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In-situ measurements of pore water stable isotope composition in a semi-arid environment with implications for spatio-temporal variability of unsaturated zone processes.

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Northern Namibia is a region with high population growth, limited water resources and a transboundary aquifer system where groundwater recharge and groundwater flow processes are not yet well understood. Our study is an interdisciplinary approach to improve the understanding of links between hydrological, geochemical and ecological processes to estimate areas that contribute to recharge a shallow aquifer system. To determine the spatial variability of infiltration and evapotranspiration processes within the critical interface and between the atmosphere and the groundwater nine plots in an area of 9,000 m^2 were investigated. Stable isotopes (deuterium, δ^2H, and oxygen-18, δ^{18}O) of soil pore water were measured directly in the field using a LGR-DLT100 and commercially available soil gas probes (BGL-30, UMS). Additionally, soil moisture and temperature were recorded.

After drift correction of the isotope data the long term precision using a quality check standard for 221 measurement points of a two week period was between 6.3 – 7.4 ‰ for δ^2H and 1.3 – 3.6 ‰ for δ^{18}O. Each point was measured with six repetitions were the mean standard deviation for all quality check standards was 1.3 – 1.6 ‰ for δ^2H and 0.23 – 0.30 ‰ for δ^{18}O. It could be observed that the quality of the measurements decreased with increasing number of measurements due to a memory effect of the probes enhanced by organic contamination of the membrane pores. However, results support the applicability of an in-situ system for the determination of stable isotopes in soil pore water. Spatially and temporal variability affected by intermitted light rainfall events can be deduced with the observed data.