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On a multi-phase modeling framework for sediment transport[1]
TIAN-JIAN HSU, Woods Hole Oceanographic Institution, JAMES JENKINS COLLABORATION, GAIL KINEKE COLLABORATION, PHILIP LIU COLLABORATION, PETER TRAYKOVSKI COLLABORATION — Understanding sediment transport in the heterogeneous environment, including river, beach, estuary, shelf and submarine canyon, is crucial to the preservation and restoration of coastal ecosystem. A multi-phase modeling framework is developed in order to study sediment transport driven by a variety forcing (current, tide, wave and gravity-driven flow) with a range of sediment characteristics. As an example, constitutive relation for intergranular interaction (particle stress) based on kinetic theory of granular flow is adopted in a two-phase model and is shown to be capable of modeling wave-induced sheet flow transport in the sandy-beach environments. Recently, to further model typical fine sediment transport processes of long timescales (e.g., tidal), spatial inhomogeneity, and multiple sediment classes, the two-phase model is rationally simplified. The simplified model is much efficient yet robust to retain essential mechanisms of fluid-sediment and intergranular interactions. Adopting rheological closure based on viscous suspension, preliminary results indicate that the model captures field observed lutocline behavior of fluid mud under tidal flow and wave-supported gravity-driven fluid mud on the continental shelf.

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Tian-Jian Hsu
Woods Hole Oceanographic Institution

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