Drivers of Cloud Condensation Nuclei at the ENA Site

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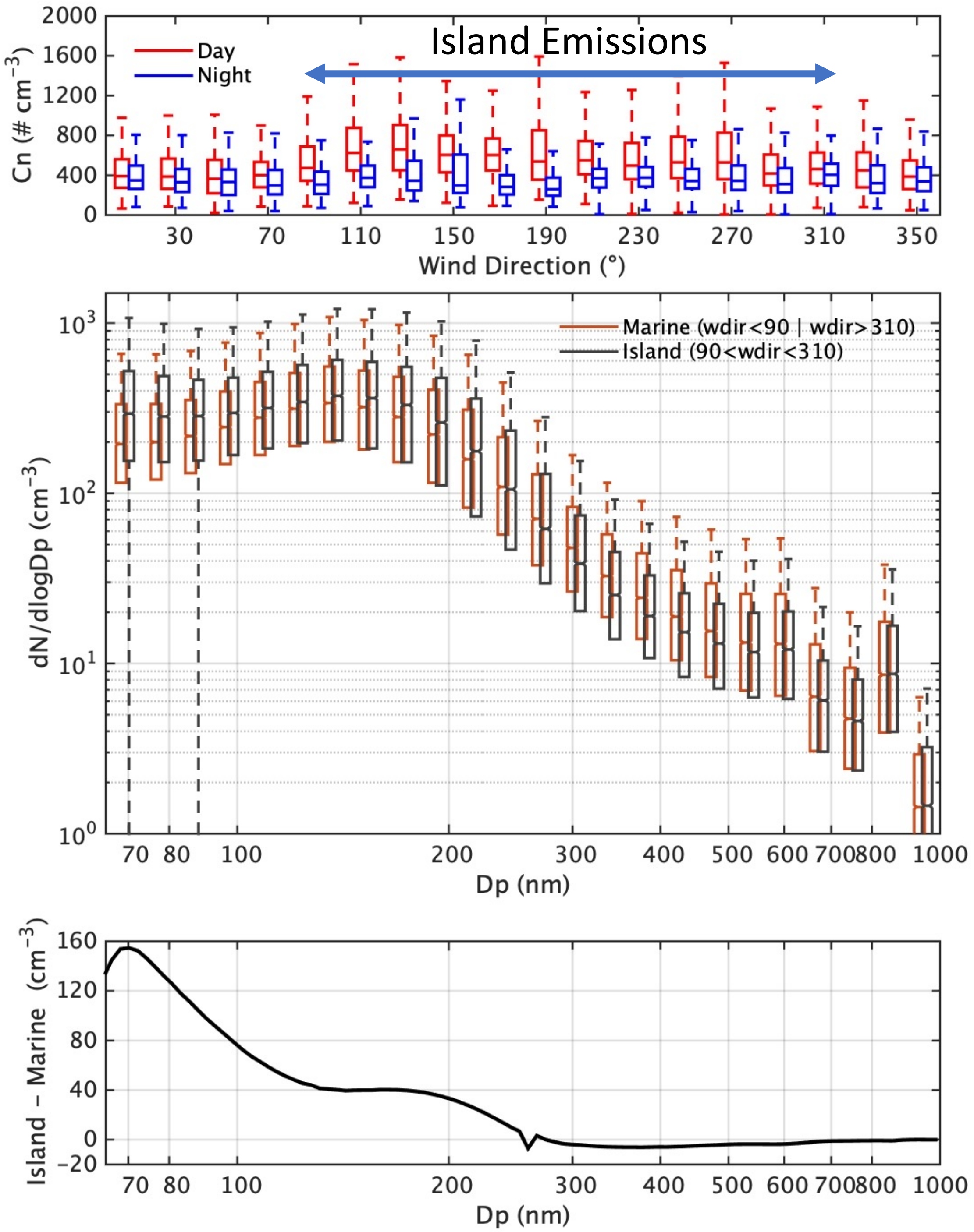
ASR Atmospheric System Research

