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Mapping channel morphology and stream habitat with a full waveform water-penetrating green lidar

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Basic topographic mapping and objective description of physical habitat in channels remains problematic using traditional field methods of cross section and thalweg surveying. Even ground GPS surveys are impractical for stream lengths in excess of a few hundred meters. The Experimental Advanced Airborne Research Lidar (EAARL) is a water-penetrating, full waveform lidar, operating at 532 nm, with the ability to seamlessly map channel and floodplain topography and riparian vegetation over extensive stream networks. We used EAARL to continuously map the topography of 85 km of streams in the watershed of the Middle Fork Salmon River, Idaho, USA. Data were compared to control field surveys in six reaches of plane-bed and pool-riffle channels for accuracy assessment. Results suggest point elevation accuracy comparable to that of terrestrial near-infrared lidars. Continuous thalweg profiles were interpreted in the frequency domain using wavelet analyses to investigate periodicity of channel topography at a variety of spatial scales. The wavelet analyses accurately mapped transitions in channel types, and spectral power was closely correlated to preferred spawning sites for Chinook salmon in one test stream segment.

EAARL data appear to support fundamental hydrologic and geomorphic measures such as bankfull depth, pool and riffle definition, channel classification, residual pool volumes, channel slope, cross-sectional area, bedform hydraulic roughness, and water turbidity. Biological applications include delineation of habitats important for fish spawning, rearing, and feeding across a range of spatial scales pertinent to fish metapopulation, population, and individual processes. Future work is planned to ex-

ploit the three-dimensional bed topography mapped by EAARL and refine local predictions of bed shear stress and bed mobility, substrate median grain size, and hyporheic exchange throughout stream networks.