Bishop, 1995. **Drainage rearrangement by river capture, beheading and diversion**. *Progress in Physical Geography*. DOI: 10.1177/030913339501900402.

Summary:

The paper is about a review of drainage rearrangement processes, such as drainage capture, drainage diversion, and/or beheading. The author suggests that processes involved in drainage rearrangement could be not so self-evident as previously thought. For example, the main process of drainage capture is the drainage head retreat, which is difficult to consider as a normal component of drainage rearrangement. The author makes the statement that drainage capture may be a relatively rare event in long-term landscape evolution. In addition, one could have uncertainties related to problems with identifying elbows of capture and maintaining drainage lines during the denudation of significant chunks of crustal rocks.

Changes in drainage rearrangement can alter the quantities and even the provenance of sediments (sediment budget and provenance) and significantly impact their biota (biogeography).

The sediment budget and provenance are important for predictive and explanatory studies of basin stratigraphy. In the face of these challenges, the geologists focused on sea-level, climate, and tectonic factors, although the geomorphic components and dynamics remain poorly understood. The author argues that such rearrangements should be better analyzed in order to better constrain the long-term sediment supply to sedimentary basins, especially the ones on continental margins. Another important economic factor is related to placer deposits (gold, diamonds). One could use the interpretations of drainage rearrangement to study the modes of occurrence and provenance of this type of deposit.

The biogeography can be analyzed from the perspective of drainage rearrangement and its processes. The author argues that drainage rearrangement can be responsible for genetic separation related to populations that were physically separated by one of the processes described earlier (capture, diversion, or beheading). Therefore, in this hypothetical situation, one could find fish species similar in terms of genetics but found in adjacent drainage basins. In the same way, it would be possible to use this genetic relation to elucidate drainage history. However, one must have caution because this situation could lead them to a circular argument, which means using two elements of an explanation that are not independent.

Types and Evidence

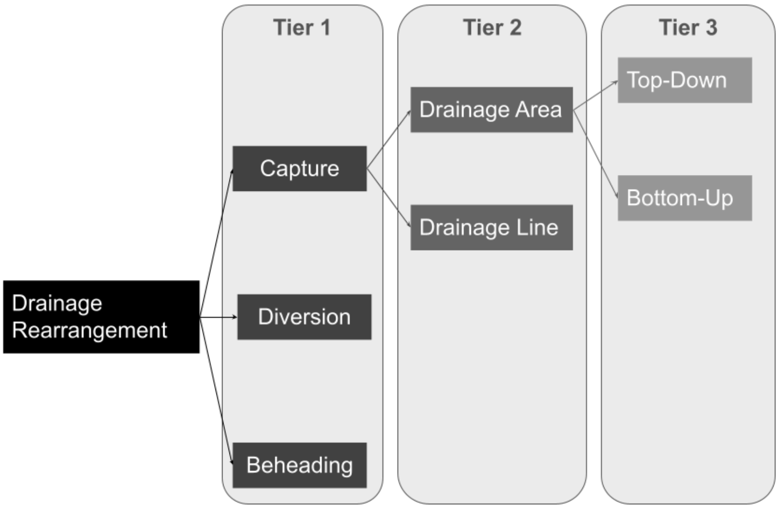
The author describes three different types of drainage rearrangement: capture (Figure 1), diversion (Figure 2), and beheading (Figure 3). He argues that it is important to classify (for all three types) the rearrangement using the catchment areas[1] and drainage lines[2] sub-types. Lastly, one has to distinguish between “top-down”[3] or “bottom-up”[4] processes in drainage rearrangement.

Notes:

1. “(...) progressive encroachment of one catchment boundary into the adjoining catchment. Resulting in the transfer of drainage area of one system to another.”
2. “(...) involves the transfer of both catchments and drainage lines, with the latter’s original channel planforms at least partly preserved”
3. “(...) ’top-down’ to convey the notion of the diverted system being actively involved in the drainage rearrangement”
4. “(...) result in a river’s ’active’ interception and abstrac- tion of an

adjacent system;”

Therefore, we propose here the following classification: first, one must classify the drainage rearrangement between the *capture*, *diversion*, and *beheading* types (tier 1); second, one will have to describe if the rearrangement is happening through *drainage area* or *drainage line* shifts/exchange (tier 2); third, distinguish whether the processes are *top-down* or *bottom-up* type (tier 3). You can find below an example of this workflow:



Example of proposed flow-chart.

