Geophysical Research Abstracts
Vol. 18, EGU2016-4661, 2016
EGU General Assembly 2016

A fully automated meltwater monitoring and collection system for spatially distributed isotope analysis in snowmelt-dominated catchments

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In many mountainous catchments the seasonal snowpack stores a significant volume of water, which is released as streamflow during the melting period. The predicted change in future climate will bring new challenges in water resource management in snow-dominated headwater catchments and their receiving lowlands. To improve predictions of hydrologic extreme events, particularly summer droughts, it is important characterize the relationship between winter snowpack and summer (low) flows in such areas (e.g., Godsey et al., 2014). In this context, stable water isotopes (^{18}O, ^{2}H) are a powerful tool for fingerprinting the sources of streamflow and tracing water flow pathways.

For this reason, we have established an isotope sampling network in the Alptal catchment (46.4 km^2) in Central-Switzerland as part of the SREP-Drought project (Snow Resources and the Early Prediction of hydrological DROUGHT in mountainous streams). Samples of precipitation (daily), snow cores (weekly) and runoff (daily) are analyzed for their isotopic signature in a regular cycle. Precipitation is also sampled along a horizontal transect at the valley bottom, and along an elevational transect. Additionally, the analysis of snow meltwater is of importance.

As the sample collection of snow meltwater in mountainous terrain is often impractical, we have developed a fully automatic snow lysimeter system, which measures meltwater volume and collects samples for isotope analysis at daily intervals. The system consists of three lysimeters built from Decagon-ECRN-100 High Resolution Rain Gauges as standard component that allows monitoring of meltwater flow. Each lysimeter leads the meltwater into a 10-liter container that is automatically sampled and then emptied daily. These water samples are replaced regularly and analyzed afterwards on their isotopic composition in the lab. Snow melt events as well as system status can be monitored in real time.

In our presentation we describe the automatic snow lysimeter system and present initial results from field tests in winter 2015/2016 under natural conditions at an experimental field site. Fully functional deployment in a forested and an open field location in the Erlenbach subcatchment (0.7 km^2) is envisaged for winter 2016/2017.

Godsey, S.E.,* J.W. Kirchner and C.L. Tague, Effects of changes in winter snowpacks on summer low flows: case studies in the Sierra Nevada, California, USA, Hydrological Processes, 28, 5048-5064, doi: 10.1002/hyp.9943, 2014.