EGU21-12515
https://doi.org/10.5194/egusphere-egu21-12515
EGU General Assembly 2021

Rock and Roll: RFID Tracking of Fluvial Bedload Transport and Interaction with Large Wood

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Bedload transport is a fundamental process by which coarse sediment is transferred through landscapes by river networks and is characterized by cyclic sequences of particle motion and rest. Bedload transport has many complex physical controls but may be well described stochastically by distributions of grain step length and rest time obtained through tracer studies. To date, none of these published tracer studies have specifically investigated the influence of large wood on distributions of step length or rest time, limiting the applicability of stochastic sediment transport models in these settings. Large wood is a major component of many forested rivers and is increasing because of disturbances such as wildfire and insect infestations as well as its use in rivers as part of 'Natural Food Management' (NFM) practice. This study aims to investigate and model the influence of large wood on grain-scale bedload transport.

St Louis Creek, an alpine stream in the Fraser Experimental Forest, Colorado, is experiencing increased wood loading resulting from the infestation of the mountain pine beetle in the past decades. We inserted 957 Passive Integrative Transponders (PIT) tagged cobbles in 2016 upstream of a wood loaded reach and measured and tagged > 20 pieces of large wood in the channel. We resurveyed the cobbles and wood on an annual basis after snowmelt, building distributions of rock-step lengths as well as observing any changes and transport of large wood. Additionally, a novel modelling approach based on linear mixed modelling (LMM) statistical approaches is implemented to establish the significance of wood and other factors on probability of particle entrainment, deposition and step length.

Tracer sediments accumulated both up and downstream of large wood pieces, with LMM analysis confirming a reduction in the probability of entrainment of tracers closer to wood. In addition, when tracers were remobilised, their subsequent step lengths were shorter the closer they were deposited to large wood. In 2019, large wood significantly reduced the step lengths of tracer particles, forcing premature deposition of tracers. This study demonstrates the role of large wood in influencing bedload transport in alpine stream environments, with implications for both natural and anthropogenic addition of wood debris in fluvial environments.