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Hydrological regime as key to the morpho-texture and activity of braided streams

Y. Storz-Peretz and J.B. Laronne
Ben-Gurion University of the Negev, Beer-Sheva, Israel (storz@bgu.ac.il)

Braided streams are a common fluvial pattern in different climates. However, studies of gravel braided streams have mainly been conducted in humid braided systems or in flume simulations thereof, leaving arid braided streams scarcely investigated. Dryland rivers have bare catchments, rapid flow recession and unarmoured channel beds which are responsible for very high bedload discharges, thereby increasing the likelihood for braiding. Our main objective is to characterize the morpho-texture of the main morphological elements - mid-channel bars, chutes and anabranches (braid-cells) in the dryland braided system and compare them to their humid counterparts. Selected areas of the dryland braided Wadis Ze'elim, Rahaf and Roded in the SE hyper-arid Israel were measured, as were La-Bleone river in the French pre-alps along with the Saisera and Cimoliana rivers in NE Italy representing humid braided systems. Terrestrial Laser Scanning (TLS) of morphological units produced point clouds from which high resolution accurate Digital Elevation Models (DEMs) were extracted. Active braid cells in humid environments were also surveyed by electronic theodolite. Roughness and upper tail Grain Size Distribution (GSD) quantiles were derived from the scanned point clouds or from Wolman sampling.
Results indicate that dryland anabranches tend to be finer-grained and less armoured than the bars, contrary to the humid braided systems, where the main or larger anabranches are coarser-grained and more armoured than the bars. Chutes are commonly similar or coarser-grained than the bars they dissect, in accordance with their steeper gradients due to the considerable relief of the bar-anabranch. The morpho-texture displayed in the steep braided Saisera River, located in the Italian Dolomites having the highest annual precipitation, has similarity to that of the dryland braided channels.
In drylands coarse gravel is deposited mainly as bars due to the high flux of bedload, whereas the rapid flow recession is responsible for deposition of finer sediment with minimal winnowing in the branch channels. Therefore, channels are finer-grained than the bars. This process is associated with the mid-channel deposition of central bars. However, the steeper chutes and coarser anabranches are associated with erosive braiding processes, such as chute cutoffs and multiple bar dissection, allowing winnowing to occur also during rapid recession. Hence coarser-grained anabranches in drylands are essentially chutes.
Lengthy flow recession in humid braided channels allows winnowing of fines, thereby generating armored channels, the finer sedimentary particles often deposited downstream as unit bars. Therefore, channels are coarser-grained than the bars they surround. Even though the steep Saisera is in a humid region, its hydrological regime is ephemeral with rapid and short recessions, responsible for a morpho-texture similar to that of dryland braided streams. Hence, the hydrologic regimen is a key to understanding the morpho-textural character of braided channels and for the higher activity of the ephemeral unarmoured channels in sub-barful events compared to their humid counterparts.