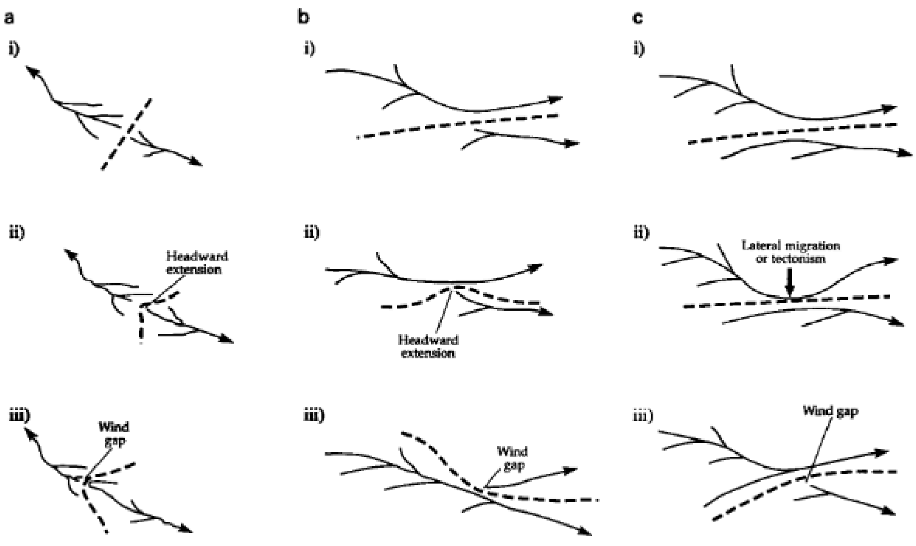


Figure 2 Planform patterns of drainage rearrangement via stream piracy (capture) resulting in preservation of drainage lines and transfer of drainage area between catchments. The dashed line is the drainage divide; (a) illustrates the formation of barbed drainage (boat-hook bends) by headward extension (bottom-up process); (b) and (c) illustrate capture by lateral intrusion into an adjacent drainage basin, either by headward extension of a tributary (b) or lateral migration of a trunk stream to capture an adjacent tributary (c). Note that a rejuvenation head would be expected in the *captured* stream, at or above the point of capture. Compare (c) with Figure 4

Figure 1 - Types of drainage capture (extracted from Bishop, 1995).

