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High frequency, realtime measurements of stable isotopes in liquid water

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We developed a method to measure in-situ the isotopic composition of liquid water with minimal supervision and, most important, with a temporal resolution of less than a minute. For this purpose a off-the-shelf microporous hydrophobic membrane contactor for under 200€ was combined with an isotope laser spectrometer (Picarro). The contactor, originally designed for degassing liquids, was used with nitrogen as carrier gas in order to transform a small fraction of liquid water to water vapor. The generated water vapor was then analyzed continuously by the isotope laser spectrometer. To prove the membrane's applicability we determined the specific isotope fractionation factor for the phase change through the contactor's membrane for a common temperature range and with different waters of known isotopic compositions. This fractionation factor is then used to derive the liquid water isotope ratio from the measured water vapor isotope ratios and the measured temperature at the phase change. The system was compared for breakthrough curves of isotopically enriched water and the isotope values corresponded very well with those of liquid water samples taken simultaneously and analyzed with a conventional method (CRDS). The introduced method supersedes taking liquid samples and employs only relative cheap and readily available components. This makes it a relatively inexpensive, fast, user-friendly and easily reproducible method. It can be applied in both the field and laboratory wherever a water vapor isotope analyzer can be run and whenever real-time isotope data of liquid water are required at high temporal resolution with the same accuracy as collecting individual water samples.