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Laboratory evaluation of water vapour concentration dependence of commercial water vapour isotope cavity ring-down spectrometers for continuous onsite atmospheric measurements in the Amazon rainforest

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Commercially available laser-based spectrometers permit continuous field measurements of water vapour (H_2O) stable isotope compositions, yet continuous observations in the Amazon, a region that significantly influences atmospheric hydrological cycles on regional to global scales, are largely missing. In order to achieve accurate on-site observations in such conditions, these instruments will require regular on-site calibration, including for H_2O concentration dependence ([H_2O]-dependence) of isotopic accuracy.

With the aim of conducting accurate continuous $\delta^{18}O$ and $\delta^{2}H$ on-site observation in the Amazon rainforest, we conducted a laboratory experiment to investigate the performance and determine the optimal [H_2O]-dependence calibration strategy for two commercial cavity-ring down (CRDS) analysers (L1102i and L2130i models, Picarro, Inc., USA), coupled to our custom-built automated calibration unit. We particularly focused on the rarely investigated performance of the instruments at atmospheric H_2O contents above 35,000 ppm, a value regularly reached at our site.

The later analyser model (L2130i) had better precision and accuracy of $\delta^{18}O$ and $\delta^{2}H$ measurements with a less pronounced [H_2O]-dependence compared to the older L1102i. The [H_2O]-dependence calibration uncertainties did not significantly change with calibration intervals from 28 h up to 196 h, suggesting that one [H_2O]-dependence calibration per week for the L2130i and L1102i analysers is enough. This study shows that with both CRDS analysers, correctly calibrated, we should be able to discriminate natural diel, seasonal and interannual signals of stable water vapour isotopes in a tropical rainforest environment.