

Interactive comment on “Comparison of IAGOS in-situ water vapour measurements and ECMWF ERA-Interim Reanalysis data” by P. Reutter et al.

Anonymous Referee #1

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The study of Reutter et al. uses the IAGOS measurement data set to evaluate water vapour and ice saturated regions in ERA-Interim. The manuscript provides meaningful information that should be considered in further investigations of clouds and radiation in the UTLS using ERA-Interim. The manuscript is well and clearly written and the figures are appropriate. The results are meaningful interpreted and understandable although they could be more in-depth at some places. So far, the focus is quite technical because it only describes the differences between the data sets. According to the aims of the journal, studies investigating "chemical and physical processes" are requested. You may add scientific value to your study by further dividing your data set. You could e.g. try if there are differences in your results when you subdivide the data according to season, latitude or elevation of the tropopause. Nevertheless, I recom-

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mend the manuscript for publication if modifications are made the following comments are addressed:

Specific questions:

1. I would use a more applicable title such as: Validation of ECMWF ERA-Interim Reanalysis with IAGOS in-situ water vapour measurements in the UTLS region
2. How many data points does your comparison involve (and how many in each level)? Instead of the PDFs in Fig. 1 you could plot the total number of measurements per grid box.
3. I don't see much added value of showing PDFs and box plots of the same data especially because they are not interpreted in detail each. I would prefer the box plots in the paper and to just mention the shape of the PDFs where required. Showing the two data sets in one box plot side by side would make the comparison easier.
4. Fig. 2: Could be the non-Gaussian distribution of temperature values in UT3 be a result of the used tropopause definition?
5. The wave-like structure in Fig. 2 (mentioned on p. 7 l. 3) would be worth investigating to increase the scientific statement of the paper, especially because it is not only visible in UT3, but continues to UT2 and UT1. You could analyse the data of the discrete steps or waves, separately and explore their properties (see scientific suggestions above).
6. subsection 3.2: Dyroff et al. 2015 found a moist bias in ECMWF analyses and forecasts in the lower stratosphere. Please discuss why this bias is not apparent in your data.
7. P. 11 l. 7: The sentence is a bit weird: Do you call ERA-Interim a climate model or do you draw from your results that climate models must show an underestimation of ISSRs as well? Please reconsider/reformulate.

8. Do the negative RHi for IAGOS in the LS in Fig. 6 make sense?
9. How does your statistics of temperature and mixing ratio (Fig. 3, 5) appear inside (and outside) of the ISSRs? Is there a way to relate the underestimation of $\text{RHi} > 100\%$ in ERA to either of these variables?
10. P. 12 l. 6ff and Fig. 8: Does your ISSR fraction mean the (relative) number of ISSRs among all data points? Please clarify.
11. subsection 3.4.1: What are the flight distances of your examples? It would prefer a length axis instead of or in addition to time in Fig. 9.
12. subsection 3.4.1: To add some scientific content it would be very interesting to discuss the weather situation behind the flights, e.g. with a satellite image.
13. As far as I understood the first paragraph of 3.4.2 refers to the comparison of IAGOS (1km) and ERA in Fig. 10? If so, it would help to draw the reader's attention to the respective lines in the figures e.g. (see black and red lines in Fig. 10).
14. P. 14 l. 8: "Already with a resolution of 1km the cumulative distribution exhibits a different character." Different to what? Or do you mean "10km" instead of "1km"?
15. P. 15 l. 1: What exactly do you mean by: "...the behaviour of the ERA data set changes for pathlengths of 100km..."? Please revise.
16. P. 16 l. 8-11: This is part of the motivation and should appear much earlier, in the introduction.

Additional comments:

1. P. 1 l. 23: Remove the "s" from clouds
2. P. 2 l. 25: hydroxyl?
3. P. 9 l. 14: "that IAGOS data set shows": add "the" before IAGOS or remove "set"
4. P. 11 l. 11: $\text{RHi} > 1$: Do you mean $\text{RHi} > 100\%$?

5. P. 12 l. 9: Remove double "the"
6. P 12 l. 14: Correct "reanalysis"
7. P. 14 l. 10: Delete one "s" in "median values increases"
8. P. 15 l. 5. Lower case "s" in ISSRS
9. P. 15 l. 26: I would change "Moving up to the stratospheric layers, as expected, the RH_i values are" to "...layers the RH_i values, as expected, are"

Literature:

Dyroff, C., A. Zahn, E. Christner, R. Forbes, A. M. Tompkins, and P. F. J. van Velthoven, 2015: Comparison of ECMWF analysis and forecast humidity data with CARIBIC upper troposphere and lower stratosphere observations. *Quart. J. Roy. Meteor. Soc.*, 141, 833–844, <https://doi.org/10.1002/qj.2400>.

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