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New Isotopic Water Analyzer for Hydrological Measurements of Both Liquid Water and Water Vapor

T. Owano, M. Gupta, E. Berman, and D. Baer
Los Gatos Research, Mountain View, United States (d.baer@lgrinc.com)

Measurements of the stable isotope ratios of liquid water allow determination of water flowpaths, residence times in catchments, and groundwater migration. Previously, discrete water samples have been collected and transported to an IRMS lab for isotope characterization. Due to the expense and labor associated with such sampling, isotope studies have thus been generally limited in scope and in temporal resolution.

We report on the recent development of the first Isotopic Water Analyzer that simultaneously quantifies δ^2H, δ^{17}O and δ^{18}O in liquid water or in water vapor from different natural water sources (e.g., rain, snow, streams and groundwater). In High-Throughput mode, the IWA can report measurements at the unprecedented rate of over 800 injections per day, which yields more than 140 total unknown and reference samples per day (still with 6 injections per measurement). This fast time response provides isotope hydrologists with the capability to study dynamic changes in δ values quickly (minutes) and over long time scales (weeks, months), thus enabling studies of mixing dynamics in snowmelt, canopy throughfall, stream mixing, and allows for individual precipitation events to be independently studied.

In addition, the same IWA can also record fast measurements of isotopic water vapor (δ^2H, δ^{17}O, δ^{18}O) in real time (2 Hz data rate or faster) over a range of mole fractions greater than 60000 ppm H_2O in air. Changing between operational modes requires a software command, to enable the user to switch from measuring liquid water to measuring water vapor, or vice versa. The new IWA, which uses LGR's patented Off-axis ICOS technology, incorporates proprietary internal thermal control for stable measurements with essentially zero drift despite changes in ambient temperature (over the entire range from 0-45 degrees C). Measurements from recent field studies using the IWA will be presented.