Sediment Transport Magnitude-Frequency Metrics for Process-Based Channel Design

Joel Sholtes
Department of Civil and Environmental Engineering, Colorado State University

Abstract. Process-based channel design must consider the interaction of flow hydrology and sediment supply to arrive at a dynamically-stable design. Magnitude-frequency analysis of rivers to calculate the effective discharge (*Qeff*), or the discharge that transports the greatest sediment load over time, represents a much-studied and useful tool in process-based channel design. However, clear relationships between effective discharge and stable channel geometry do not always exist. I present two intuitive sediment transport metrics based on magnitude frequency analysis that aid in characterizing the relationship between flow and sediment supply: the fraction of sediment transported above the effective discharge (*f*+), and the dimensionless inter- quartile range of flows centered on the effective discharge (*IQR*), which transport of the total sediment load over time, that is, *IQR* = (*Q*75th - *Q*25th) / *Qeff*. These metrics utilize other information present in effective discharge analysis to inform the channel designer under what flows the majority of sediment is transported in a channel of interest (e.g., high, intermediate, or low frequency flows). I first develop relationships between these metrics, flow and sediment supply regimes, and geomorphic context using theoretical approaches and case studies. I then use this information to demonstrate how varying flow and sediment supply regimes interact to create a spectrum of complexity in design problems. Finally, I incorporate uncertainty analysis to create confidence intervals for these metrics.