



ACE-ENA flight campaign - preliminary analysis of data from ENA and the G-1 aircraft

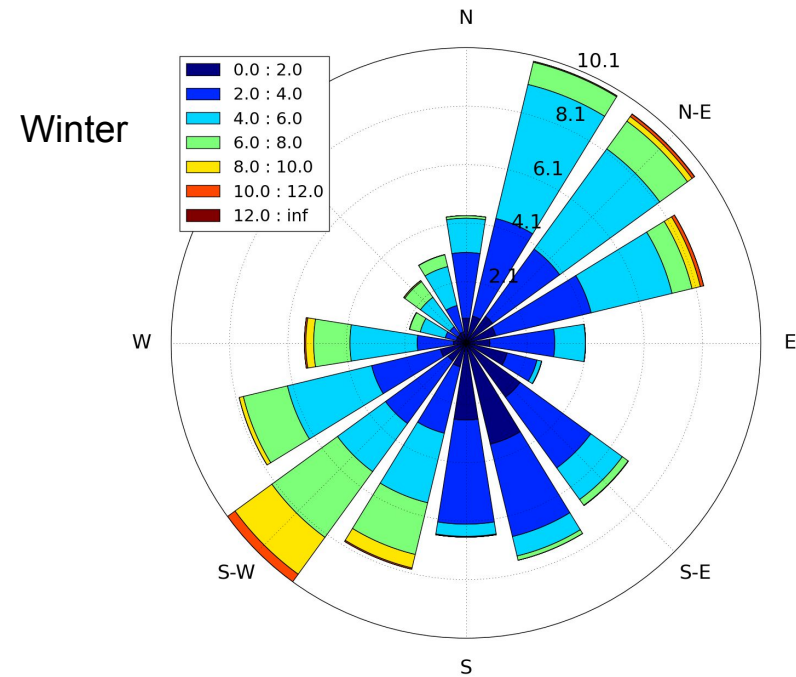
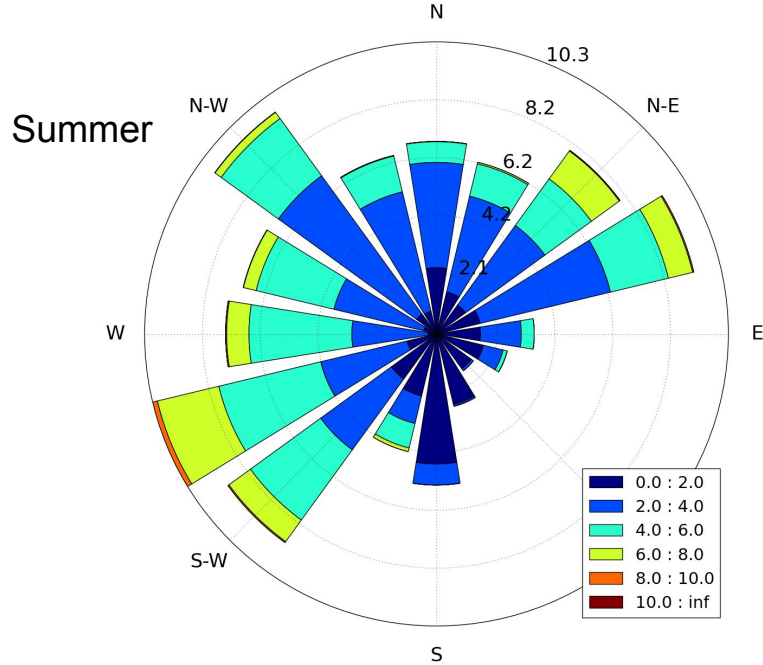
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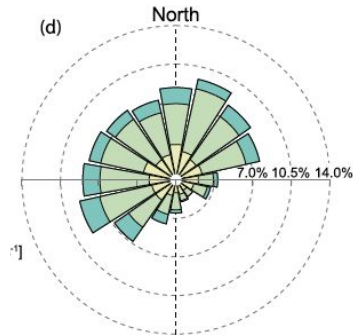
Thanks to the entire ACE-ENA science team, instrument mentors, AAF team

