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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Comparison of in-situ FISH measurements of water vapor in the UTLS with ECMWF (re)analysis data" *by* A. Kunz et al.

Anonymous Referee #2

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1 General comments

Kunz et al. used in-situ measured water vapour data to evaluate the quality of water vapour fields in ECMWF reanalyses (ERA-interim) and operational analyses. The in-situ data had been taken with the FISH instrument during many campaigns between 2001 and 2011, in different regions of the world (tropics, subtropics, mid-latitudes, polar regions) and in all seasons. The operational system of ECMWF was updated several times within these ten years so that the evaluation can show improvements in the modelling of water vapour fields. The sheer amount of information the authors give is difficult to digest on a single reading, but some general tendencies are presented both in the abstract and the summary section. This is a valuable contribution to quality

checking of ECMWF's forecast system and should be published after consideration of the following comments.

2 Major comment

Although I call this a "major comment", I think a minor revision should suffice to fix the only problem that I have with the presentation of the results. This is the use of the ratio Δ. As it is defined (ECMWF H2O concentration divided by FISH H2O concentration), it is an asymmetric quantity, that is, underestimations have $\Delta \in (0, 1]$ while overestimations have $\Delta \in [1, \infty)$. The asymmetry of the measure is not a problem *per se*, so that most figures can remain as they are.

The problems begin when statistical quantities like mean values and standard deviations are presented. In fact, it is not clear how a mean value $\langle\Delta\rangle$ can be interpreted. Assume we have 2 values of Δ, say $\Delta = 0.5$ and $\Delta = 2$. Their mean value is $\langle\Delta\rangle = 1.25$. However, we have one underestimation and one overestimation each by a factor of two. Is this really expressed by a mean value of 1.25? One could construct many such examples, and it is obvious that there is no clear relation between a nominal mean value and the actual over- and under-estimations. Figures showing mean values of Δ should be deleted or replaced.

Similar problems arise for the interpretation of a standard deviation of such an asymmetric quantity. I think there are two possibilities to get rid of these difficulties. First, you might consider $\log \Delta$ instead of Δ (a log with base 2 would be good). Alternatively, you can treat underestimations and overestimations separately as two different quantities, e.g. Δ_- and Δ_+, with corresponding pairs of mean values and standard deviations.

3 Minor comments

P. 14407, l. 17: The description of the temporal interpolation is hard to understand. Please rewrite.

P. 14408, bottom line: check sentence "the ratio of the ECMWF water vapor is calculated". This sounds like a ratio of one item alone.

P. 14410, around line 20: you might consider to give the uncertainty bounds for $\Delta = 1$ as well, that is to give the range where ECMWF data are undiscriminable from the measured data.

P. 14411, l. 16-17: Equality of mean and median indicate a symmetric distribution but not necessarily a good agreement. Perhaps you want to say that both median and mean are close to 1.

P. 14411, l. 19: variances are hard to interprete, see above.

P. 14413, ll. 24-27: Perhaps there is a possibility to split this very long sentence in order to increase comprehensibility.

Section 3.3: The sheer amount of information in this section is hard to digest and also the figures don't actually help to condense the information. Please think about restructuring the section to help the reader to gather the information. Perhaps you might introduce subheadings, e.g. tropics vs. extratropics, or stratosphere vs. troposphere, etc.

Figures are too small and hard to read in print, Figures 6-10 didn't print at all on my printer. On my screen all Figures are nice and clear. Please take care that these problems are fixed in the final version to be published.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 14399, 2014.