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Atmospheric Measurement Techniques Discussions

Interactive comment on "Continuous measurements of methane mixing ratios from ice cores" *by* C. Stowasser et al.

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1 Contents of the paper

This paper presents a novel technique to meausure CH_4 in ice cores using a melthead that liquefies the ice core at a $\pm$ constant rate. The liquid is worked up and degassed via a hydrophobic membrane module, which separates the gas from residual water. The gas is then dried by a nafion drier and analyzed by a modified wavelength scanned-cavity ringdown spectrometer.

2 Assessment

This is definitely a carefully written paper on a novel development in measurement technique to quickly obtain time series of CH_4 concentrations in ice cores. As the authors state in their Summary and conclusions, the main advantage of this new method over traditional ones is that a spatial resolution of around 6 cm is possible at a processing speed of 20–25 m of ice per day. I recommend to accept the paper after minor revisions in relation to the four issues that I detail below.

3 Issues to address in revision

3.1

I found Figs. 5, 6 and 7 unclear and would like Peter Werle to have a look at these:

- Panels (a) are "normalized" responses, but the units are ppbv. I would have expected a dimensionless number (fraction from 0 to 1), but since no mention could be found in the text on how the "normalization" was done, this could be a wording error as well.
- Panels (b) show d/dt of the "normalized" responses, in ppbv/s, and the numbers are to be multiplied by 10^{-3}, which makes that the range goes from –0.006 to 0.01 ppbv/s. I have a hard time to judge whether this is correct or whether the wrong impression I get has to do with the units (where does ppbv come from if values were normalized?). Moreover, in the text you use dm/dt, so the same notation should be used in the y-axis label.
- Panels (c) are explained to show the transfer function, but again I do not expect a

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transfer function to have units of ppbv. In fact, Eq. (5) shows $\hat{G}(f)$ as the transfer function, in which m' has units of 1/s (from Eq. (4)) which in Eq. (5) are multiplied with dt in seconds to yield a dimensionless function as expected. So my best guess is (as in the other panels) that the units in the Figures are wrong.

- Also in panels (c) I have a conceptual problem: if I use a transfer function for a signal, then I should not see a noise at the high frequencies (that's the concept of the red line in Fig. 5c). So why should $\hat{G}(f)$ be termed a "transfer function" if it transfers the signal as expected at low frequencies but not at high frequencies?

3.2

In my understanding the dimensions and configuration of the hydrophobic membrane module are a key element for the performance of such a device. However, the authors only sloppily write "The performance of the gas extraction module depends on the pressure gradient over the hydrophobic membrane." (p. 215, l. 21–22). I'd appreciate if you could elaborate in more detail which considerations in your set-up let to a selection of a 0.5×1 (units?) MicroModule.

3.3

You mention several times that the commercially available analyzer measures $CH_4|CO_2|H_2O$, but you never explain why you still want to have a Nafion drier in the line which may simply smear out your signal. Or does the instrument not correctly correct for H_2O effects without the nafion drier? Please elaborate.

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3.4

It remains unclear whether the authors were sponsored by Picarro or whether the collaboration was only related to the adjustment of the fitting software to the lower cavity pressure that the authors selected. Please specify in the acknowledgments if you received finances from Picarro (e.g. special rebate or free instrument) – or declare independence if this can be claimed.

4 Minor issues

p. 213, l. 20: what does $\pm$ 13–36 ppbv mean? Is it the $\pm 1\sigma$ or the 95% confidence range that is expressed? Or something else?

p. 222, l. 4–5: what is meant with "the cavity pressure cannot be maintained constant"? Do you mean the pressure is too high or too low, or is it too variable around the correct set point?

p. 222, l. 21: replace unfeasible by inacceptably

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