1. Surface meteorology
2. Aerosol
3. Vertical structure
4. Cloud and precipitation

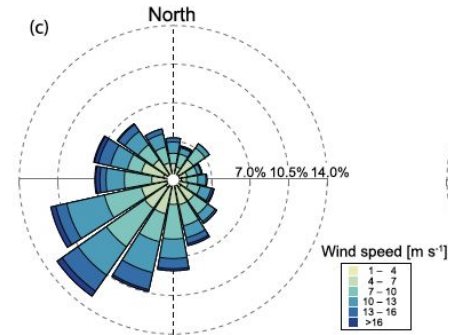
Surface Meteorology

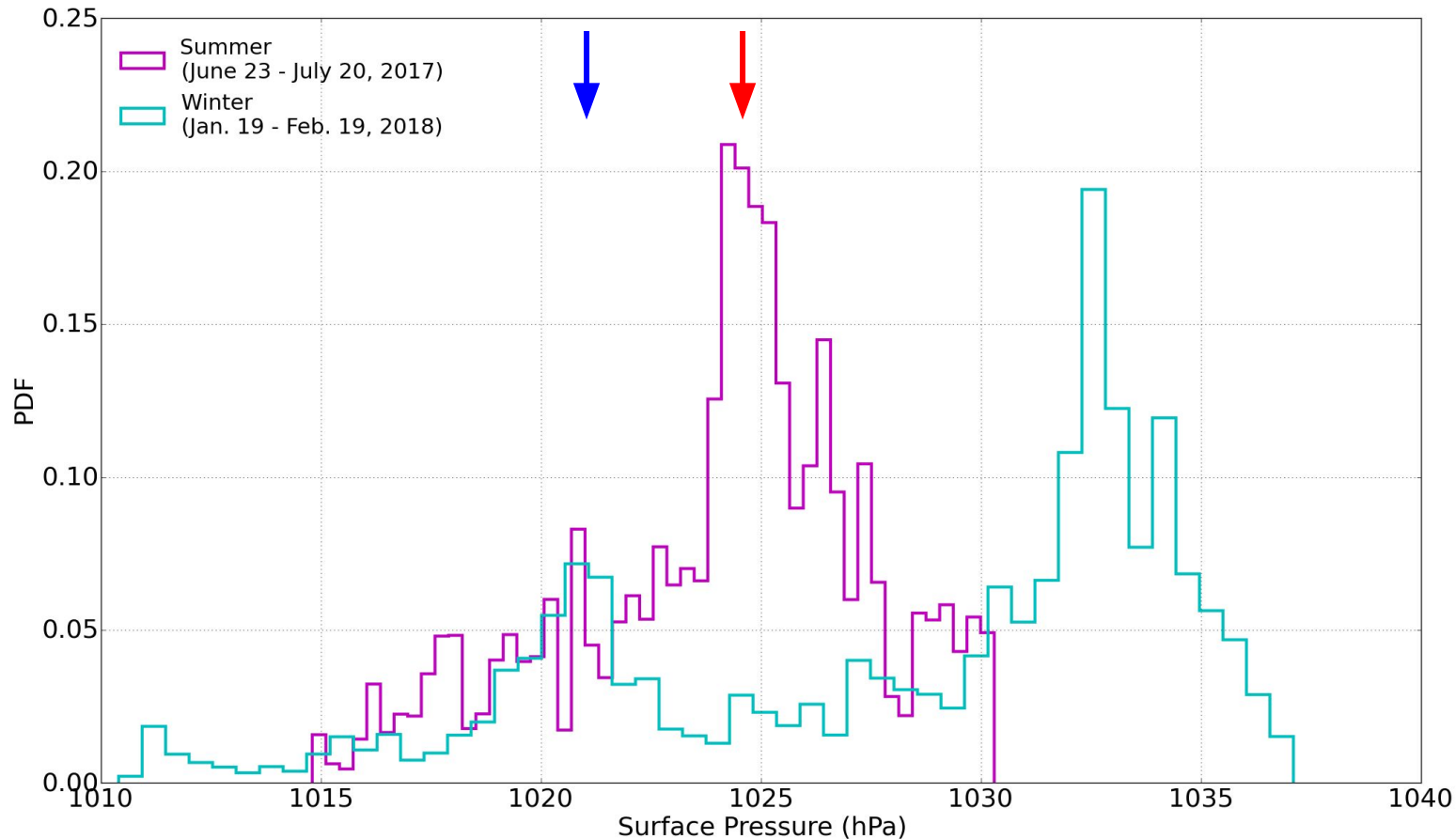


July and Jan winds
from 2009-2010
[Wood et al. 2015,
BAMS]



- Summer winds similar to CAP-MBL July
