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Hydrology and Earth System Sciences Discussions

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9, C1792–C1795, 2012

Interactive Comment

Interactive comment on "Technical Note: On the memory effects in the analysis of δ^2H and δ^{18}O water samples measured by different laser spectroscopes" *by* D. Penna et al.

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The memory effects on laser-based instruments to measure δ2H and δ18O are well known. As the authors note, both instrument manufacturers recommend ignoring the first few injections to alleviate memory effects. For example, the standard LGR procedure for analyzing samples with as wide a range of isotopic ratios as has been analyzed in the present paper would involve injecting the unknown water sample repeatedly for 10 times, discarding the first 6 injections, and averaging the values obtained in the last 4 injections. As the authors note, this procedure essentially eliminates any memory effect in the sample measurement. It is also important to note, as the authors have, that since the instruments from the different manufacturers have different injection rates, the memory effects also vary with the respective injection timing.

Specifically, the following plot recasts the data presented from Figure 1 (δ2H of Std 3) so that the variation of δ2H is a function of total measurement time (not number of injections) using the analysis times stated in the manuscript. This plot shows that the entire analysis has been completed on some instruments before the memory has been eliminated on other instruments primarily due to the differences in the measurement rates.

In addition, when memory effects are evaluated, it is important to consider all of the components in the sampling system. In particular, how was the memory of the syringes accounted for in this investigation? Were syringes with identical performance used on all instruments? In our testing at LGR, we have found significantly worse memory with gas-tight syringes, particularly in δ18O measurements, which is why LGR recommends zero-dead-volume syringes instead of gas-tight syringes.

An additional point of note: based on the data extracted from the manuscript, it appears as though the LGR instruments are exhibiting uncharacteristically large memory, with 1/e values greater than 1 injection – normally LGR instruments should exhibit values closer to 0.8 injections or less). We suspect that this could be due to the syringe and/or a dirty injection block. So, if the injection block was cleaned and/or syringe was changed, the observed memory on the LGR instruments could be even smaller.

Finally, as the first reviewer noted, the authors used a first-generation and second-generation LGR Liquid Water Isotope Analyzer in this investigation. LGR's current models represent "third-generation" instruments that incorporate several improvements including redesigned injector (or evaporator), refined plumbing, faster pumping speed, faster measurement timing and comprehensive thermal control. The general result is significant improvement in speed, precision and overall performance compared with

HESSD

9, C1792–C1795, 2012

older models.

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HESSD

9, C1792–C1795, 2012

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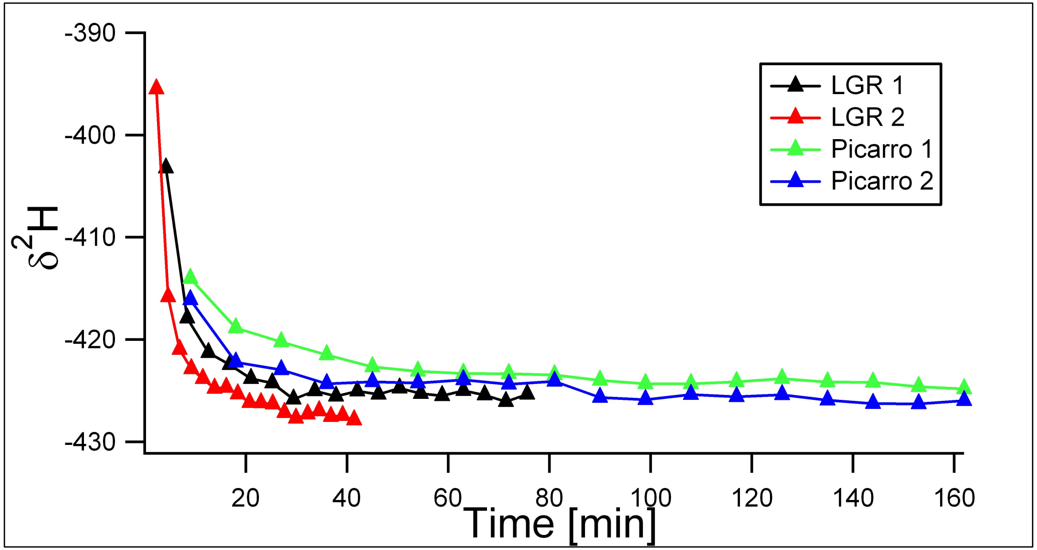

Fig. 1. Variation of δ2H (of Std 3) as a function of total measurement time (not number of injections) using the analysis times stated in the manuscript.