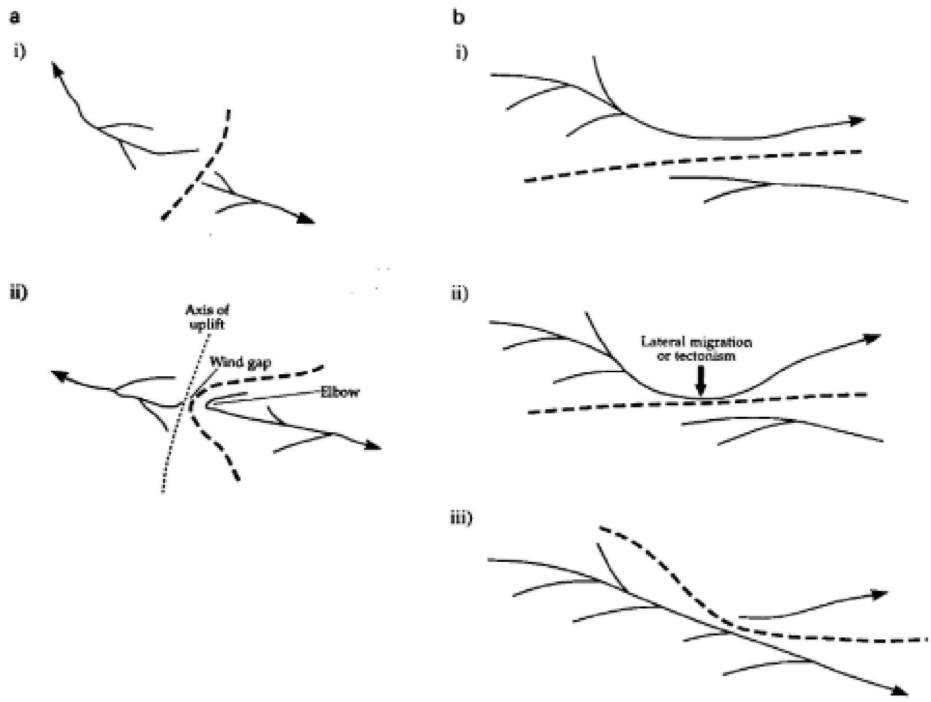


Figure 3 Planform patterns of two forms of drainage rearrangement via stream diversion as a result of lateral migration or tectonism (top-down processes) and involving preservation of drainage lines and transfer of drainage area between catchments (dashed line is the drainage divide); (a) illustrates the formation of barbed drainage (boat-hook or fish-hook bends); (b) illustrates diversion into an adjacent drainage basin. Note that a rejuvenation head may or may not be expected at or above the elbow, depending on the original height difference between the beds of the two rivers involved in the rearrangement and the change in discharge in the stream receiving the diverted flow (see text)

Figure 2 - Types of stream diversion (extracted from Bishop, 1995).

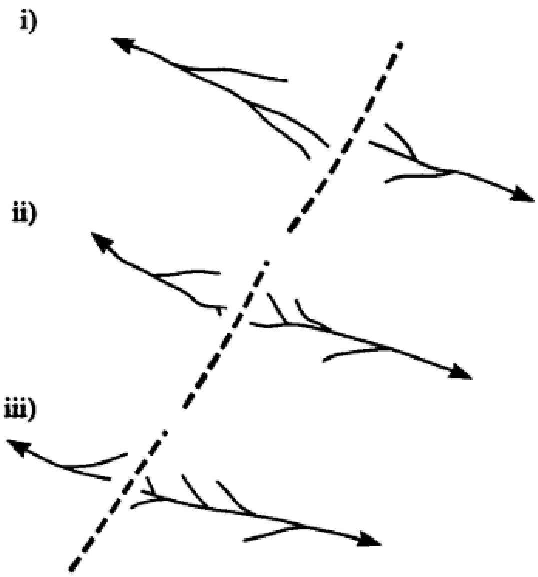


Figure 4 Planform patterns resulting from drainage rearrangement via beheading, involving transfer of drainage area between catchments but no preservation of drainage lines (dashed line is the drainage divide)

Figure 3 - Types of beheading (extracted from Bishop, 1995).

Protocol for identification and analysis of river captures

The first part of the work will consist of classifying river captures that occur by changing the drainage area and with bottom-up processes (Figure 1-a). See the figure below for an example of identifying a river capture in plain view and how it appears in the longitudinal profile. Note also that the figures are organized to demonstrate how a river catch evolves over time at their study site (obs.: it is not the same fluvial capture, but even so it can be understood as evolving steps of river piracy in this area).

