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Comment on acp-2021-617

Anonymous Referee #2

Referee comment on "Novel assessment of numerical forecasting model relative humidity with satellite probabilistic estimates" by Chloé Radice et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-617-RC2, 2021

Novel assessment of numerical forecasting model relative humidity with satellite probabilistic estimates

Chloé Radice, Hélène Brogniez, Pierre-Emmanuel Kirstetter, and Philippe Chambon

1. General Comments

This paper presents a novel method for assessing humidity fields from numerical weather prediction models with estimates from the SAPHIR instrument. The probabilistic methodology used to estimate relative humidity from SAPHIR is exploited to provide a new approach for model assessment. The methodology also allows for a confidence interval to be placed on comparisons where classical 'bulk' comparisons.

This study demonstrates an innovation that yields more nuanced results for satellite and model inter-comparisons. This is important for relative humidity, where uncertainties in satellite measurements can be as high as 10% RH for some instruments (especially heritage infrared sounders). Overall, I find that this study is of scientific value and recommend it for publication, after all the issues that I have highlighted are addressed.

2. Specific Comments

- Line 21: The final sentence in your abstract is illustrating a key point of your study but it is missing the "why" of its importance. Adding another sentence or editing this final one will make it more impactful.
- Line 42: Why use a reference for precipitation when talking about humidity? There are plenty of water vapour retrieval algorithm papers that perform an inversion between an atmospheric stat vector and observed radiances/brightness temperatures. Please update.
- Lines 45-47: Averaging is not the only method used to get data on the same resolution. The discussion here does not include the use of averaging kernels, which are used to smooth model or in situ profiles relative to the vertical resolution of the satellite measurement. See " Rodgers, C.D. and Connor, B.J., 2003. Intercomparison of remote sounding instruments. Journal of Geophysical Research: Atmospheres, 108(D3)."
- Lines 65-67: It reads a bit strange when you talk about RH and then reference a precipitation paper for further discussion. If this is the only suitable reference there needs to be slightly more elaboration as to why. For instance, is the discussion point in the paper about representativeness but in the context of precipitation?
- Line 93: A figure here might illustrate this point better for the channels on SAPHIR. Not all readers may be familiar with MW remote sensing, especially the 183 GHz region where the +/- values relate to where on the wings of the 183 GHz feature SAPHIR is sampling. Alternatively, the sentence could be updated to reflect this point and why it is done.
- Lines 96-108: Is the SAPHIR measurement noise (measurement uncertainty) used at all in the RH retrieval?
- Line 115: "RH fields range between -5 and +5 % (resp. 5 and 25%)" what do the values in brackets relate to?
- Line 120: Does the vertical averaging account for SAPHIR weighting functions? – in a similar way to which upper tropospheric humidity is calculated?
- Line 133: do you mean uncertainty in a metrological sense? If not you might want to change the word used. This is linked to the comment about lines 96-108.
- Line 164: what is the uncertainty here? Source, magnitude? Or is it an error?
- Line 192: I don't think you mentioned what you're a priori error assumption is before this point, what is it? Do you get an a posteriori error? Do you calculate the error reduction?
- Figure 5: Did 12:00 UTC look different? Is there any correlation to convection?

3. Technical Comments

- Line 17: ".The study first …" – change to ". This study first …"
- Line 18: "It warrants the need …" - this sounds like you are eluding to a future direction in a conclusion. Would something more like "We demonstrate the need …"
- Line 33: change "relies" to "rely"
- Line 72: "such a probabilistic approach." – missing 'a'
- Figure 1b: X axis label missing, also cannot see bars for values > 10, log scale might help here
- Line 137: "complementarities" – change to similarities
- Lines 232-236: need a space between %RH, i.e. % RH. There is no need for a space between the value and the percent, e.g. 12% RH.
- Line 265: need a space between %RH, i.e. % RH
- Line 280: need a space between %RH, i.e. % RH
- Line 295: need a space between %RH, i.e. % RH

- Figure 6: need a space between %RH, i.e. % RH
- Figure 7: need a space between %RH, i.e. % RH
- Lines 343-359: need a space between %RH, i.e. % RH
- Line 412: need a space between %RH, i.e. % RH
- Line 427: need a space between %RH, i.e. % RH
- Lines 439-440 : need a space between %RH, i.e. % RH