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# Measuring and modeling multidimensional dispersion in a meandering river

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As part of a study to separate and characterize the active and passive components of sturgeon larval dispersal in a large river, we made detailed measurements of the dispersion of a large pulse of Rhodamine dye injected at a single upstream point. The study occurred on the Kootenai River, USA, a 200m-wide meandering river with an unusually low gradient, $2x10^{-5}$, and an average depth of 5 m at the moderate study flow of 271 $m^3/s$. For the first 14 river kilometers downstream from the injection site, a detailed concentration data set describing the spatial and temporal evolution of the dye pulse was obtained using GPS receivers and high-accuracy fluorometers mounted on several boats. Beyond this initial reach, the dye was predominantly well-mixed in the cross-stream direction except near the leading and trailing edges of the pulse, and only longitudinal dispersion was measured. These measurements were made at a series of 11 fixed locations for an additional 45 river kilometers downstream, at which point peak dye concentrations were near the detection limit. Even for a relatively simple channel, the data indicate that local topography and bank irregularity exert a strong influence on the distribution of dye. While most of the dye pulse was apparently well mixed in the cross-stream and vertical directions, deep pools and lateral separation zones produced complex 3-dimensional structure in the concentration field, especially at the leading edge of the dye pulse. The dispersion data show that travel times in different reaches were more variable than predicted by a simple 1-dimensional model. Comparisons of the field data with results from multidimensional computational models indicate that uncommon channel features play a disproportionately important role in determining the storage and subsequent release of constituents that are passively advected and diffused.