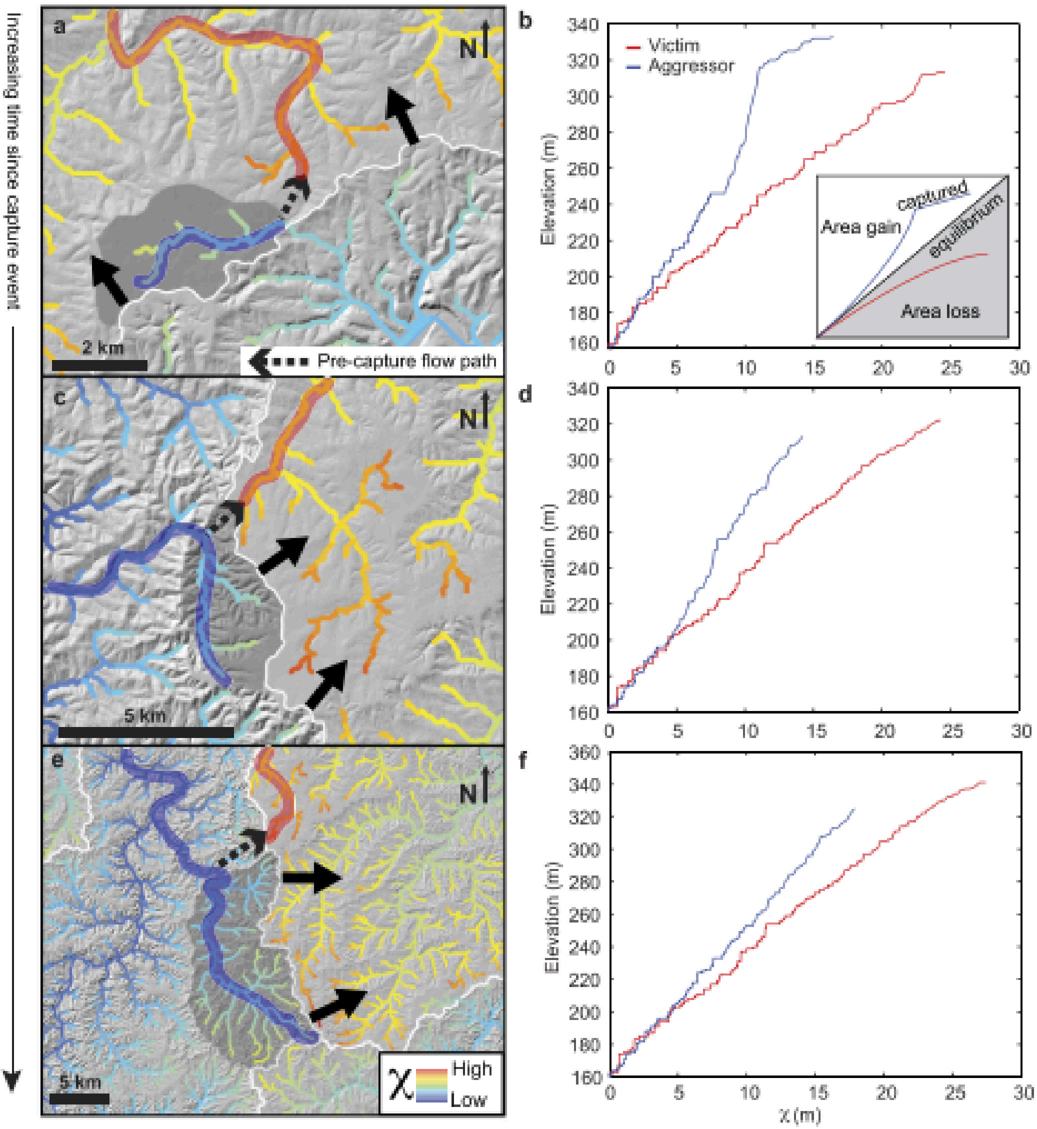


Figure 4 - Evidence of stream capture across scales. (Left) Hillshades overlain by χ maps. White lines show river basin boundaries, solid arrows indicate predicted divide migration direction, arrows with a dashed stem indicate inferred pre-capture drainage direction, and dark grey areas delineate inferred captured drainage area. (Right) χ-plots for the corresponding victims (red) and aggressors (blue). a, b, 1 km2 capture of the Bourbeuse River by the Meramec River. c, d, 30 km2 capture of Flat Creek by the White River. e, f, 1000 km2 capture of the Arkansas River by the White River. Inset in b shows the characteristic signature of recent drainage area gain via stream capture in a χ-plot. See Fig. 2 for capture locations (Extracted from Beeson et al., 2017).

Other examples of river capture can be found in figure 5. In it, we can observe that the course of the captured river reachs follows the direction and geometry of the captured river which we call the victim). As a result, after river capture, the capturing river (which we call the aggressor) presents a peculiar geometry, in which part of its channel flows in a different direction than expected (black arrows).

