1. INTRODUCTION

Present parameterizations of air-sea fluxes are reasonably valid up to wind speeds of about 25 m/s. Extrapolation of these parameterizations to higher wind speeds are inconsistent with theoretical analyses of the strength of tropical cyclones [Emmanuel, 1995]. One major issue is the relative balance of momentum and scalar (heat/moisture) transfers. It is speculated that this balance is affected by the relative balance of momentum and scalar (heat/moisture) transfers. It is speculated that this balance is affected by tropical cyclones [Emmanuel, 1995].

Extrapolation of these parameterizations to higher wind speeds reasonably valid up to wind speeds of about 25 m/s. The shortest step was 84 s and the longest was 1000 s; the typical step was about 300 s.

3. DATA ANALYSIS

Droplet concentrations are computed from droplet counts in each size bin using the expression

\[ n(r) \approx \frac{TotalCounts(r)}{a U dt dr} \]

where \( U \) is true airspeed in cms\(^{-1} \), \( dt \) the sample time interval, \( dr \) the sample radius bin width (12.5 \( \mu \text{m} \)), and \( a \) the size-dependent sample cross-sectional area in cm\(^2 \) (provided by the manufacturer). For this analysis, concentrations were computed for each step run yielding a set of 40 droplet spectra.

For the simple case of a near-surface source of droplets where the profile is a result of the balance of upward turbulent diffusion versus mean gravitational settling, the concentration at height \( z \) can be related to the concentration at height \( h \)

\[ n(r, z) = n(r, h) \left( \frac{V_r}{z} \right)^{\kappa} \]

where \( V_r \) is the size-dependent droplet fall velocity, \( \kappa \) is von Karman’s constant, and \( u^* \) the friction velocity. Thus the concentration is expected to have a power-law decrease with altitude. For these data (\( u^* \), about 1.1 ms\(^{-1} \) based on mean wind speed), the powers are, for example, 1.5 and 3.4 for 100 and 200 \( \mu \text{m} \) radius droplets.

Fig. 1 shows the measured and expected concentration profiles for 100 \( \mu \text{m} \) droplets for each flight. The flights on Sept. 3, 4, and 12 indicate concentrations increasing with altitude, which we take as an indication of drizzle or possibly sea spray produced elsewhere in a stronger part of the storm and then advected into the region at altitude. Such conditions are not relevant to our attempts to relate sea spray droplet concentrations to local production, so we have used only the Sept. 2 and 13 flights for the remaining analysis.
Given the wind speeds at the location of the step profiles, the counting statistics do not favor a detailed analysis of height dependencies. In Fig. 2 we show the sum of all droplets counted in the 10 usable profiles at altitudes less than 250 m (about 1 hour of data). The median droplet count (also shown) is 0 for droplets larger than 400 μm and significantly exceeds 1 only for droplets smaller than 100 μm. These results are shown in Fig. 3 for the concentration spectrum where the red line is the sum of two exponential distributions with radius modes of 10 and 100 μm.

The concentrations at r=100 are consistent with near-surface measurements (e.g., De Leeuw, 1990), but the mean curve implies many more large droplets (r>500). At this writing it is unknown if this represents unexpected physics or a measurement/conceptual problem but we have yet to examine other sources of data from the flights.

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REFERENCES


