ABSTRACT BOOK

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Field testing of tube-dip-in water precipitation collectors used in isotope hydrology

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Abstract

The oxygen and hydrogen stable isotope composition in precipitation serves as a benchmark in most isotope atmospheric, (eco-)hydrological, and paleoclimatological applications. Several rain collectors have been designed for collecting monthly, daily or event-based precipitations aiming to prevent evaporation and associated isotope fractionation. Oil collectors have been the most widely used for many years and only recently they are being progressively replaced by free-oil Tube-dip-in water collectors, especially after their formal publication by Gröning et al. (2012) and the production of a commercial version (Palmex Ltd). Although the reliability of this precipitation collector has been proven, many doubts remain when dealing with small precipitation amounts (Michelsen et al., 2018). Field testing of precipitation collectors is therefore encouraged, which should be carried out under the same environmental conditions of areas where researchers want to undertake their studies.

In this work, we tested the field performance of different precipitation collectors in preventing evaporation and isotope fractionation. Two main objectives were behind this study: i) to evaluate the reliability of tube-dip-in water collectors for very low precipitation amounts; ii) to test a homemade Tube-dip-in water collector for different water amounts. The experiment consisted of simulating the collection of small monthly precipitation samples in spring and summer when atmospheric conditions are more likely to promote evaporation. The experiment was carried out on the rooftop of the Earth Science Department of the University of Pisa from March 2022 to July 2022. Four different collector designs were tested simultaneously over four different periods (each lasting approximately one month): a Control collector with no anti-evaporative system; an Oil collector; a Palmex Tube-dip-in water collector; a homemade Tube-dip-in water collector. They were filled to 1.4% of their total volume (10 L) with water of known isotope composition. Since the diameter of 13.5 cm of most common funnels, this percentage corresponds to ~10 mm. Other two homemade Tube-dip-in water collectors were filled to 5% and 10%, corresponding to ~35 mm and ~70 mm. All the collectors were placed outside at the start of each period. Evaporative mass losses were determined gravimetrically and samples for isotope analyses were collected at the end of each period. On average, the Oil collector showed the smallest mass losses, and the isotope shifts were much lower than analytical errors. The Palmex collector failed, with even larger mass losses and isotope shifts ($\Delta\delta^{18}O$ = 0.42‰ and $\Delta\delta^{2}H$ = 1.6‰) than the Control collector. The home-made Tube-dip-in water collectors performed well and better than Palmex. Mass losses and isotope shifts tended to increase with increasing temperature and decreasing relative humidity.

References

Gröning, M., Lutz, H.O., Roller-Lutz, Z., Kralik, M., Gourcy, L., Pöltenstein, L., 2012. A simple rain collector preventing water re-evaporation dedicated for δ18O and δ2H analysis of cumulative precipitation samples. J. Hydrol. 448–449, 195–200. https://doi.org/10.1016/j.jhydrol.2012.04.041

Michelsen, N., van Geldern, R., Roßmann, Y., Bauer, I., Schulz, S., Barth, J.A.C., Schüth, C., 2018. Comparison of precipitation collectors used in isotope hydrology. Chem. Geol. 488, 171–179. https://doi.org/10.1016/j.chemgeo.2018.04.032