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Introduction

More than half of the global stream network does not have permanent flow (Messager et al. 2021). Temporary streams are very dynamic systems in terms of water, sediment, and nutrient transport (Fortesa et al. 2021) and are important habitats (Sánchez-Montoya et al. 2016). It is predcited that climate change will impact these streams and result in longer dry periods (Reynolds et al. 2015).

However, there are few observations for temporary streams as gauges have mainly been installed in perennial streams. Alternative sensors and visual approaches have been developed to determine the flow state of temporary streams.

In this study, we tested how well citizens can observe the flow state of temporary streams based on six classes.

Research questions:

How accurate, sensitive, and precise are observations of temporary stream flow states by citizen scientists? II) How **consistent** are citizen scientists in their observations?



Methods

In 2022 (Apr-Sep), we asked 1268 citizens about the flow state of the temporary stream that they could see in front of them. Structured pen and paper interviews were conducted at eight different streams on 23 days in southern Germany and Switzerland.





Fortesa, Josep; Ricci, Giovanni Francesco; García-Comendador, Julián; Gentile, Francesco; Estrany, Joan; Sauquet, Eric et al. (2021): Analysing hydrological and sediment transport regime in two Mediterranean intermittent rivers. In CATENA 196, p. 104865. DOI: 10.1016/j.catena.2020.104865. Messager, Mathis Loïc; Lehner, Bernhard; Cockburn, Charlotte; Lamouroux, Nicolas; Pella, Hervé; Snelder, Ton et al. (2021): Global prevalence of nonperennial rivers and streams. In *Nature* 594 (7863), pp. 391–397. DOI: 10.1038/s41586-021-03565-5. Reynolds, Lindsay V.; Shafroth, Patrick B.; LeRoy Poff, N. (2015): Modeled intermittency risk for small streams in the Upper Colorado River Basin under climate change. In *Journal of Hydrology* 523, pp. 768–780. DOI: 10.1016/j.jhydrol.2015.02.025. Sánchez-Montoya, María Mar; Schiller, Daniel von; Ruhí, Albert; Pechar, Giuliano Sting; Proia, Lorenzo; Miñano, Jesús et al. (2016): Responses of grounddwelling arthropods to surface flow drying in channels and adjacent habitats along Mediterranean streams. In *Ecohydrology* 9 (7), pp. 1376–1387. DOI: 10.1002/eco.1733.

How well can citizen scientists observe temporary streams?

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Results - Accuracy, sensitivity, and precision



The mode of the selected flow states matched the expert's opinion for 14 of the 23 survey days. Between 15% and 98% (median: 46%) of the participants per survey day chose the same class as the expert. The overall agreement of the participants with the expert's opinion was 56%. Four out of five observations were within one class. The variability in the chosen flow state was highest for the trickling class.



Even though the precision was highest for the dry streambed class, the sensitivity was low because participants also chose the dry streambed class when the expert's opinion was damp/wet streambed (P2, Th3) or isolated pools (T2, T3).

The sensitivity was highest for the flowing class; precision was the second highest.

The precision and sensitivity were lowest for the trickling state. This state was only observed at one stream and by the lowest number of participants (n = 106).

D: Danube T: Toess Dr: Dreisam Th: Thur Z: Zuriberg S: Sihlwald H: Hinterzarten P: Pizol

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Results - Consistency



YES NO No Data

Factors that were considered by participants when deciding on a flow state:

- Length of the stream section
- Source of the water: rain, stream and groundwater
- Weather: drought in summer 2022
- Knowledge about the stream
 - Flow state on previous days
 - Water abstractions/withdrawals
 - Newspaper articles

Conclusion

Citizens can determine the flow state of temporary streams well, particularly the most extreme states (dry streambed, flowing). However, participants also chose the dry streambed state when isolated pools were present. Merging the different flow states after data collection could improve the quality of the data further.





When asked additional questions about the stream, 2-22% of the participants were inconsistent in their answers, especially for the dry streambed class. For example, 18% of the participants stated that the streambed was completely damp/wet but had chosen the dry streambed class earlier.

Possibly, one or two word descriptions of the flow states are not sufficient to convey their meaning and further explanations should be provided.

In addition, participants also considered different locations or moments when answering the different questions.



