Single- and multithread rivers originate from (im)balance between lateral erosion and accretion

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Editor's summary

In rivers, water and sediment move down one or more pathways, or threads. Dams and dikes have forced many multithreaded rivers into single pathways, and effective restoration depends on knowing the mechanism behind a river's original state. Using satellite imagery to measure changes over 36 years, Chadwick *et al*. determined that multithreaded rivers develop from an imbalance that favors erosion over deposition. Contrary to the common practice of erosion prevention, these findings suggest that allowing bank erosion would be a more effective way to bring modified rivers back to their natural state. —Angela Hessler

Abstract

Why river channels confine flow to a single pathway or divide flow into multiple interwoven pathways (threads) forms a long-standing fundamental question in river science, which to date remains poorly understood. In this study, we probed channel-pattern origins by mapping thread dynamics along 84 rivers from 36 years of global satellite imagery using particle image velocimetry. Results show that single-thread channels originate from a balance between lateral erosion and accretion, which enables a thread to migrate while maintaining equilibrium width. In contrast, multithread channels originate from imbalance—erosion outpaces accretion in individual threads, causing threads to repeatedly widen and split. Thread-width imbalance provides a mechanistic explanation for how multithread channels develop on Earth and other planets and, in application, can help lower the cost of nature-based river restoration projects.