- Winter has more cases with NE winds, consistent with anomalously strong Azores high

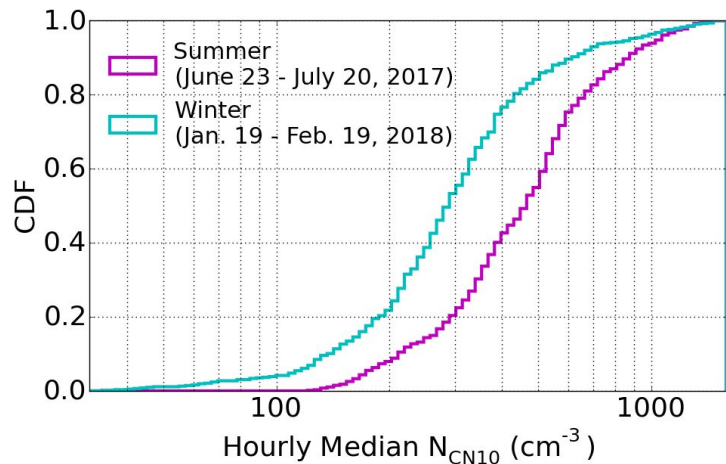
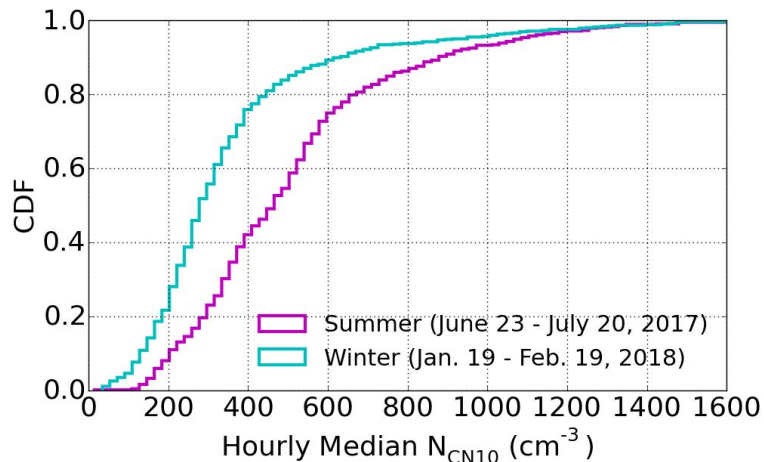




Mean surface pressure during summer deployment consistent with climatology

Winter period shows peak at climatological value but additional peak associated with anomalous Azores high

