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A radio frequency tracing experiment of bedload transport in a small braided mountain stream

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Radio frequency identification technology is used for monitoring the displacement of coarse particles in streams since the beginning of the 2000s. Passive integrated transponders (PIT tags) are small, cheap and long-lasting electronic tags that can be programmed with their own identification code. Initially used in environmental research for animal tracking, they have been deployed successfully in a variety of fluvial environments for coarse sediment tracing. Pioneering studies conducted in both semiarid and humid small upland streams with low intensity bedload transport gave recovery rates above 85% (Nichols 2004; Lamarre et al. 2005). Here we present an experiment of radio frequency sediment tracing implemented on a small braided mountain stream with a high intensity bedload transport and a wide active channel (mean active channel width: about 20 m). The study site is the Bouinenc Torrent, a tributary to the Bléone River in SE France that drains a 39 km^2 mountainous drainage basin of the Southern Prealps. In spring 2008, we deployed 451 tracers with b-axis ranging from 23 to 520 mm. Tracers were deployed along 8 cross sections located in the upstream part of the lowest 2.3 km of the stream. We developed a RFID detection system composed of an antenna and a reader unit; this system is characterized by a range of detection of 80 cm in optimal configuration. Two small intensity flow events occurred in June 2008 and entrained the tracers deployed in the most active part of the active channel. We mapped the position of the displaced tracers with a dGPS in July 2008. We obtained an overall recovery rate of 88%. The recovery rate calculated for the active tracers (those that were displaced after the flow events) was 76%. The projection of the tracer dispersion cloud on high resolution aerial photographs obtained with a drone allows us to calculate the distance of transport for each tracer. Mean and maximal distances of transport were respectively 796 m (+/- 53 m) and 2.3 km. We found several tracers on the last gravel bar located at the confluence with the Bléone River. This experiment allowed us to characterize (1) the influence of the grain size on the distance of transport, (2) the performance of theoretical critical shear stress calculations, and (3) the time-integrated bed-material transport of the torrent.