Abstract Submitted
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Using refractive index matching to image flow above and within a highly-permeable laboratory stream bed DEREK LICHTNER, JIM BEST, University of Illinois, GIANLUCA BLOIS, TAEHOON KIM, KENNETH CHRISTENSEN, University of Notre Dame — Turbulent flow over a rough, porous gravel bed is investigated with particle image velocimetry (PIV) and refractive index matching (RIM). A model stream bed was constructed with 4224 pre-cast acrylic spheres (D = 1.27 cm) in a fixed cubic pattern. The flow above and within the bed was measured in the streamwise-wall-normal plane at $Re_b = 3.20 \times 10$, with an image resolution of 11 Mpixel, and the flow was seeded with silver-coated hollow glass spheres ($\rho = 1700$ kg m^{-3}). The highpermeability of the interface in these experiments permits large, instantaneous, near-bed streamwise momentum due to vertical exchange viaturbulence. The mean velocity flow structure exhibitsa significant slip velocity at the bed interface. In the pore spaces, mean velocities are near-horizontal and 5-10% of the maximum free stream velocity. High Reynolds stresses near the bed, particularly around the crests of spherical roughness elements, suggest turbulence is produced by flow separation and the shedding of vortices from streambed grains. The dimensions of turbulent flow structures, determined via two-point correlations and Galilean decompositions, appear similar to those of hairpin vortices, although the resemblance remains unconfirmed without time-resolved data.

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