Turbulence-resolving Two-Phase Flow Simulations of Wave- and Current Supported Turbidity Flows

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Wave- and current-supported turbidity currents (WCSTCs) form a subset of turbidity currents that have been discovered over the last three decades. Its significance as a carrying agent of fine sediments over low gradient shelves has been recognized with growing evidence. High fidelity multiphase flow models are important tools to understand the fundamental physics of WCSTCs due to practical limitations to create such flows in a laboratory and challenges in field experiments. This study presents the culmination of two-phase, turbulence-resolving simulations, i.e. Direct Numerical Simulations (DNS), of wave- and alongshore current-supported fine sediment turbidity currents across a mild bathymetric slope. The simulation results suggest the presence of a threshold for WCSTCs to transition to self-supporting turbidity current. The given threshold is dependent on slope, sediment concentration, and settling velocity of the suspended sediments. The numerical simulations also provide significant insights on how to model these turbidity currents in a regional-scale model. Ramifications of such model development include but not limited to: (i) accurate estimation of mud depo-centers in a shelf and (ii) how the dynamics of submarine geomorphology is affected such as in the clinoform development.

Bio-sketch

Dr. Celalettin Emre Ozdemir is an Assistant Professor of Civil and Environmental Engineering jointly appointed with Center for Computation and Technology in Louisiana State University (LSU). He obtained his B.S. and M.S. degrees from Civil Engineering Department of Middle East Technical University. He earned his Ph.D. from Civil Engineering in University of Florida. Prior to his joining LSU, he worked as a postdoctoral investigator in the University of Delaware and Woods Hole Oceanographic Institution. Dr. Ozdemir's research interests are mainly related to computational modeling of sediment transport and its drivers that include fluid-mud dynamics, multiphase and boundary layer turbulence modeling, hydrodynamic instability analyses, and high-performance computing. He is a member of American Society of Civil Engineers (ASCE), American Geophysical Union (AGU), and American Physical Society (APS).