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A wave vortex force formalism for wave-current interaction in strongly sheared flows ZHIFEI DONG, JAMES T. KIRBY, University of Delaware — In the river plume, waves can be strongly affected by spatial and temporal variations in ambient current fields, which can induce shoaling, refractive and focussing/defocussing and breaking effects in analogy to variations in bathymetry. In turn, waves can modify the current distribution, determining the shape of river plume by affecting its centerline velocity, lateral spreading and plume thickness. As part of the ongoing study of highly concentrated sediment transport in plumes developed by small mountainous rivers, we formulate a general framework for describing the interaction of small amplitude surface gravity waves and relatively strongly sheared currents in finite depth water, where shear can exist in both the vertical and horizontal. In contrast to existing formulations, where the wave at leading order responds to a depth-uniform current field, the present formulation allows for an arbitrary degree of vertical shear, leading to a description of the vertical structure of waves in terms of solutions to a Rayleigh stability equation. The resulting formulation leads to a conservation law for wave action, and forcing terms for the description of the mean flow formulated using the Craik-Leibovich vortex formalism. A special case for strong current with linear shear is discussed. Results are provided to compare with the existing formulations. Applications to numerical model is left for further development.

Zhifei Dong
University of Delaware

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