5: I was not aware that there was a GRUAN site at Manus Island. When did this come online and is it still in operation?

- Page 7, Lines 8–9: See General Comment #2 above.

- Page 7, Lines 13–15: Why is this detail not given for the Manus site?

- Page 7, Lines 24–25: I'm not sure I fully understand — if the radiosondes are being used as truth, then how can they be used as the a priori?

- Page 8, Line 5: "this altitudes" should be "these altitudes"

- Page 12, Line 25: "about every 10 m" — I'm not sure this is correct. My understanding is that the balloon ascent is about 5 m/s, and the Vaisala processed radiosonde reports every second.

- Page 12, Line 27: Insert "statistically" between "performed" and "in two steps", thus "is performed statistically in two steps"

- Page 13, Lines 3–4: Replace "In order to get the in situ profile data that are comparable to the remote sensing data we have to smooth the" simply with "The" and insert "may be smoothed" after x_{GRUAN} and "according"

- Page 14, Line 17: The logarithmic dependence of these formulations is not immediately apparent in the second lines of these equations, which simply denote relative values. I recommend inserting the intermediary mathematical step.

- Page 15, Line 4: Recommend using percents here so that it is clear that one is talking about relative values.

- Page 17, Line 7: "ca" should be "can"

- Page 24, Figure 3 caption: More information is needed in the caption. The gray lines look like the actual averaging kernel matrix, so I'm assuming the colored lines are the row kernels? Also, what do the heights in the legend correspond to?

- Page 26, Figure 5 caption: Delete "Please"

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