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Monitoring intermittent streams with low-cost water-presence sensors

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The study of intermittent and ephemeral streams is gaining more and more popularity, as the scientific community has acknowledged the fundamental impact of these streams on basic hydrological processes and important ecosystem services. Nevertheless, the understanding of the physical processes that drive this intermittency has been long hampered by the limited availability of empirical data. In fact, monitoring the event-based expansion and contraction of temporary streams through visual inspection is very demanding and time-consuming. To circumvent this limitation, several low-cost sensor designs for monitoring flow presence have been suggested in recent years. These sensor exploit either water temperature or electrical conductivity. However, these sensors are typically characterized by pointwise probes that water flows can easily dodge, particularly in streams with complex and unstable morphologies. Moreover, very few studies have been conducted that use networks of probes to monitor stream intermittency at the catchment-scale.

Here we present a field-application of an advanced version of the low-cost water presence sensor developed by Chapin et al., 2016. In particular, we tested a new probe design to continuously measure the electrical conductivity across a channel cross-section and, thus, infer the presence of water therein. More than 50 probes were installed to monitor the dynamics of several intermittent tributaries of a small headwater catchment in northern Italy during the summer and fall of 2019. This catchment encompasses a wide variety of stream types: mild and steep slopes, incised and flat geometries, rocky and vegetated riverbeds. The field application shows that the proposed probes are able to provide useful information about the temporary activation of ephemeral streams under a variety of environments and conditions. The reconstructed temporal dynamics of the stream network comply with the persistency maps previously derived based on visual inspection. This new sensor design enables the continuous-time monitoring of the activity of intermittent streams, providing easily interpretable data under diverse conditions. We conclude that low-cost water presence sensors provide a unique opportunity to expand the coverage of the available datasets about the dynamics of intermittent streams.