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Low-flow characteristics across Switzerland and their relation to landscape

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Low flows impact humans and the environment. However, our understanding of which and how climatic drivers and landscape properties affect low flows is limited. We explore how climatic conditions relate to the timing and magnitude of low flows across Switzerland, and how landscape properties (topography, geology, landuse) affect the response of catchments to dry periods.

We analyzed streamflow and climate data from 380 catchments across Switzerland for the time period 2000 to 2018 with special focus on the low-flow extremes of 2003, 2015 and 2018. These extreme events are largely shaped by a combination of climatic drivers (low precipitation and high evaporation) and their deviation from the long-term mean. Nevertheless, we found major differences in the recession behavior during climatic extremes as well as in the recovery after extended droughts (here shown for 2003, 2015 and 2018) by comparing different catchments in different physiographic settings. Most of these differences, relevant for occurrence and magnitude of low flows, could be traced back to distinct differences in landscape characteristics such as topography, geology and landuse.

We present a framework to cluster the relevant landscape information to assess their influence on low-flow characteristics in a qualitative manner, and used this landscape information in a predictive machine-learning regression approach. With this approach, we can identify the main climatic influences on low flows and describe the dominant landscape characteristics that influence low flow magnitude, and characterize the different reaction of different landscapes to droughts throughout Switzerland.