Observeing Sea Spray Aerosol Production in the Surf Zone of Hawaii

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Sea spray aerosol (SSA) play a significant role in the local climatology of coastal areas through direct radiative forcing and the indirect aerosol effect. Quantifying the size and concentrations of SSA is essential to understanding their influence in these coastal regions. Current observations of SSA in the surf zone come from coastline station measurements. These stations are often limited to observing only the mass of SSA produced and are unable to differentiate SSA concentrations of varying sizes. NCAR has developed an instrument known as a giant nucleus impactor (GNI) that allows deliquesced salt particles to impact onto polycarbonate slides exposed to a free airstream. These slides are then analyzed in a humidified environment under a microscope providing information about the SSA sizes and concentrations present. By modifying the NCAR GNI, we created a smaller, low-cost method known as a mini-GNI from 3D printing and Arduino microcontrollers. Using this new instrumentation, we attached the mini-GNI to a drone that sampled four locations over the ocean perpendicular to the coastline: the outer reef crest, inner reef crest, lagoon area, and shoreline. While sampling occurred, atmospheric and oceanographic measurements were recorded. This methodology provided us a baseline concentration or “open-ocean” concentration at the outer reef crest. It allowed us to compare how sizes and concentrations changed as the air parcel interacted with the surf zone. As the sampling locations moved closer to the shore, we’ve observed an increase in larger and more concentrated SSA that were contributed by the surf zone. We’ve also found that SSA concentrations have a stronger relationship to wave activity than to wind speed in our coastal environment. The ultimate goal is to quantify how the ocean environment and atmospheric conditions contribute to SSA production in the surf zone.