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Monitoring Streambed Scour and Deposition Dynamics Using Temperature

Charles Luce (1), Daniele Tonina (2), Erin Bray (3), Thomas Dunne (4), Timothy DeWeese (2), and Aston Carpenter (2)

(1) USDA Forest Service Research, Boise, Idaho, United States (cluce@fs.fed.us), (2) University of Idaho, Center for Ecohydraulic Research, Boise, Idaho, United States, (3) California State University, Northridge, Water Science Program, Northridge, CA, United States, (4) University of California, Santa Barbara, Bren School of Environmental Science & Management, Santa Barabara, CA, United States

One of the challenges of measuring streambed morphology and sediment transport is the difficulty in watching where and when scour and deposition occur under high flow conditions, when sediment is moving. Recently developed theory on the advection and diffusion of temperature signals through streambeds provides a method to monitor the evolution of streambeds over time using variations in water temperature and temperature in streambed pores, with important application to estimating bed scour near bridge piers, sediment transport processes. Here we briefly present the theoretical equations and experimental verification along with a few examples of application and validation of the technique for use in rivers during flood conditions during active sediment transport. Examples include monitoring scour around bridge piers, measuring erosion of a debris flow deposit in a river, and lateral redistribution of gravels after habitat restoration downstream of a dam. The method requires determination of bed thermal properties prior to changes occurring, but no calibration to change events is required after the initial determination of properties. Validation shows a method robust to the non-ideal nature of field conditions. Further examinations are exploring the utility of the method to distinguish changes in thermal properties that are hypothesized to occur if sediment properties change with changes in particle size, for example. This emergent technology shows promise in advancing our understanding of how the bed is changing during the times it is hardest to watch and most active.