ARM

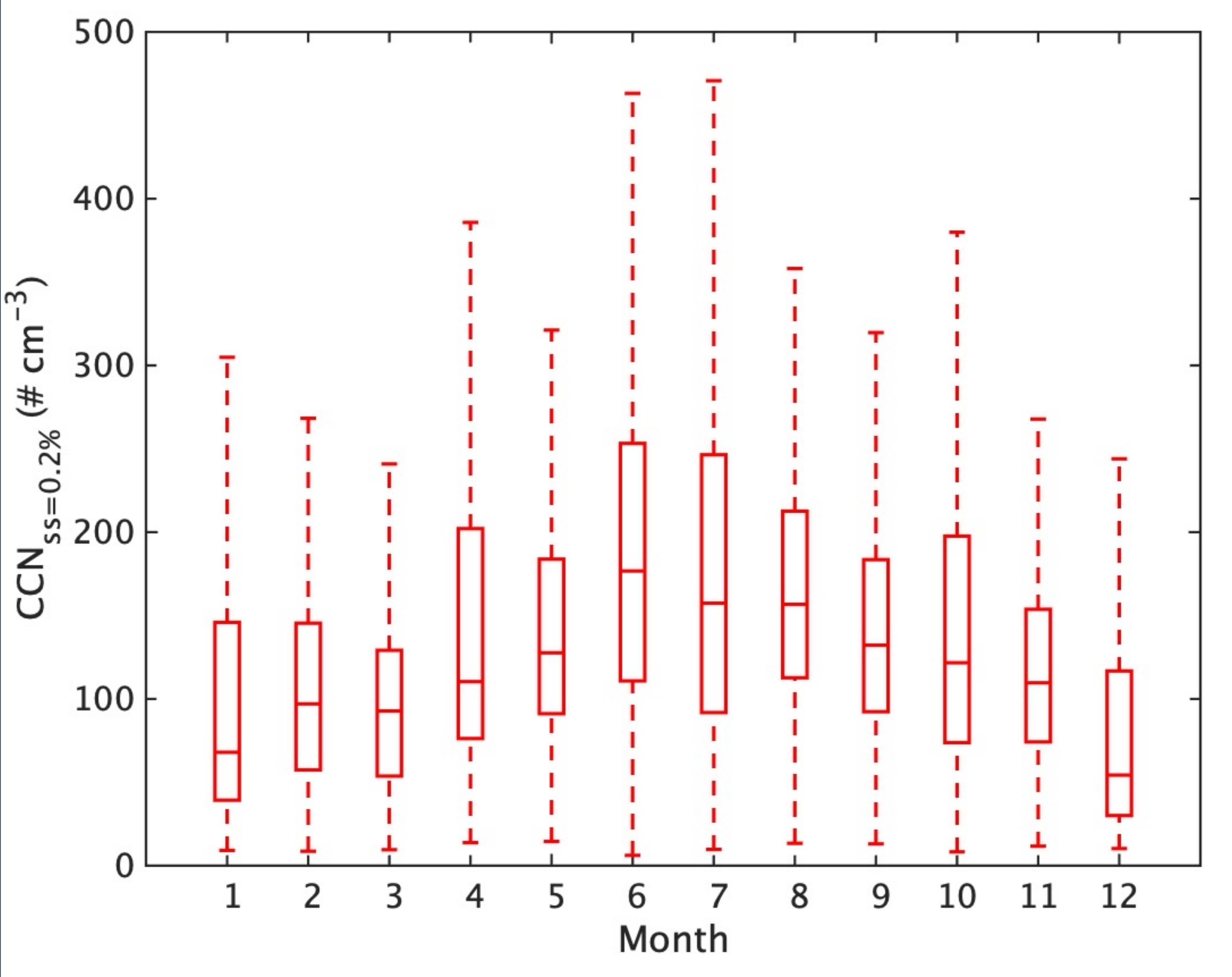
Island Effect

- Greater day-night differences during wind direction 90-310°, downwind of local sources.
- Island emissions are of smaller sizes (lower than 250 nm).



CCN Climatology – Marine Conditions

- Higher CCN during the summer months as compared to the winter months.
- Significant variability within each month.



