

Interactive comment on “Intercomparison of mid-latitude tropospheric and lower stratospheric water vapor measurements and comparison to ECMWF humidity data” by Stefan Kaufmann et al.

Anonymous Referee #1

Received and published: 14 August 2018

Overview: This paper describes comparison results from a recent HALO aircraft campaign with a payload including multiple water vapour/total water instruments. The measurements are found to agree reasonably well both internally, and with output from an ECMWF forecast model. The publication provides a service to the community who would be interested in analyzing this data, but there is little in the way of scientific analysis in the paper as it stands. It may be better suited to AMT rather than ACP. It should be ultimately publishable, after addressing comments from all reviewers. Comments below with a * are the most substantial. The others are largely editorial.

Detailed comments:

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Overall: The model comparison seems to be a small part of the paper, and perhaps doesn't need to be included in the title.

Page 1: line 17, change "turned out to be" to "is"

Page 2: line 11/12, rewrite sentence...does this not happen in a "non-changing climate"? also, eliminate the "like; e.g."

Page 2: line 12/14, rewrite this sentence " The radiative effect of clouds is much more complex than the effect of greenhouse gases due to very inhomogeneous cloud cover as well as microphysical and radiative properties of clouds at different altitudes." what does "more complex" really mean?

Page 2: line 14, change "countervailing" to "opposing"

*Page 2: line 17-26, What are you really trying to say here? I think it is: 1) It's hard to measure water vapor 2) the accuracy required depends on the research question 3) For radiative questions in the stratosphere, you want an accuracy of 1ppm or less 4) For cloud questions, you want an accuracy of 10% or less RHi

Rewrite to make those points clear, or possibly even delete the entire paragraph, as it is not critical for the main points in the paper.

*Page 2: line 28, is this 10% absolute water vapour measurement in the stratosphere? Or is it in the troposphere, or is it 10% RHi? I believe the campaigns mentioned imply 10% absolute and in the stratosphere, but if that is so, it should be made clearer in the text.

Page 2: line 33, instead of "was improved compared" perhaps instead "was better relative"

Page 3: line 11-13, rewrite sentence

Page 3: line 15, make measurement plural.

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Page 4: line 4/5, sentence needs a verb

Page 4: line 14, change "utilized" to "use"

*Page 6: line 9, (HAI) Why do you only use data from one of the four channels?

Page 6: line 26, change " we use a couple of other parameters" to " we use additional parameters"

Page 6, line 30 change " of the Cloud" to "from the Cloud"

Page 7, line 5-9, this paragraph just needs to be rewritten, or even mostly deleted. Really, only the last sentence is needed.

Page 7: line 12, change "on the investigation" to " rather the investigation"

Page 7: line 12, change "consists" to "consist"

Page 7: line 24, change " vertical distance to the cirrus upper edge" to " vertical distance from the cirrus upper edge"

*Page 8: lines 13-20, You note that supersaturated cloud free cases are not considered. Do you have an idea of the fraction of the filtered data falls under this criterium? Does this bias your results in any way?

*Page 9: first paragraph, I'm not quite clear what your reference is. Is the lower stratosphere only using FISH and AIMS; and the upper troposphere clear sky, there are 4 instruments? Or, is the reference always the 4 instruments mentioned (without WARAN)?

Figure 2: caption, delete Exemplary and just start with "Water Vapor"

Page 9: line 15, add a comma after "Except for the WARAN"

*Page 9: line 23, states " Sequences with such contamination are identified for the entire data set and filtered out for the intercomparison." Can you note how much data you had to throw out because of this contamination?

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Figure 3: caption, change " WARAN which occasionally occurs during the first ascend" to " WARAN that occasionally occurs during the first ascent"

*Page 10: line 19/21 states " As shown in Table 2, the mean deviations of AIMS, FISH, SHARC and HAI are below 2.5%, indicating that there is no consistent systematic bias in any single instrument." Although true when averaged over the entire range measured, that is not true for specific water vapor ranges. It may be instructive to make plot those via decade of water vapor. And, in fact you effectively contradict that statement with the one on line 26.

*Page 10: line 26, I'm a little confused what you're trying to say with " In fact, there is a systematic difference between both instruments between 4 and 10 ppm." It sounds like the difference between the instruments is 4-10 ppm; but I think you really mean when the reference value is between 4 and 10 ppm. I suggest a rewrite.

*Page 10: line 27/28, states "Interestingly, the difference between the instruments for the driest conditions (3.5 to 4.5 ppm) is smaller than for the next several bins (2.4% versus 6.5%)" Is this really a robust conclusion? There seems to be a large amount of spread there.

Page 11: line 16, missing space between "of" and "meteorological"

*Page 11: discussion of RH_i, have you considered the effect of uncertainty of the T & P measurements to the RH_i? (looking further in the paper...if there is a temperature bias, what is the potential impact on the RH_i distributions?)

*Figure 5, since there are different numbers of points included, is there any bias for conditions when SHARC sampled and AIMS did not? Do you get the same picture if you only select the subset of points where both instruments measured at the same time?

*Page 11: line 29-31, I assume the shift you're talking about here is the difference from a peak at 100%? (the 97% and 94% vs an expected value of 100%). If so, please

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make that clear. Or are you talking about the shift in distribution between instruments.

*Page 12: first paragraph, is there a difference between flights in the average ambient temperature or pressure for each flight? Could that contribute to flight by flight differences (if the water instruments have some sensitivity to ambient conditions)?

Page 12: line 20; the paper here acknowledges temperature could be an issue, but what does "significantly off" mean. What temperature or pressure bias could cause a 6% change in RH at the conditions sampled?

*Page 13/14: comparison with model, I'm not sure that an interpolation the model to the 1 Hz aircraft locations is really the best way to do the comparison. It seems that that is attempting to impose structure on the model that is non-existent. Another tactic would be to average the aircraft points within the grid box of the model, and then do the comparison. It may produce essentially the same result, but reduce the scatter on the plot. This should probably also be considered with regards to vertical resolution as well. And, as noted elsewhere in the paper, whether the model and measurements are looking at the same height relative to the tropopause is also probably a factor. An attempt to quantify whether there is such a difference using the aircraft vertical profiles to identify a tropopause height, and then compare to the model representation would be useful in explaining discrepancies between model and measurements.

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