

Atmos. Meas. Tech. Discuss., referee comment RC1
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Comment on amt-2022-263

Anonymous Referee #1

Referee comment on "Laser-induced sublimation extraction for centimeter-resolution multi-species greenhouse gas analysis on ice cores" by Lars Mächler et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2022-263-RC1>, 2022

The manuscript describes a new system for measuring major trace gases (CO₂, CH₄ and N₂O) as well as d₁₃C of CO₂ from small sample amounts extracted through sublimation from ice core samples. The manuscript is well written and describes in detail the individual parts of the systems as well as the measurement procedures.

This system is a major step forward in the ability to analyse ice cores both in time resolution as well as precision.

Minor comments:

Abstract line 7: the vertical resolution depends on the cross section. Please add '(3.5x3.5cm cross section)'

Abstract line 16: Suggest to change to '...Pleistocene ice and highlighting the ...'

Page 2, line 27: Change to 'These limitations will..'

Page2 line 31: Replace 'optimize' by 'increase'

Figure 1: This figure shows 'only' the inner parts of the system. It would be nice to have a sketch that includes all insulating, and cooling parts maybe in an appendix.

Page 6, line 139: Is there a particular reason for choosing -100°C for the external trap?

Page 6, line 146: I am not clear how this manifold looks like. What part is made out of aluminium?

Figure 3: Please add a legend explaining the symbols for pumps and gauges.

Page 9, line 203: Milli-Q water is not gas free. It can under unfortunate conditions even be oversaturated in gases!

Page 9, lines 210 and following: I observe (Figure 4) that 1) The flow does not drop to 0 in neither the 1cm nor the 2 cm experiment. In the 1cm experiment the minimum level reached is about 0.1microliter/s and about half of that in the 2 cm experiment. There is no obvious trend over the course of the experiment. I agree with the conclusion that the side sublimation is limited to some centimetres below the sublimation front. However, it seems to me that this reaches way beyond 2cm. The contribution to the flux is still a couple of % which may cause a problem when different samples are measured.

Page 12, line 264: Replace 'produced' with 'prepared'

Page 12, line 267 and following: Is there any evidence that the consecutive cleaning of the extraction vessel makes a difference.

Page13, line 3: I find it hard to believe that the Ar completely hinders laboratory air from entering. I suggest replacing 'hinders' to 'limits' or 'reduces'

Page 13, line 296: Is there any evidence that 10 min is long enough to reach equilibration with the surfaces?

Figure 6: Please label Std#6

Section 3.2: You write 'This standard is used later to pointwise correct any offset in the concentration values.' Later you write of 'bracketing values'. That implies that you correct by using standard measurements from before and after the sample but it does not look like you do that. Therefore, I suggest you use a different term than 'bracketing' to describe your procedure.

Page 20, lines 410 and following on sample 768.35: This sample shows higher variability than the others except for CH₄. Clathrate formation/decay should not have an effect, since you extract 100% of the sample. Gas loss should affect all gases also CH₄. I am unclear what your explanation for the higher variability in the specific sample is and why it is not better than from previous systems.