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High Speed Drop Impact on Floating Oil Layers: Splash Behavior and Oily Marine Aerosol Production[1] DAVID MURPHY, CHENG LI, JOSEPH KATZ, Johns Hopkins University Department of Mechanical Engineering — Little is known about splash phenomena and marine aerosol formation occurring as high speed raindrops (We=$\rho v^2 d/\sigma > 2000$) impact on thin crude oil slicks on seawater. Our experiments examine the effects of oil thickness and dispersant addition, which lowers the oil-air surface tension by 18% and oil-water interfacial tension by orders of magnitude. High speed imaging reveals that layer thickness and interfacial tension substantially impact splash behavior. In all high energy cases, a subsurface air cavity forms, and a supersurface crown with composition dependent on the layer thickness develops. When this crown closes, it generates upward and downward jets that contribute to oil entrainment. The initial raindrop impact ruptures only thin oil layers (< 200 μm). For thicker films, the crown comprises a short-lived upper oil film and a thicker lower section containing water and oil layers. Holographic microscopy shows a bimodal size distribution for airborne droplets ejected from ligaments on the crown rim, with peaks at 50 and 225 μm. The presence of oil increases the droplet production rate, as do increasing oil layer thickness and adding dispersant. Ejecta produced less than 0.3 ms after impact is another source of thousands of airborne microdroplets.

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