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PTV measurements of Lagrangian particle transport by surface gravity wave groups TON VAN DEN BREMER, University of Edinburgh, COLIN WHITTAKER, ALISON RABY, University of Plymouth, PAUL TAYLOR, University of Oxford — We present detailed PTV (particle tracking velocimetry) measurements of the Lagrangian transport and trajectories of neutrally buoyant particles underneath two-dimensional surface gravity wave groups in a laboratory flume. By focussing our attention on wave groups of moderate steepness, we confirm the predictions of standard second-order multi-chromatic wave theory, in which the body of fluid satisfies the potential flow equations. Particles near the surface are transported forwards and their motion is dominated by Stokes drift. Particles at sufficient depth are transported backwards by the Eulerian return current that was first described by Longuet-Higgins & Stewart (1962) and forms an inseparable counterpart of Stokes drift for surface wave groups ensuring the (irrotational) mass balance holds. Finally, we provide experimental validation of a simple scaling relationship, derived based under the assumption of separation of scales, for the transition depth: the depth above which Lagrangian particles are transported forwards by the Stokes drift and below which such particles are transported backwards by the return current. We present results for a range of effective water depths.

Ton van den Bremer
University of Edinburgh

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