THE MORPHOLOGY OF RIVER BIFURCATIONS

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Recent work has demonstrated, both theoretically and empirically, that river networks fed by subsurface flow form bifurcations on average at an angle of $2\pi/5$ [1]. Yet, a network-wide averaging of several thousand such channel bifurcations on the Florida panhandle reveals a departure from this angle near the point of bifurcation (Fig. 1). On average, these bifurcations initially open at a wide angle, greater than $2\pi/5$, only to return to angle narrower than $2\pi/5$ after a few meters. We suggest that these two shapes are suggestive of a competition between two processes in our system: channel migration, and growth in the direction of the groundwater field. While erosion due to groundwater reemergence plays a predominant role in directing channel growth as a valley initially forms, rivers may migrate in response to asymmetric fluxes to the valley sidewalls, ultimately leading to adjustments on the valley scale. We therefore study how these processes might reconcile, and extract the shapes of our channels as they lengthen to present empirical evidence supporting our findings.

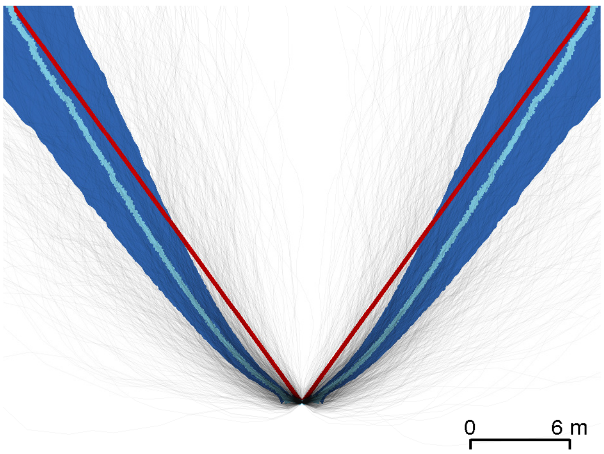

Figure 1. Average shape of 1225 first-order bifurcations (light blue), against a $2\pi/5$ bifurcation (red). The individual channels are superimposed in grey. (x, y) coordinates were binned radially according to distance from bifurcation.

References

[1] O. Devauchelle, A.P. Petroff, H.F. Seybold, and D.H. Rothman. Ramification of stream networks. 2012:2–6.