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Breakup of an oil slick mixed with dispersants by breaking wave[1]
CHENG LI, ANNE HOLSER, JOSEPH KATZ, Johns Hopkins University — After oil spill, coherent oil slick are entrained by breaking ocean waves together with air, which produces a complicated three-phase flow, involving a wide range of length and time scales. The oil droplet size distribution is a crucial factor affecting the physical and chemical dispersion of oil spills, but little is known about oil droplet formation mechanism and droplet size distributions during and immediately after the impact of breaking waves. In our experimental study, we investigate the breakup of an oil slick in a specialized wave tank. The widely used dispersant Coexist 9500-A at different dispersant to oil ratio is used for varying the surface tension of crude oil (MC252 surrogate) in the 10^{-1} to 10 mN/m range. The dispersant is applied either by premixing or surface spraying, the latter consistent with typical application. The results include high-speed images of the oil and bubbles' entrainment, showing the resulting formation of a series of droplet clouds during multiple "plunges" associated with a single propagating breaking wave. High-speed inline digital holographic cinematography is employed to quantify the oil droplet size distribution, and the impact of droplet-bubble interactions on the entrainment process for varying Weber numbers, and wave properties, from spilling to plunging breakers.

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