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An ecohydraulic view on stream resilience and ecosystem functioning – what can science teach management?

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Streams and rivers are increasingly exposed to environmental change across various spatial and temporal scales. Consequently, ecosystem health and integrity are becoming compromised. Most management strategies designed to recover and maintain stream ecosystem health involve engineering measures of geomorphology. The success of such engineering measures relies on a thorough understanding of the underlying physical, chemical and biological process coupling across scales. First, we present results from experimental work unraveling the relevance of streambed heterogeneity for the resilience of phototrophic biofilms. This is critical as phototrophic biofilms are key for nutrient removal and hence for keeping the water clean. These biofilms are also the machinery of primary production and related carbon fluxes in stream ecosystems. Next, we show how climate change may affect primary production, including CO_2, in streams and the networks they form. In fact, streams are now recognized as major sources of CO_2 to the atmosphere and contributors to the global carbon cycle. Despite this, we do not yet understand how geomorphological features, themselves continuously reworked by hydrology and sedimentary dynamics, affect CO_2 fluxes in streams. We show that gravel bars, clearly conspicuous geomorphological features, are hotspots of CO_2 fluxes compared to the streamwater itself. This has major implications for carbon cycling and stream ecosystem functioning. Finally, we discuss what stream management could learn from ecohydraulic insights from young scientists doing excellent basic research.