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Flow generated by surfaces waves

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Trajectories of fluid parcels on the surface have been described analytically for progressing irrotational waves, where particles move in the direction of wave propagation. Waves in the laboratory and in nature are more complex due to the development of instabilities that render ideal planar 2D propagating waves into complex 3D waves. The motion of particles in such waves is not well understood.
In this talk I will present experiments in the short wavelength gravity-capillary range that demonstrate the generation of surface flows by propagating waves driven by a vertically oscillating plunger. At low amplitude, in a quasi-linear wave regime, buoyant particle tracers move in the direction of the wave propagation. At high wave amplitude, modulation instability (or Benjamin-Feir instability) renders the planer wave front into wave packets. This affects the macroscopic flow such that floaters drift against the direction of the wave, towards the plunger wave source [1]. The role of surface vorticity generation by waves will be discussed.

Reference:
Punzmann H., Francois N., Xia H., Falkovich G. and Shats M.; Generation and reversal of surface flows by propagating waves, Nature Physics 10, 658-663 (2014).