Geophysical Research Abstracts
Vol. 15, EGU2013-1942, 2013
EGU General Assembly 2013

A Novel Approach to Monitor Spatio-Temporal Variation of Streambed Elevation from Hyporheic Temperature Time Series

Daniele Tonina (1), Charles Luce (2), and Frank Gariglio (3)

(1) Center for Ecohydraulics Research, University of Idaho, Boise, ID, United States (dtonina@uidaho.edu), (2) US Forest Service Research, Boise, United States (cluce@fs.fed.us), (3) CH2M HILL, Boise, ID, United States (Frank.Gariglio@ch2m.com)

Stream temperatures provide a natural tracer to study interaction between surface and hyporheic waters. For several decades, temperature time series have been used to quantify infiltration velocity of surface waters into the sediment and most recently to quantify hyporheic fluxes in streams. Here, we present a novel derivation of the solution of the one-dimensional heat transport equation in its non-dimensional form to show that such measurements can be used to monitor the thickness of the streambed above a sensor. Our theoretical analysis shows a simple explicit solution for monitoring the temporal variation of streambed elevation solely based on time series of pore-water temperatures recorded by temperature probes buried in the sediment with another probe in the stream water. This interpretation is based on the observation that sediment thermal properties are commonly time invariant and can be estimated by the same data set during a period when depths are known. Analysis of paired temperature time series of the stream flow and those of the hyporheic water provide the information to quantify local scour with approximately daily time scale resolution. The resolution depends on magnitude of the daily temperature fluctuation of the surface water. The methodology applied in a natural stream predicted a sequence of experimentally manipulated scour and filling well. This advance in methods allows geomorphologists to measure both the magnitude and timing of scour in a stream for very low cost, representing a substantial improvement over current scour monitoring techniques.