Comments by Reviewer #2

We would like to thank the Reviewers for their thoughtful and constructive comments that helped us to improve our manuscript. We addressed their comments individually and made revisions in response to their suggestions, as detailed below. The Reviewers' comments are highlighted in blue, followed by our response. Modifications to the manuscript text are reproduced in red.

Machler et al describe a new analytical technique and system for analysis of trace gases in ice cores via laser induced sublimation combined with quantum cascade laser absorption spectroscopy (QCLAS). In my opinion, this system represents a very large advance in ice core trace gas analysis. The analytical precisions are on par with some of the best prior techniques, but the prior techniques required similar or (sometimes much) larger sample sizes for analysis of a single species, whereas here CO2, CH4, N2O and d13CO2 are analyzed simultaneously. The capability of the system in terms of depth resolution is very impressive and is better than what continuous flow analysis (CFA) systems can currently do for trace gases. The system seems very well suited and ready to be used for the stated purpose of generating high-resolution records from the Beyond EPICA – Oldest Ice Core. There is an impressive range of technical innovations / excellent design ideas that have been incorporated into the system. The testing of system is very thorough. The paper is very well written and the results are clearly presented. My only real suggestion for further improvement is to conduct a series of tests with Holocene ice from a relatively high-accumulation ice core where the trace gas species are very well characterized and there is high confidence that no significant changes in concentrations / isotopes are expected. Overall, the authors are to be congratulated on a fantastic new system / technique / manuscript. Below are some very minor suggestions / typo corrections:

The suggested additional measurements on Holocene ice would be certainly possible, obviously with considerable time and effort, but we don't think that this is absolutely essential for the method assessment. If the aim is to further test reproducibility then a low accumulation core such as EDC should be better suited as it has a wider gas age distribution and thus less expected variability on small scales. On the other hand, if the additional measurements are to serve a better comparison to existing records (to judge accuracy at the ppm level), we run into well-known issues between different extraction techniques (e.g. for N_2O concentration) and yet unresolved offsets between CO_2 records from different cores, all of which frustrate a meaningful comparison to other records. Overall, given the time constraints and the (in our opinion) lack of absolute necessity for the suggested additional measurements, we believe that the presented data should suffice to confirm the measurement performance in its current form. We also point out that first publications to reconstruct real ice core records using this technique will follow this methodological paper, which will give ample opportunity to investigate reproducibility and replication of previous records. However, if the editor deems it important enough to delay publication of this paper for it, we are happy to do these measurements as soon as practical. As of the three people who have run the system in the past two have left the lab and the third is in Antarctica for fieldwork, the measurements could be performed in April/May at the earliest.

Line 39 replace "shortly" with "briefly"

Replaced.

Line 108 change to "sealed glass vessel with a flat base and lid"

Changed.

Figure 3: include a legend explaining all symbols
Added as suggested.

Line 161 “combi” ï “combination”
Corrected.

Line 201 “the Byrd ice core”
Changed.

Line 220 change to “…increase or decrease…”
Changed.

Figure 5. Clarify: was the photo on the left from a sublimation with P < 0.15 hPa?
We changed the figure caption to: *Ice after 4 cm of sublimation. Penitentes in the right picture occur at pressures of more than 0.15 – 0.2 hPa measured at the top of the extraction vessel, while on the left the pressure was kept below 0.15 hPa.*

Line 270 “from the inner surface”
Changed.