

# **The role of water droplets in air-sea interaction: rain and sea spray**

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The flow on both sides of the air-sea interface is significant for a variety of ocean-atmosphere interaction processes which control the fluxes of heat and momentum, and essentially drive both the long term climate and short term meso-scale weather conditions. As the wind speed increases, waves and currents at the surface of the ocean are generated. The surface waves sustain some of the air-sea stress and eventually break thereby generating currents and turbulence, entraining bubbles, and generating sea spray. Rapidly, the flow on both sides of the air-sea interface becomes an intricate coupled turbulent multiphase flow.

In this presentation, we will particularly focus on the role of airborne water droplets and in particular sea spray and rain. Although consensus around the effects of spray droplets has been building in recent years, the quantification of the spray mediated fluxes of momentum, heat and mass has remained elusive. Ultimately, the spray mediated fluxes depend on three controlling factors: the number and size of drops formed at the surface, the duration of suspension within the atmospheric marine boundary layer, and the rate of momentum, heat and mass transfer between the drops and the atmosphere. With a combination of measurements and modeling, we present some estimates of the spray-fluxes. In addition, we will examine some of the effects of rain in air-sea interaction and will focus on results from a series of laboratory experiments aimed at looking into the details of the near surface turbulence generation and the injection of momentum by the rain drops. We will show that that mixing occurs in bursts associated with vortex rings generated by single drops, which are then sheared by the background current. This shearing and loss of coherence in the vortices generated by the drop impacts prevents significant vortex pairing thereby limiting the depth of the rain-mixed layer. Nonetheless, this intense near surface mixing has potentially profound implications on air-sea gas fluxes in tropical regions.