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Low-Cost Automated Water Sampling Systems for Multiple Compartments and Stable Isotope Analysis (H, O): Challenges and Opportunities

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The development of laser spectrometry for water isotope analysis has significantly reduced the time per analysis and cost required for sample processing, allowing the processing of an increased number of field samples. This advancement has driven the development of automated sampling systems in recent years by different scientific groups using stable water isotopes to investigate hydrological processes. However, ensuring sample integrity is crucial, as isotopic fractionation during storage must be minimized to obtain reliable results.

In this contribution, we present insights from long-term laboratory tests to develop a field-ready water sampling system [1]. We demonstrate applications of low-cost samplers, including automated surface and groundwater sampling systems, adapted from Michelsen, Laube [2], for nitrate and water isotope analysis in an agricultural catchment in Germany [3] (Figure 1B). Additionally, we discuss do-it-yourself (DIY) precipitation samplers for urban Canadian environments ([4], [5], Figure 1A), designed and tested using accessible materials based on existing literature.

These findings demonstrate the feasibility of low-cost water sampling systems for isotope hydrology while addressing challenges in sample preservation and data quality. Optimizing sampler designs improves data reliability and enables high-resolution isotopic sampling, making isotope-based hydrological studies more accessible, particularly in developing regions.

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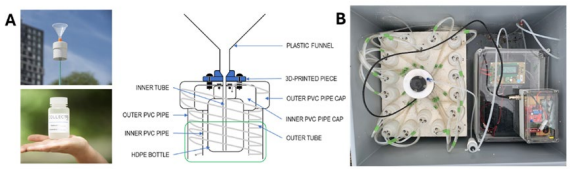

Figure 1: Different sampling principles – A: DIY sampling system for precipitation after Carton, Barbecot [4]; B: automatic sampling system after [2] and further adjusted for surface and groundwater [3]