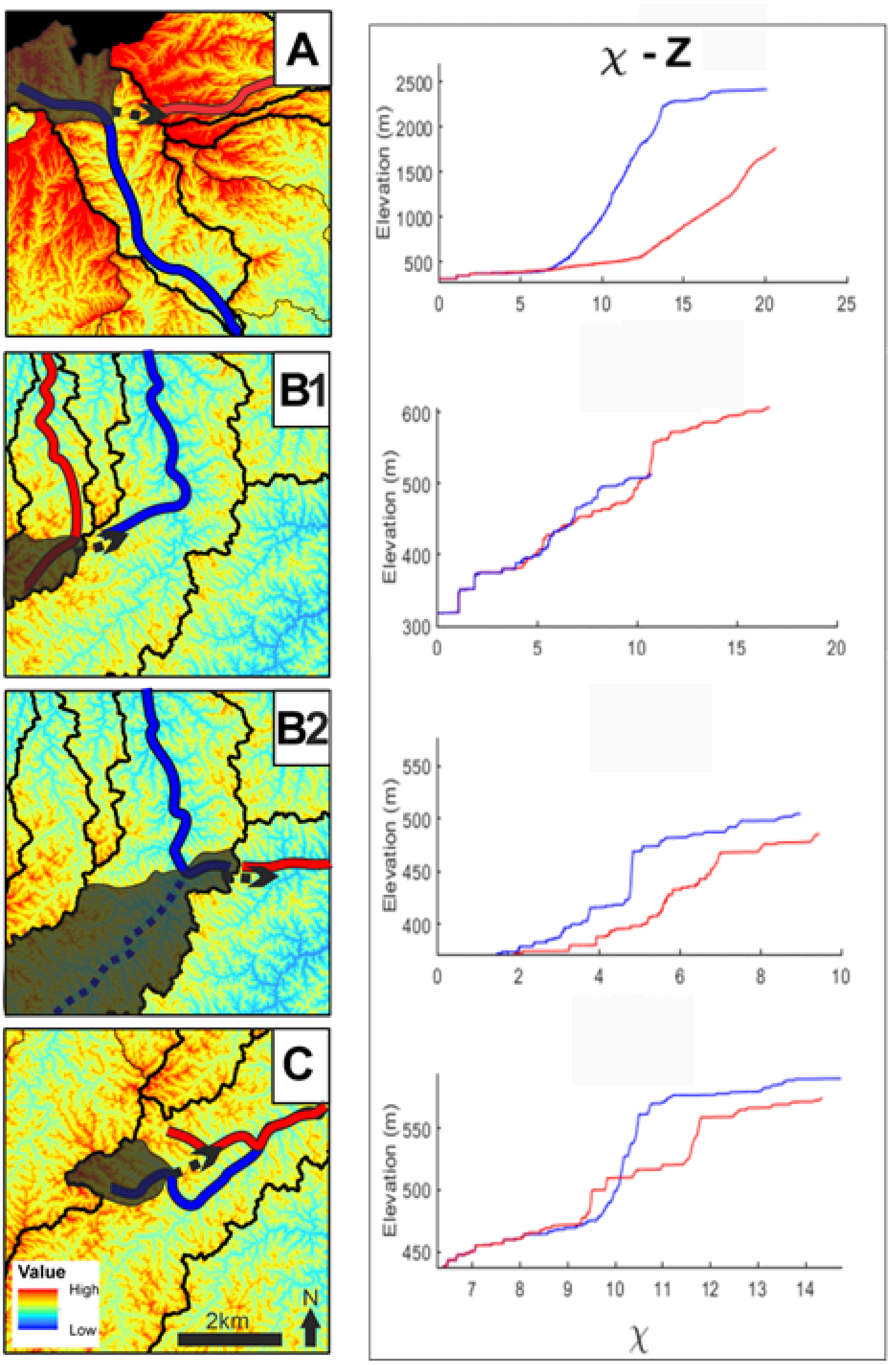
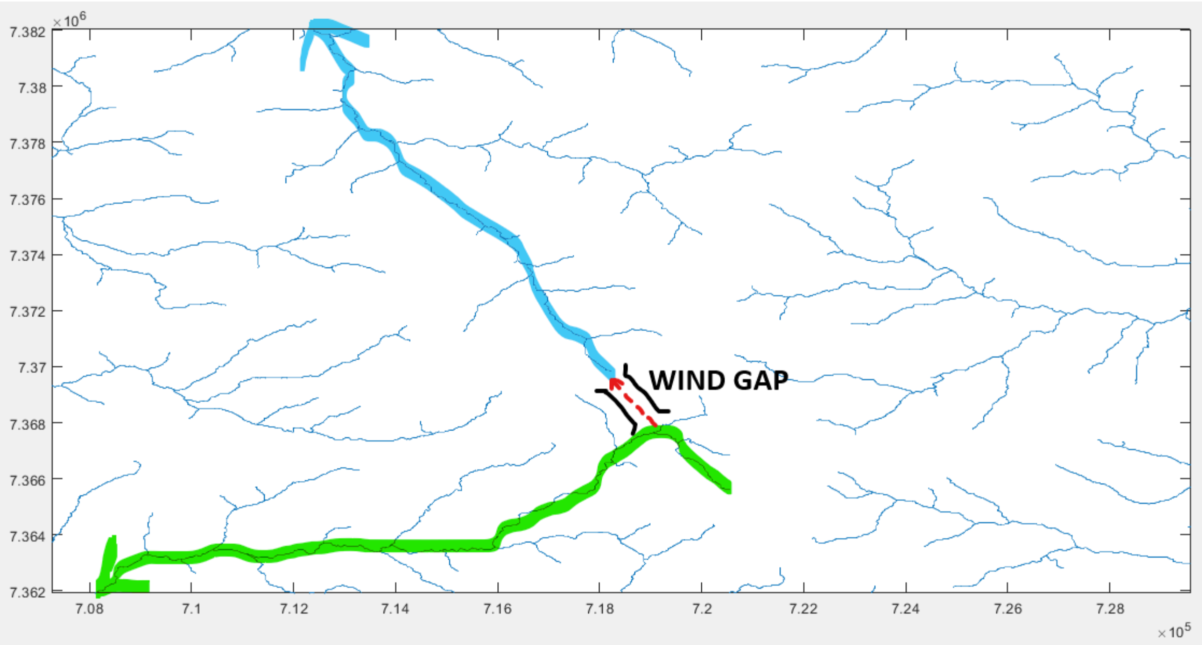
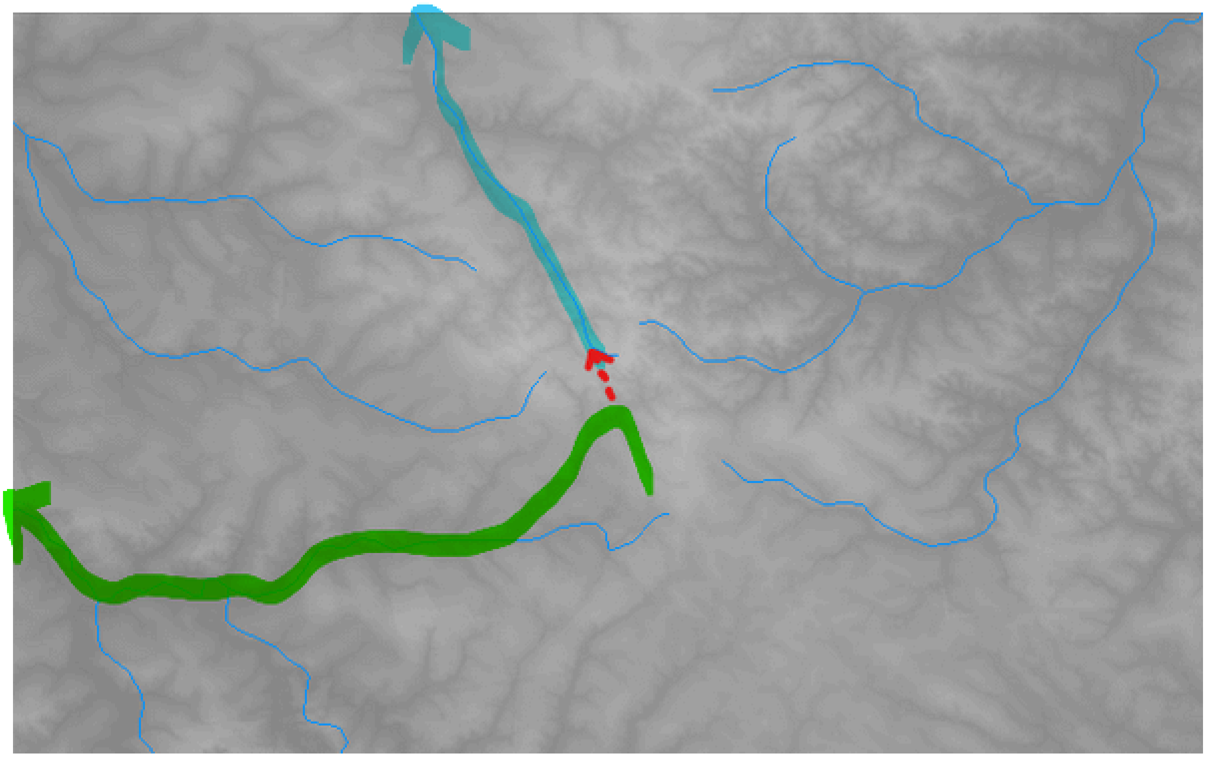


Figure 5 - Drainage captures located at Southeastern Brazil (Extracted from Silva et al., 2023).

Examples from Paraná, Brazil

The Paraná Sedimentary Basin is a region of significant geological interest due to its complex drainage networks and history of fluvial dynamics. One area of particular interest within this basin is the Ourinhos region, which has become a focal point for studies on river capture processes. River capture, or stream piracy, is a geomorphological process where a river or stream is diverted from its original course, usually due to natural processes such as erosion, tectonic movements, or sediment deposition. Find in the following figures a good example:





Reference and Data Access (GitHub):
https://github.com/renatovillela93/Topotoolbox_Parana/tree/main