Sediment Resuspension and Ripple Dynamics in Highly Turbulent Flows

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Particle resuspension due to turbulence in a facility designed to achieve low secondary mean flow is investigated to determine an appropriate parameterization of the turbulent stress to define a non-dimensional Shields-like parameter that defines the particle motion regime. Prior laboratory studies have utilized grid-stirred tanks (GSTs) to generate turbulence with little mean shear; however, relatively high levels of mean flow still exist (based, for example, on the ratio of the turbulent kinetic energy to the mean flow kinetic energy). We utilize the recently developed Randomly Actuated Synthetic Jet Array (RASJA), which is more controllable and generates significantly less mean flow relative to GSTs. We filled the bottom of the tank with a layer of sand, which is narrowly graded with a median grain size (D_{50}) of 250 mm. Particle Imaging Velocimetry (PIV) and Particle Tracking Velocimetry (PTV) have been used to observe fluid and sediment velocity, respectively, to study the turbulent structures responsible for sediment resuspension and to determine statistical metrics of the flow. Furthermore, the interaction of turbulence with a permeable sediment boundary results in patterned ripple formations. We hypothesize this depends upon the integral length scale of the turbulence, and will perform additional experiments using the Aquadopp HR Profiler to qualify metrics of the flow as we vary the turbulence levels and examine the resulting bed formations and boundary layer profiles.