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LAC-IC 2018: Evaluation of the first IAEA regional water δ18O/δ2H interlaboratory comparison exercise

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Throughout the past decades, $\delta^{18}O$ and $\delta^{2}H$ of the water molecule have been widely used as tracers in the hydrological and climatological sciences. Until the late 2000s, isotope-ratio mass spectrometry was the only available analytical technology, with associated capital investments, operating expenditures and human resource and infrastructure requirements. The advent of laser spectrometric techniques during the last decade has reduced most of these requirements and enabled a great number of research groups to conduct their own analyses rather than contracting these out. This is a crucial advance especially for countries where resources to operate mass spectrometry laboratories are limited and has resulted in a boost of the usage of $\delta^{18}O$ and $\delta^{2}H$ in research and applied water management. However, the rapid proliferation of laser spectrometers has raised occasional QA/QC concerns about the data resulting from such laboratories, which is not only to the detriment of the research groups concerned, but also to the science and analytical technology as such.

To address these concerns, we organized a geographically constrained laboratory intercomparison exercise involving 25 laboratories with $\delta^{18}O$ and $\delta^{2}H$ analytical capabilities in the Latin American and Caribbean (LAC) region. The exercise was preceded by a survey questionnaire which provided information on the instrumentation, reference materials, data processing techniques and QA/QC approaches, as well as a self-assessment of the available human resources for $\delta^{18}O$ and $\delta^{2}H$ analysis. Consecutively, three test samples were provided to the laboratories, and results collected in a template form. We used z-scores to assess performance per sample and aggregated to laboratory level, with a fairly tight standard deviation of the proficiency test of 0.1 ‰ for $\delta^{18}O$ and 0.8 ‰ for $\delta^{2}H$, which we deemed fit for purpose in hydrological investigations. Laboratory performance was ranked as satisfactory if $z<2$, questionable if $2\leq z<3$ and unsatisfactory if $z\geq3$. After the deadline, all laboratories received an individual performance report.

Our results show that: (i) that 90% of the submissions were measured by laser spectrometry; (ii) for $\delta^{2}H$, 80% of the laboratories submitted satisfactory results (10% questionable) and (iii) for $\delta^{18}O$ the results were more variable resulting in 50% satisfactory and 35% questionable submissions. We therefore conclude that most laboratories in the region can provide $\delta^{2}H$ results that are fit for purpose, however with quite some margin for improvement in $\delta^{18}O$. This may be explainable in part by the technical challenges of $\delta^{18}O$ assays on laser spectrometers compared to $\delta^{2}H$ (e.g. dependency of $\delta^{18}O$ on the H_2O concentration). We attempted to identify key factors of good and

poor performance; however, on the fairly small number of participants, no obvious causes could be identified. There are indications that commonly known questionable practices may negatively influence performance, with the reasons for that (lack of resources or access thereto, inadequate training or awareness) to be determined.