*Science* editors,

Please find the enclosed manuscript ‘Ephemeral stream contributions to United States drainage networks’, in which we present the first continental-scale assessment of ephemeral stream hydrology and biogeochemistry for every river, lake, reservoir, canal, and ditch in the United States. We find that ephemeral stream channels (those that only flow following rain events) contribute the majority of water to U.S. river networks and have potentially major implications for downstream water quality across the global river network. By incorporating state-of-the-art models in a novel routing framework for over 20,000,000 surface water features, this study represents a major advancement in our understanding of the role that ephemeral streams play in global water quantity and quality.

Streams transport pollutants, and other solutes from the land surface to larger rivers downstream and ultimately exported into the ocean. The most upland streams are often ‘ephemeral’ channels, which flow only in direct response to precipitation and are disconnected from groundwater year-round. Temporary streams (which include both ephemeral channels and those that have intermittent groundwater connections) make up over half of the global river network. It is also regionally established that headwater streams contribute meaningfully to downstream water quality. However, these two ideas have never been reconciled at scale, nor are there any existing assessments capable of distinguishing between ephemeral and intermittent contributions to global water quantity and quality.

To address that gap in knowledge, we use geomorphic theory, existing models, and a novel continental-scale river-lake-reservoir routing framework to map the fraction of water (by volume) that is ‘ephemerally sourced’ for the over 20,000,000 discrete rivers, lakes, reservoirs, canals, and ditches that drain the contiguous United States. We also use existing data and models to estimate the average annual number of days that ephemeral streams flow. We find that, on average, 67% of water exported from United States drainage networks comes from ephemeral streams that only flow, on average, 104 +/- 28 days per year. This significant contribution is facilitated by small headwater streams, where on average 88% of headwater streamflow is ephemeral.

Thus, the ephemeral terrestrial-aquatic connection is a substantial pathway through which pollution (and other solutes) may enter the downstream perennial drainage network and influence water quality. This should have significant implications for global hydrology and biogeochemistry, which to date do not explicitly account for ephemeral streams in their models.

More broadly, our results suggest that ephemeral stream regulation is important to maintaining downstream water quality standards. Ephemeral streams’ regulated status under the United States Clean Water Act has been a long-debated and often contentious topic whose status is uncertain. Due to the timeliness of our results in the context of ongoing Supreme Court deliberation, if our manuscript is sent to review, we request it receive an expedited review process to rapidly assess for publication.

The authors of this study all approve of this submission, and there are no conflicts of interest. None of the material in this manuscript is under review or published elsewhere. We provide the data and code underlying our analysis in a private repository () and, if accepted, will make this repository public. Thank you for your consideration of this article (and of an expediated review process). If there are any questions regarding our methods, findings, or the broader implications of this work, please do not hesitate to contact corresponding author Craig Brinkerhoff.

On behalf of all authors,

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