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The evolution of the surface signature of a canopy-generated shear instability using free-surface synthetic Schlieren TRACY MANDEL, HAYOON CHUNG, JEFFREY KOSEFF, Stanford University — We present results from a laboratory imaging technique, free-surface synthetic Schlieren, to remotely measure surface turbulence based on the apparent distortion of submerged roughness features. The shear instability generated by a model vegetative canopy yields a clear signal in the surface slope field. We measure the propagation speed, frequency, and length scale of the Kelvin-Helmholtz vortices at the surface and connect these to properties of the subsurface flow and canopy geometry. We also observe that in more energetic flows, the vortices break up into strong surface-impacting boils before they reach the end of the canopy. These dynamics are related to changes in the Reynolds stress within the water column and show a transition from periodic coherent structures to chaotic turbulent motion, yielding important insights into mass and momentum transfer in vegetative canopies. More broadly, these results suggest that the surface signature generated by bottom roughness can be used to characterize the structure of the bed and the flow, in hopes that future field and laboratory studies can reduce the number and scope of measurements required to study the dynamics of interest.

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