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Flow intermittency changes in-stream carbon processing of Alpine streams

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Hydrological conditions are a major driver of carbon processing in Alpine headwater streams. So far, the consequences of flow intermittency on dissolved carbon are mainly studied in Mediterranean and desert areas. However, the hydrological regime of most Alpine headwater streams is predicted to change drastically due to climate change and anthropogenic uses such as hydropower and water abstraction. Hence, understanding how extreme events, such as flow intermittency, affect sources and fate of carbon in these streams is crucial.
We tackled this question by a mesocosm experiment, where we measured relevant parameters of the carbon cycle during artificially introduced drought scenarios. These drought scenarios consisted in different magnitudes of discharge which were applied on six flumes fed by the stream water of a well-studied Alpine stream over three weeks.
Monitoring of dissolved organic matter (DOM) quantity and quality, oxygen and CO_2 of surface water and the hyporheic zone permitted us to find the threshold of low base flow that causes severe changes in DOM quantity and quality and link these changes to primary production. Even though autotrophs were identified as the principal source of DOM increase in the flumes with low discharge, we also found a relevant imprint of hyporheic heterotrophic activity on DOM quality and increasing carbon mineralization, due to enhanced water residence times and exchange with the hyporheic zone.
These results suggest that DOM quality and quantity of Alpine streams will experience similar changes with flow intermittency, as found in other climatic regions. Further they help to improve the understanding of in-stream metabolism (autotrophic vs. heterotrophic) related to carbon processing during drought events.