CCN (N_a) Budgets – Marine Conditions

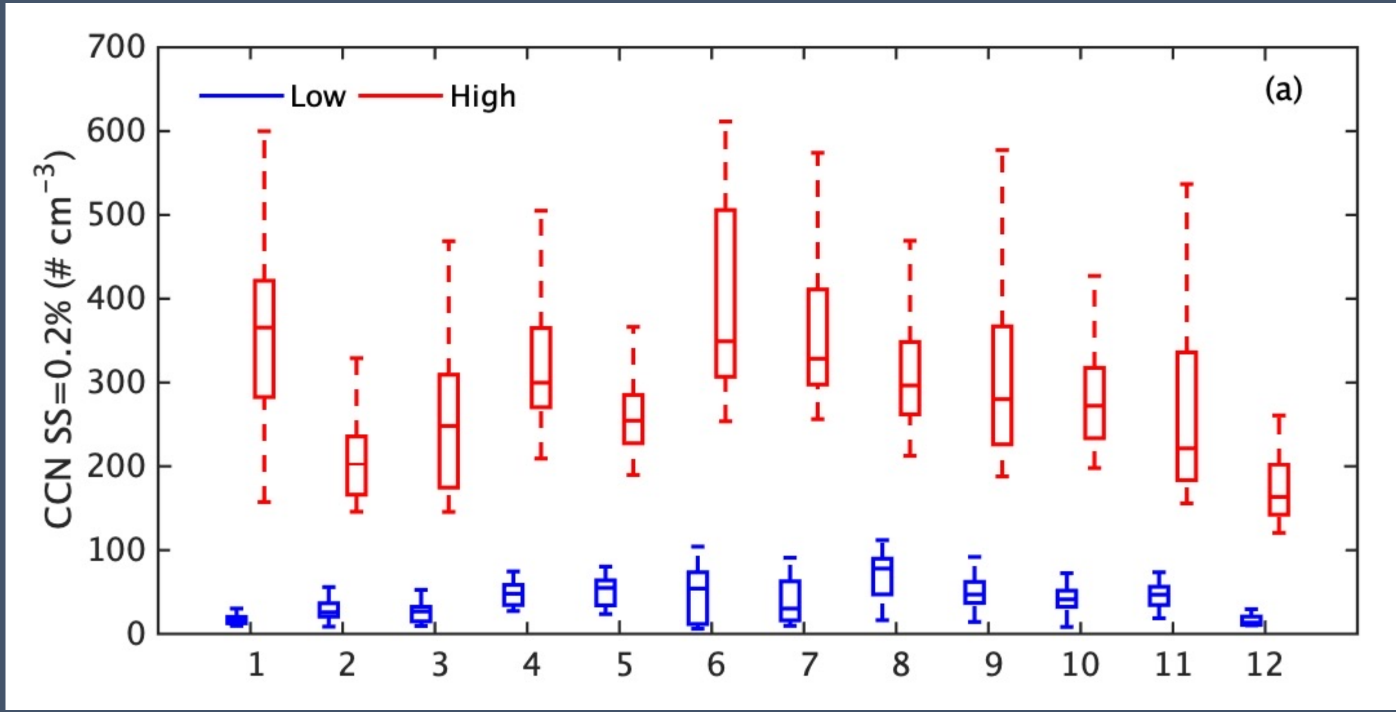
$$\cancel{\frac{\partial N_a}{\partial t}} + U.\nabla N_a = \underbrace{\frac{F(d)U^{3.41}}{z_i}}_{\text{Surface Production}} - \underbrace{\frac{KN_aP_{cb}h}{z_i}}_{\text{Precipitation Scavenging}} + \underbrace{\frac{w_e(N_{FT} - N_a)}{z_i}}_{\text{Entrainment}}$$

- Positive CCN advection at the ENA site.
- Primary balance between advection and precipitation on monthly timescales with substantial variability.
- Precipitation rate drive the annual cycle of scavenging term.
- Entrainment term is positive and highest in spring months.

Mohrmann et al. 2018

High and Low CCN events – Marine Conditions

- Identified high and low CCN events based on top and bottom 25% quantiles.
- Contrasted the aerosol and cloud properties in Lagrangian and Eulerian framework.



Time (month)

Higher cloudiness, thicker clouds, and stronger rain rates at the site and upstream of it during low CCN events as compared to the high CCN events.

Results and Conclusion

- Significant impact of local aerosol emissions on the observed aerosol field – wind direction and size dependence.
- Positive CCN advection was balanced by precipitation scavenging on monthly timescales, with significant variability.
- CCN entrainment flux was positive highest in the spring, with significant variability.
- Sub-monthly changes in CCN governed by cloud processes both at the site and upstream of it.