The Implications of Riverscape Complexity and Methods for its Measurement

Mark Fonstad
Assistant Professor of Geography
University of Oregon

Fifty years of fluvial studies have posited a variety of conceptual frameworks for characterizing river forms and processes throughout entire basins, including hydraulic geometry, the river continuum concept, self-organized criticality, and sediment links. 'Hyperscale' comparisons support using of each these frameworks at specific scales, but also indicate irreducible amounts of variation in both datasets across many different scales that are not captured by these conceptual frameworks. Moreover, the scales and locations where one framework, such as hydraulic geometry, works well are often not the same scales and locations where another framework, such as the river continuum concept, works well. Because the conceptual frameworks appear to operate at scales and locations distinct from one another, the measurement approaches necessary to observe them must also be at different scales and locations. We suggest that these separations between measurement scales represent an incommensurability issue in river studies, making it very difficult to both communicate among and test between two or more competing theories. Making simultaneous hyperscale observations of the river is one approach to minimizing the theory-ladeness of observation, as deviations from different predictions can be observed at many scales.

To enable river scientists and managers to better monitor their riverscapes and the complexity within them, we offer two new methods into river science. The first, called "topographic structure from motion" (SfM), is a new photogrammetric approach recently developed in the computer vision sciences. Like traditional photogrammetry, SfM uses photos taken from different vantage points in order to reconstruct three-dimensional topography and feature geometries. Unlike traditional photogrammetry, SfM does not require camera positions and lens parameters for each photograph – these are calculated as part of the SfM procedure, meaning that both archival imagery and nonstandard, uncoordinated imagery might now be used for primary river data collection. The second method is an extremely low-cost lidar-like instrument – the Microsoft Kinect – developed for the home video game market, but that can be turned into a precision field tool. With the Kinect, small area surveys can be conducted with point densities similar to a terrestrial laser scanner, but with costs at the amount of a college textbook. We present these two methods in the hopes that river scientists will have the ability and reason to collect riverscape data whenever they choose, with ease of work that is hitherto unseen, at resolutions that are relevant, and at costs that are almost essentially unimportant.