Abstract Submitted
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Numerical simulation on fine sediment transport in steady and oscillatory boundary layer – The role of rheology XIAO YU, University of Delaware, EMRE OZDEMIR, WHOI, TIANJIAN HSU, University of Delaware, SIVARAMAKRISHNAN BALACHANDAR, University of Florida — Turbulence-resolving 3D numerical simulations of fine sediment transport in both steady and oscillatory boundary layers are carried out to study the interplay between turbulence modulation and rheological stress. A high-accurate scheme is developed to resolve all the scales of carrier flow turbulence. Fourier expansions are adopted in both streamwise and spanwise directions. To incorporate both the hindered settling effect and rheology models, a sixth-order compact finite difference scheme is implemented in vertical direction to keep the spectral-like accuracy. A recent numerical study (Ozdemir et al. 2010, J. Fluid Mech.) on fine sediment transport in the wave boundary layer reveals the evolution of transport regimes from a well-mixed sediment distribution, to the formation of lutocline and a complete laminarization of wave boundary layer due to increasing sediment availability and settling velocity. We are motivated to further study the effect of rheology in determining the transition of flow regimes and hydrodynamic dissipation. By including the rheology, simulation results shows that the increased effective viscosity tends to increase the thickness of viscous sub-layer and further reduce the thickness of turbulent regime, which is limited by the lutocline.

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