

Interactive comment on “SEALDH-II – a calibration-free transfer standard for airborne water vapor measurements: Pressure dependent absolute validation from 5–1200 ppmv at a metrological humidity generator” by Bernhard Buchholz and Volker Ebert

Anonymous Referee #2

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The paper addresses the relevant scientific questions on how to measure atmospheric water vapour more accurately. The experiments are thoroughly conducted and the results well discussed, as they seem to tackle the real measurement issues. The text gives enough details and clarifications, so that it is fairly easy to follow, although it would benefit from shortening it a bit.

My main comment is about the argument that the instrument is calibration-free. The authors do discuss this in page 6, however I believe more careful wording would be

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needed. Namely, the instrument does indeed measure the water vapour concentration without relating it to the quantity of the same kind (humidity). This could arguably be called an absolute measurement, where water vapour concentration is indirectly measured through quantities of different kind by using an improved physical model. However, that is in essence true also for any other instrument type, e.g. gravimetric hygrometer through mass, chilled mirror hygrometer through temperature, an impedance-based hygrometer through impedance etc. Even though the authors do fairly discuss what they mean by calibration-free, it should still be noted, that in order to obtain the water vapour concentration indirectly, the instrument has to measure different parameters directly (temperature, pressure etc.),... which eventually requires a calibration of the individual instruments.

It could be further discussed, though, whether the principle gives a potential to serve as a primary standard. They (the primary standards) do employ the absolute measurement in this sense, but they also need to be generally accepted (or chosen by convention, according to VIM). A similar situation is with chilled mirror hygrometer, which is not treated as a primary standard, but is nevertheless typically used in conjunction with it (or the SPRTs with fixed points for instance). And regularly calibrated against it.

In this respect also a more evaluation of the long-term drift would need to be conducted before a new metrological classification could be discussed, despite the argument of the offset compensation.

For this reason I would suggest to avoid the notion of calibration-free standard, but rather to stress out an alternative advantages of the SEALDTH-II and of its evaluation.

Specific comments:

- Page 1, line 23: SEALDH is not the first metrologically validated humidity standard; consider rephrasing
- Page 2, line 34: Water vapour measurement is often needed... The word measure-

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ment or similar is missing

- Page 2, line 46: consider deleting words “such as”; giving the reference is enough
- Page 2, line 61: falsification is a strong word; consider revising
- Page 3, line 86: instead of “entirely transferred to”, “represented by” would sound more appropriate (or similar)
- Page 3, line 100: Are you talking about desorption? If so, put it more explicitly.
- Page 4, lines 120 to 124: Please consider revising in the light of general comment above.
- Page 4, line 128: Why is it called Selective Extractive. . . It seems to me that Selective would be enough (selection usually means extraction).
- Page 5, line 140: Can you provide any reference for White-type cell?
- Page 5, line 146 and 147: Is the uncertainty expanded ($k=2$)? Please add a comment. Instead of linear uncertainty it would be better a linear part of the uncertainty or similar (the same goes for the rest of the text).
- Page 5: line 151: Authors are advised to replace units, such as ccm and SLM with the SI units through the entire paper.
- Page 5, line 161: Section 2.1 is actually 2.2. The same goes for the sections 3 and 4. Also avoid calibration-free wording.
- Page 6, line 180: variables are not constants; consider rewording. . . where k_B is Boltzmann constant, . . . ; $S(T)$ is already explained in the previous page
- the second half of the page 6: please see the general comments above
- line 229: please consider replacing the word recirculation. Are you talking about back-flow due to partial pressure gradients?
- Line 234: THG seems to include both the generator and the reference instrument; I

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think it's better to keep them separate (here and in the rest of the text) in order not to confuse the two purposes. Or simply use setup, where appropriate.

- Line 274 to 277: Have you considered the effect of the water vapour equations used (pure saturation pressure and the enhancement factor) at two different pressures to the deviation in response?
- Line 297 and elsewhere: precision would better be replaced by resolution
- Line 331: linear -> linear part
- Line 372: Consider replacing the . . .one single performance statement. . . with the assessment of whether the uncertainty is within the expected/estimated value.
- Line 406: water scale would better be replaced by dew-point scale or similar
- Conclusion: Please add a discussion of the long-term drift evaluation.
- Figure 4: The variable u (mi) is not explained

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