Aerosols



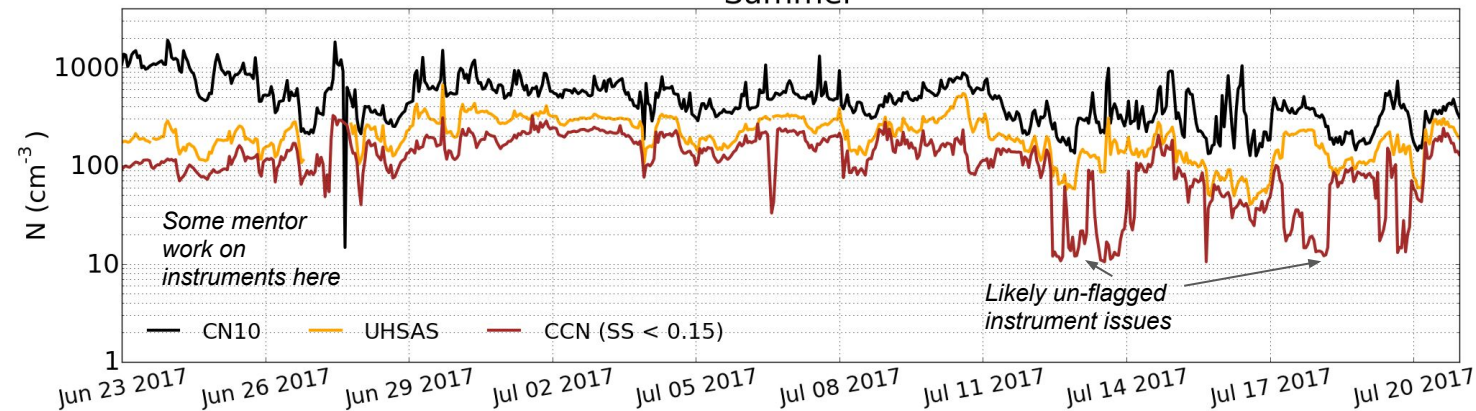
Hourly median CN concentrations from fine CPC (> 10 nm)

- Instantaneous concentrations $> 2000 \text{ cm}^{-3}$ excluded to minimize influence of local contamination
- ARM QC flagged data excluded

CDF presented with both linear and log bins (log bins to show separation at lower concentrations)

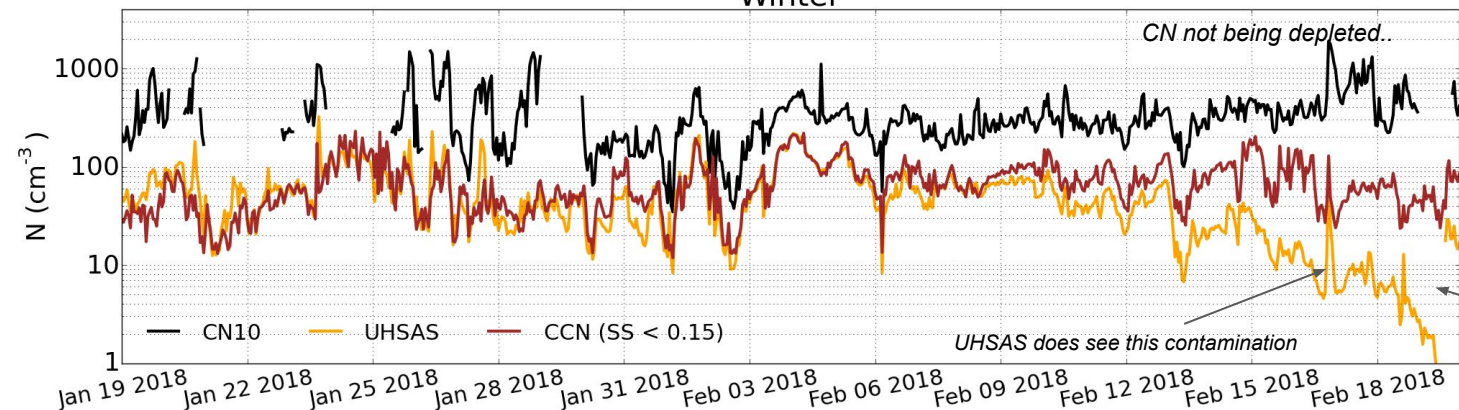
- Strong seasonality with 50% higher median CN concentration during summer

