EGUsphere, referee comment RC2
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Comment on egusphere-2022-755

Anonymous Referee #2

Referee comment on "How adequately are elevated moist layers represented in reanalysis and satellite observations?" by Marc Prange et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-755-RC2, 2022

Review of « How adequately are elevated moist layers represented in reanalysis and satellite observations? » by Prange et al.

General:

The work presented here addresses an important question, evaluating the ability of model and satellite data to describe elevated moisture layers (EML). The question is of high importance as the link between EML and atmospheric processes relevant for climate modelling is not totally understood, which leaves a number of uncertainties in modelling the consequences of the ongoing climate change.

It is therefore very important to evaluate if model and satellite can help detecting and monitoring EML, to characterise their strengths and limitations they have in that perspective and to what extent they can substitute to radiosonding, which are very sparse. The authors could elaborate a bit more on the latter point. To my knowledge this question hadn't been addressed yet in such a systematic way.

The paper also provides a unique and substantiated feed-back to model and products developers, to further explore possible improvements specifically to retrieve EMLs - e.g. P12.L319.

Overall, I find the manuscript in very mature state. It is well structured and very intelligible, with relevant references and clear figures. I would recommand its publication pending minor clarifications and considering the general points, in particular regarding quality control (QC) and acceptance of IASI products in the evaluation presented.

EUMETSAT IASI L2 QC:
The authors explain that the profiles come along with uncertainty estimates and that they reject the cases where errors on temperature are larger than 4K. This has the merit of rejecting the obvious poor retrievals from the all-sky retrievals (<1% of occurence), but still leaves retrievals of moderate to poor quality in the pool which is assessed. E.g. retrievals with temperature errors higher than 2 to 3K are arguably of lesser interest, esp. compared to models. Also, as evaluated in other studies, the cloudiness represented by the parameter OmC within the CDR has proven a valuable complementary information to the temperature uncertainty estimates for quality control (see work by Kirsti Salonen, ECMWF, https://www.eumetsat.int/IASI-assimilations, https://www.eumetsat.int/media/45896).
Including the OmC in the present evaluation might introduce too much complexity which may not be necessary at this stage. At the minimum, the authors are encouraged to revisit if the statistics with IASI products significantly differ having selected the best and good retrievals (e.g. temperature uncertainty typically <1K and within 1-1.5K or 1-2K, respectively).

CLIMCAPS or NUCAPS-IASI?
The NOAA algorithms are also applied to IASI. It would be interesting to evaluate this dataset as well and inform further the reasons of CLIMCAPS-AIRS and EUMETSAT-IASI respective characteristics. At least mention this point in the conclusion/outlook as the merits of the respective methods are discussed.

Specific:

Throughout the document:
- water-vapor —> water-vapour
- MetOp ==> Metop - Official spelling

P5.L116: IASI L2 are actually retrieved at the native IASI pixel resolution: 12km at Nadir. Only the AMSU information is available at 2x2 IASI pixels resolution, IASI and MHS are exploited at their native sampling. This is different to CLIMCAPS AIRS/IASI/CrIS, whose retrievals are not at full IR sensor resolution, but at 2x2 or 3x3 pixel resolution due to the cloud-clearing.

P6.L162: why isn't there any direct CLIMCAPS vs GRUAN comparison? This does not sound logical and should be explained.

§2.4 and P6.L166 The NOAA algorithms are also applied to IASI. It would be interesting to evaluate this dataset as well and inform further the reasons of CLIMCAPS-AIRS and EUMETSAT-IASI respective characteristics. This would also enable larger statistical match-up sample with Manus sondes.

P7.L184: the notion of static stability would deserve a short explanation for the broader reader audience. It is important for the rest of the paper.

Section 5/5.1: why not smoothing GRUAN with 2km Gaussian window? This is the commonly accepted resolution of IASI and the basis for User Requirements. AIRS and CrIS also provide humidity profiles with a similar intrinsic vertical resolution. The 5km

smoothing which is not helping is noted, however 2km would be more appropriate still wrt to User Requirements.

Section 5/5.1: It would be interesting to be a bit more conservative with QC on IASI L2. temperature uncertainties >4K are the extremely poor retrievals. Completing the study by retaining the retrievals better than e.g. 1.5K (or 2K) for instance would be advisable.

P12.L324-326: I would be careful with the statement that ERA-5 represents an upper limit. Mathematical modelling proves to yield higher precision than the original set, provided there is sufficient information in the predictors. In other words, IASI L2 is trained on ERA-5 and one would expect that it would perform at least as good as ERA-5 in terms of precision, at the scales that are accessible to the passive IR remote-sensing. The fact that it does not here (at least less than AIRS to some extents) may speak towards a suboptimal machine learning concept in view of EMLs. But it could also be the result of a loose QC on IASI L2. This is why it is important to confirmed the findings having applied criteria aiming the best retrievals.

P14.L345: IASI L2 comes at native IASI pixel resolution. 12km at Nadir, not 50km.

Conclusion - P21.L468: Actually EUMETSAT IASI L2 includes an optimal estimation (OE) as a second step - as explained in https://doi.org/10.1016/j.jqsrt.2012.02.028. The OE is part of the near-real production and further improves the PWLR (https://www.eumetsat.int/iasi-level-2-geophysical-products-monitoring-reports), yet it is not known whether this would be sufficient for the present application. The OE has not yet been applied in generating the CDR. Given the scientific feed-back and outlook proposed by the authors here, it would be useful to clarify and reference this.