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# Fluorescent particle tracers in surface hydrology: proof of concepts in natural stream and hillslope

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In this work, a new particle tracer for surface hydrology is proposed. The approach leverages the complementary advantages offered by large scale particle image velocimetry and traditional tracing technologies towards a practically feasible and low cost measurement system. Specifically, the proposed methodology is based on the detection and tracking of buoyant fluorescent microspheres through an experimental system that incorporates ultra violet lamps to elicit the fluorescence response and a digital camera to record the particles' transit. This low cost measurement system can be used in a variety of natural settings spanning from small scale streams to few centimeters rills in hillslopes. The use of insoluble buoyant particles limits the tracer dispersion from adhesion to natural substrates and thus minimizes the amount of tracing material for experimental measurements. Further, particle enhanced fluorescence allows for noninvasive flow characterization, that is, for nonintrusively detecting the tracer without deploying probes and samplers in the water. A proof of concept experiment for the proposed methodology is conducted on the Rio Cordon natural mountainous stream in the Italian Alps and on an outdoor experimental plot in the University of Tuscia. Flow measurements at selected cross sections and travel time experiments on stream reaches of varying lengths and naturally occurring hillslope rills are performed to ascertain the feasibility of the fluorescent particle tracers. Experimental findings demonstrate that particles with diameters ranging from 0.09 mm to 1 mm are visible in complex natural environments and can be successfully used to estimate flow rates from 0.1 to 2 m/s.