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Turbulent Boundary Layers and Sediment Suspension Absent Mean Flow-Induced Shear: An Experimental Study BLAIR JOHNSON, Arizona State University, EDWIN COWEN, Cornell University — We investigate turbulent boundary layers in the absence of mean shear at solid and sediment boundaries in an experimental facility designed to generate high Reynolds number (Re_λ˜300)horizontally homogeneous isotropic turbulence via randomly actuated synthetic jet arrays (RASJA - Variano & Cowen 2008). One array is an 8 x 8 grid of jets, while the other is a 16 x 16 array. We control the turbulence levels, including the integral length scale and dissipation rate, by changing the mean on-times in the jet algorithm. Particle image velocimetry (PIV) measurements are used to study the isotropic turbulence and the boundary layer. The flow is characterized by statistical metrics such as the mean flow and turbulent velocities, turbulent kinetic energy, spectra, and integral length scale. We consider the turbulent kinetic energy transport equation and examine the relationships between dissipation, production, and turbulent transport, in absence of mean flows. We compare an impermeable flat boundary, a flat permeable sediment boundary, and a rippled sediment boundary. We find that while an immobile sediment bed acts as a sink of turbulence, an active sediment boundary with frequent suspension increases turbulent velocity fluctuations. Because traditional viscous stresses due to mean velocity gradients suggest no bed friction, we develop a method for considering Reynolds stresses over short time periods as a surrogate for understanding bed stress in a zero mean shear environment.

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