Summer



Summer: CCN at 0.15% SS generally below UHSAS...suggests influence of small particles not activating

Winter

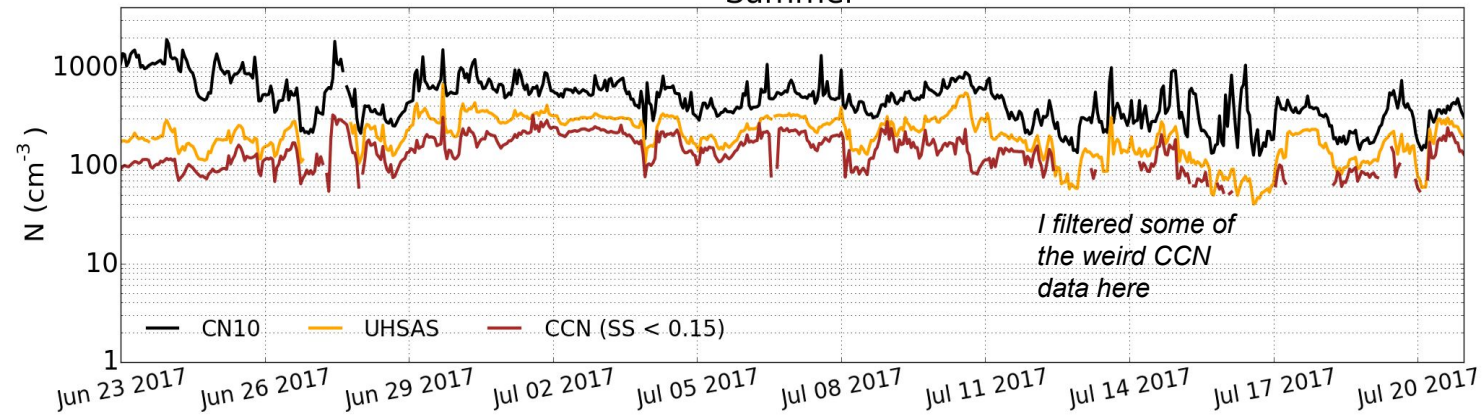


Winter: CCN at 0.15% SS varies, but often almost exactly same as UHSAS

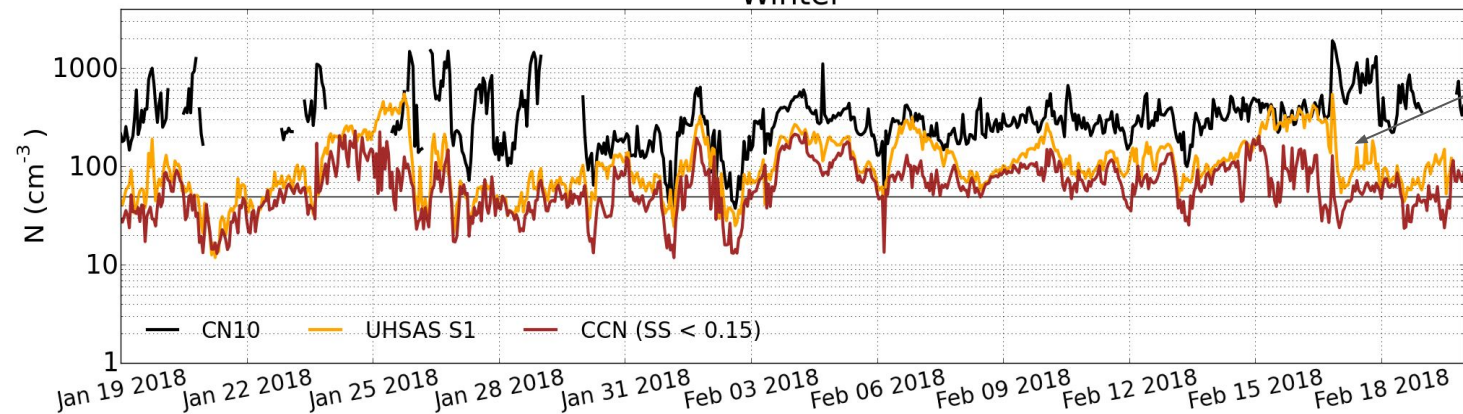
Appears to be problem with primary UHSAS instrument here toward the end....see next slide

