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On the short-term (5-30 min.) precipitation isotope (δ18O, δ2H) variability in a temperate climate

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Stable isotopes in precipitation (esp. δ18O and δ2H) have long since been used in hydrological and climatological investigation. While the established method of monthly composite sample collection has led to extensive global datasets, such as the Global Network of Isotopes in Precipitation (GNIP), sample collections at daily or event-level temporal resolution are often used as a present-day calibration for paleoclimatic records, such as speleothems or corals, as they more appropriately depict day-to-day variations and/or extreme weather events. Nonetheless, to elucidate the evolution of rainstorms and the microphysical atmospheric processes, particularly with a view to distinguishing stratiform and shallow/deep convective frontal systems, datasets are needed which disentangle individual storms into their respective phases. It becomes evident that manual collection of rainwater samples is too much labour-intensive to achieve a systematic, highly-resolved dataset.

Unattended sampling technology has evolved over the last decades from mechanical, overflow-driven systems to the in-situ deployment of laser spectrometers. Consequently, the temporal resolution has increased from several isotope data per day to several ones per hour or almost real-time, demonstrating large intra-event variations in tropical cyclones. However, a number of in-situ laser spectrometers were deployed only for shorter periods, or they were/are limited to the measurement of water vapour isotopes. A technology implementation gap still exists for settings in which, for various reasons, no laser spectrometer can be deployed in the field, but where high-resolution sampling is needed.

Here, we present a one-year feasibility study and preliminary dataset of up-to 15-minute resolved δ18O and δ2H of precipitation in Vienna, obtained using a tipping-bucket triggered, time-constrained sequential precipitation sampler. 1250 precipitation samples were analysed using off-axis integrated laser spectrometry, and their diurnal amplitude compared to 110 daily accumulated and monthly totalized samples. Our work highlights the need to develop suitable solutions for unattended yet logistically simple collection of precipitation samples at intra-event scale, as well as the need to better exploit the potential of hi-resolution δ18O and δ2H for meteorological and climatological investigations.