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River metamorphosis: insight from the comparison between individual meandering and braided threads

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Alluvial rivers exhibit a variety of planforms that extends between two well-defined end members: meandering and braided rivers. The mechanisms controlling the planform to the other has been the subject of intensive research and led to an almost century-long debate. The main outcomes as of today are that only two drivers control the planform morphology: sediment discharge and riparian vegetation.

It is now clear that a non-cohesive gravel-bed single thread channel can only remain stable if the shear stress at its center is close to the threshold value for sediment transport. Therefore a stable channel composed of noncohesive grains can only transport a small amount of bedload. If the boundary flux is too high, the channel is no longer stable and evolves into a braided planform. Only vegetation can, to some extent, prevent this change by strengthening the river banks and enabling a single-thread channel to remain stable.

One question that arises then is whether, and how a braided thread differs statistically from a meandering one. An answer would help us to understand wether a braided stream is merely a collection of single-thread streams near equilibrium or if there is something more in their morphology that distinguishes them from meandering threads.

Using field data collected in the Chinese Tianshan mountains, spanning over almost five decades in discharge, we show that meandering and braided gravel bed threads have comparable morphologies under the same climate and in the same environment. There is no significant difference in width, depth or aspect ratio between the two planforms. Thus, although they transport more, braided rivers are composed of near-threshold threads like their meandering counterparts.