**Hourly median concentrations
from three AOS instruments**

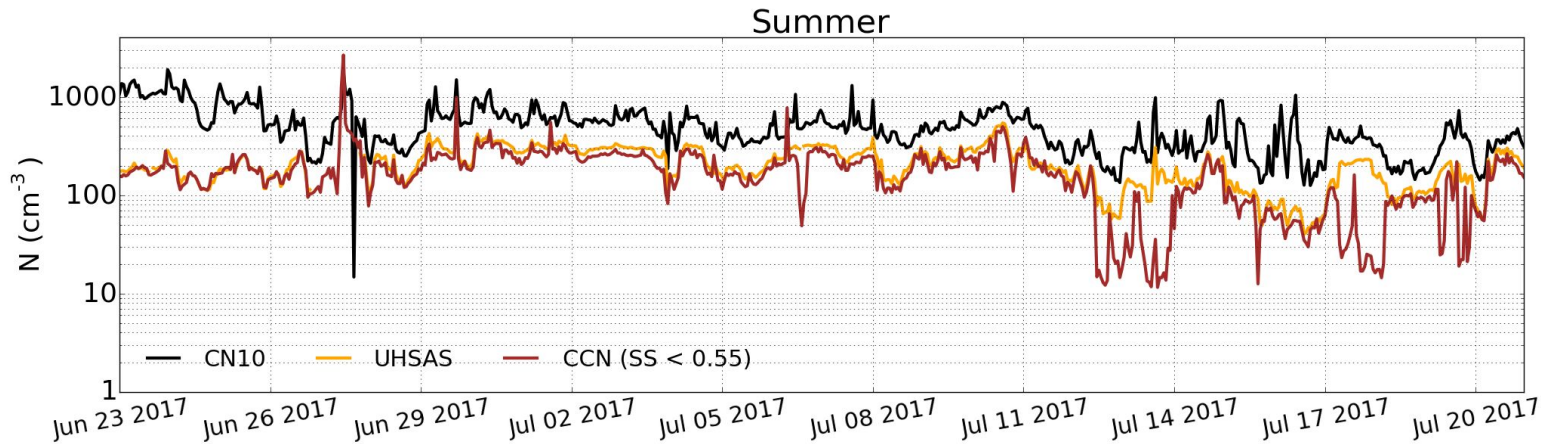
Summer



Winter

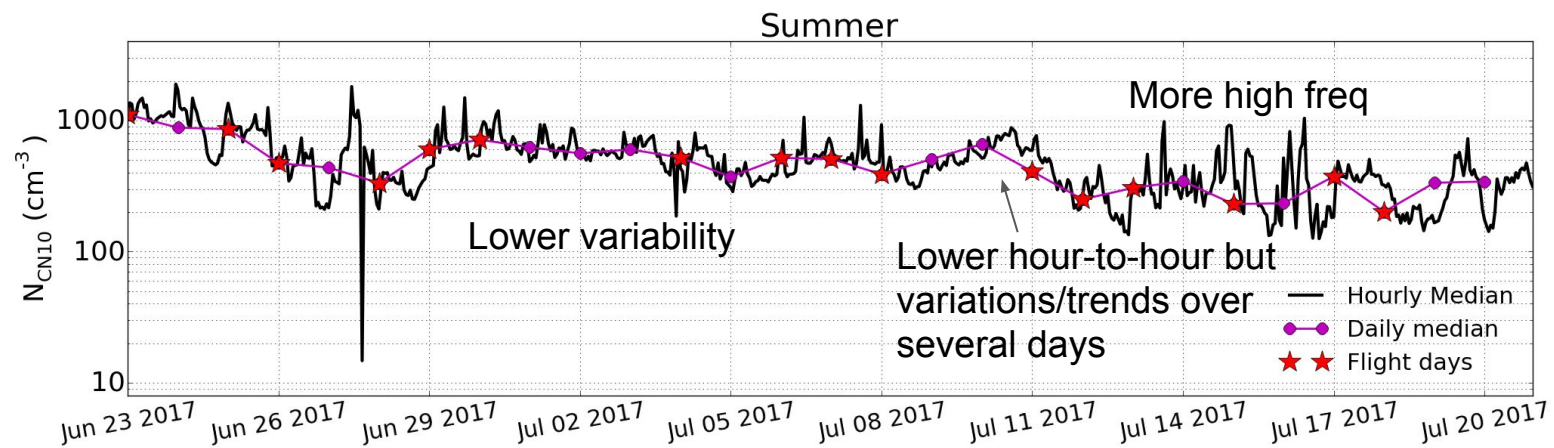


The supplemental site “satellite site” UHSAS shows a very different trend toward the end of winter campaign. I am inclined to believe something went wrong with primary given how low it was.



