

## Comment on amt-2021-10

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Community comment on "Comparison of formaldehyde measurements by Hantzsch, CRDS and DOAS in the SAPHIR chamber" by Marvin Glowania et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-10-CC1>, 2021

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The authors do an excellent job in this paper. However, I have several comments / suggestions regarding their discussion of the Picarro G2307 instrument. In particular, they focus on the H<sub>2</sub>O cross-sensitivity but do not discuss (or provide enough information for the reader to draw their own conclusions on) the methane and methane+water vapor cross-sensitivities of the instrument.

The Picarro G2307 measures formaldehyde at 5625.85 cm<sup>-1</sup>, where it is subject to baseline spectral interferences ("cross-talk") from both methane (CH<sub>4</sub>) and water vapor (H<sub>2</sub>O, specifically <sup>1</sup>H<sub>2</sub><sup>16</sup>O). The G2307 formaldehyde retrieval is based on accurate measurement of all three species. It applies a correction based on spectral modeling of the cross-interferences between species. This resolves some of the interferences, but there is residual "cross-talk" between the three species that is corrected with an empirical correction factor (Hoffnagle et al., 2017). The comparability between the Picarro and other formaldehyde instruments (e.g. Hantzsch) could potentially be sensitive to both water vapor and methane concentrations (and their cross-talk). Depending upon the software version, there could be a significant bias introduced by differences in methane concentrations as well as differences in water vapor concentrations.

My comments / suggestions are as follows:

1. Line 59: "Absorption spectroscopy has the advantage of being calibration-free" - this is highly misleading, as the Picarro instrument's formaldehyde retrieval is based partially on a factory-applied calibration and factory-programmed empirical correction factors. This is also contradicted by the later observation of a water vapor dependence on the accuracy of the instrument.
2. Line 62: There are at least 4 commercially available spectroscopic formaldehyde instruments with sub-ppb sensitivity of which we are aware:  
Aerodyne Research (absorption spectroscopy at ca. 1765 cm<sup>-1</sup>)  
Aeris Technologies (absorption spectroscopy at ca. 2832 cm<sup>-1</sup>)  
Gasera (Gasera One Formaldehyde, photoacoustic spectroscopy)  
Picarro (G2307, cavity ringdown spectroscopy at 5625.85 cm<sup>-1</sup>)
3. Section 2.3: Authors should expand their discussion of how they calibrated the Picarro instrument.

4. Line 223: Authors state that the accuracy of the Picarro G2307 is 10%. However, their own data (including the water vapor interference and the zero drift) contradict this 10% value, especially for low formaldehyde concentrations.

5. Section 3.2 - Authors should make it more clear when they are discussing synthetic (methane-free) air and when they are discussing air with ambient methane concentrations. In particular, authors ignore the potential methane (and methane+water) cross-sensitivities of the instrument and should address this in their discussion and analysis of data.