

Interactive comment on “Water isotopic ratios from a continuously melted ice core sample” by V. Gkinis et al.

Anonymous Referee #2

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General comments

This paper by Gkinis et al. presents a custom-made ice melting, sample delivery and water evaporation system coupled to a commercially available infrared laser absorption spectrometer based on the cavity ring-down technique. The authors make a great effort to calculate signal attenuation effects of the whole system, starting from signal attenuation in the ice cores down to signal dampening in the analyzer. For this purpose, they applied isotopic step changes to the water stream entering the vaporizing unit to identify the transfer function of the system. The authors admit themselves that the drawback of their procedures was that the step change in the water flow was not applied at the very beginning of the whole setup, i.e. at the ice melting unit. Instead, they use

power spectral densities of analytical data gained with both the described online and an offline method, i.e. analyzing liquid water samples from 5-cm pieces of the same ice core, using the same analyzer.

The paper presents a combination of a novel analytical technique for stable isotope analysis with an already existing technique of chemical online analysis of ice cores, enabling online water isotope analysis at an unprecedented spatial (and, thus, temporal) resolution. The mathematical procedures described in the paper in combination with the high resolution isotopic data allow for a lower noise level of measurement data, especially of deuterium excess, as compared to classical offline analysis. This will help consolidate the data basis for interpreting abrupt climate changes from ice core analysis.

The paper is well written and in the scope of Atmos Meas Tech. The technical and mathematical, mainly spectral, methods are thoroughly described. The graphs presented are clear and concise. Except for the fact that the isotopic step changes should have been applied to the front end of the system, I could not find other major weaknesses. It is likely that this paper will bring not only the ice core community but also the community of infrared laser applicants for isotopic analysis in general a step forward.

Specific comments

p. 4, l. 16f.: The high susceptibility of d18O measurements via CO to interference with NO ($m/z = 30$), generated in the ion source of the mass spectrometer, could also be mentioned here, which is a major drawback of the simultaneous analysis of d18O and dD with high temperature pyrolysis-CF-IRMS.

p. 7, l. 18: “ka b2k” should be explained at its first use for the non-ice-core expert reader, e.g. “thousand years before 2000 AD (ka b2k)”

p. 8, l. 3: Here it should be made clear that it's the delta values (d18O, dD) that show the nearly linear response to water vapor concentration fluctuations around 20000 ppm.

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p. 8, l. 6: Here it should be made clear to the reader that these values were obtained for the same individual analyzer, as each individual analyzer has its own characteristics, e.g. the response might not be linear or the slope of the response might be different. This information should be amended by the calibration details for the analyzer, i.e. frequency of calibrations, precision, accuracy, drift.

p. 13, l. 8f.: It should not have been too difficult to introduce an isotopic step change at the melting unit, i.e. around P1 in Fig. 1. This would have avoided the “detour” using power spectral densities.

Figure 8: The numbers for $\sigma(\text{cfa})$ are a bit confusing here. The numbers in the legend do not correspond to the numbers given in the figure caption.

Technical corrections

p. 4074, l. 3: Change "build" to "built"

p. 4075, l. 16: Change “usefull” to “useful”

p. 4075, l. 16: Change “it’s” to “its”

p. 4075, l. 20: Change “is introduced” to “has been introduced”

p. 4076, l. 7: Change “requires the process of” to “requires processing of”

p. 4076, l. 28-29: Change “similary” to “similarly”

p. 4077, l. 13: Change “evaporatotion” to “evaporation”

p. 4079, l. 5: Change “VSMO” to “VSMOW”

p. 4081, l. 17, and p. 4086, l. 13: Change “sceme” to “scheme”

p. 4086, l. 13 & 15: Change “on a 5 cm resolution” to “at a 5 cm resolution”

p. 4090, l. 17: Change “With the use” to “The use”

Figure 8 is mentioned in the text before Figure 7. Thus, swap the two figures.

Throughout the manuscript: Change “infra red” to “infrared”, and remove a range of misplaced commas.

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