EGU22-1378
https://doi.org/10.5194/egusphere-egu22-1378
EGU General Assembly 2022

Particle path length estimation: a signal processing approach

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The structure and function of rivers is directly related to bedload transport which is difficult to measure due to its spatial heterogeneity and the logistic constraints of field measurements. These difficulties have given rise to the morphological method wherein sediment transport is inferred from changes in morphology and estimates of the distance traveled by sediment during a flood, its path length. However, current methods for estimating path length are time and labor intensive, have low recovery rates, and are limited to some morphological units. We propose a method to estimate path length from repeat digital elevation models (DEM's of difference i.e. DoDs) which are requisite for the morphological method. We interpret the pattern of erosion and deposition downstream as a signal and apply Variational Mode Decomposition (VMD), a signal processing method, to quantify the periodicity as a proxy for path length. We developed this method using flume experiments with measured sediment flux and applied it to published field data with tracer measurements for validation. The preliminary results provide a range of values on the same order of magnitude as measured tracer and flux data and are coherent with channel geometry. This method provides a reasonable estimation of path length based solely on remotely sensed data and a range of plausible sediment fluxes associated with specific channel morphological processes through DoD interpretation.