Abstract Submitted
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Convective instability in sedimentation XIAO YU, TIAN-JIAN HSU, University of Delaware — We investigate the convective sedimentation in a stably stratified saltwater using linear stability analysis and 3D direct numerical simulation. We consider sediment particle with grain diameter in the range of 1.5 to 60 μm. Equilibrium Eulerian approach and dilute flow assumption are adopted to simplify the governing equations of the two-phase system (Balachandar and Eaton 2009, Annul Rev. Fluid Mech.). A semi-empirical closure of particle diffusivity due to long-range interaction is adopted (Segre et al. 2007, Phys. Rev. Lett.). For a fixed salt diffusivity, the particle phase can act as either slow or fast diffusing agent in a double-diffusive system depending on the particle diameter. Additionally, the settling-driven mechanism can also trigger instability. Linear stability analysis is carried out as the guideline for 3D numerical simulation. Simulation results indicate different finger patterns for different particle settling velocity and sediment concentration. For fine particle, where the double-diffusive mechanism plays an important role, the instability is enhanced by the settling. The finger size is on centimeter scale and the finger pattern is more nonlinear and asymmetric. For large particle, the interfacial instability appears long after the particles pass the density interface induced by salt where Rayleigh-Taylor instability takes place and finger pattern is more symmetric. Fully nonlinear analysis with 3D direct numerical simulations will be presented in the meeting.

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