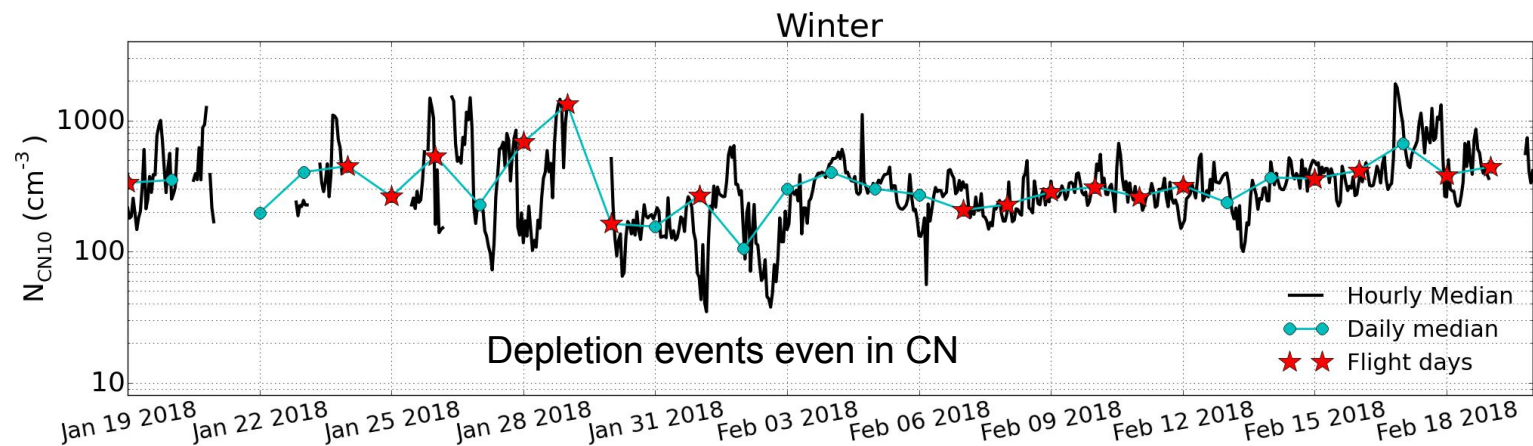
Looking up to 0.55%
supersaturations gives better
agreement between CCN and
UHSAS during summer → UHSAS
showing particles that won't activate
in typical Sc ? Good to keep in mind
when we see higher concentrations
of small particles

Likely even worse b/c I'm throwing
out 50 - 100 nm bins from UHSAS



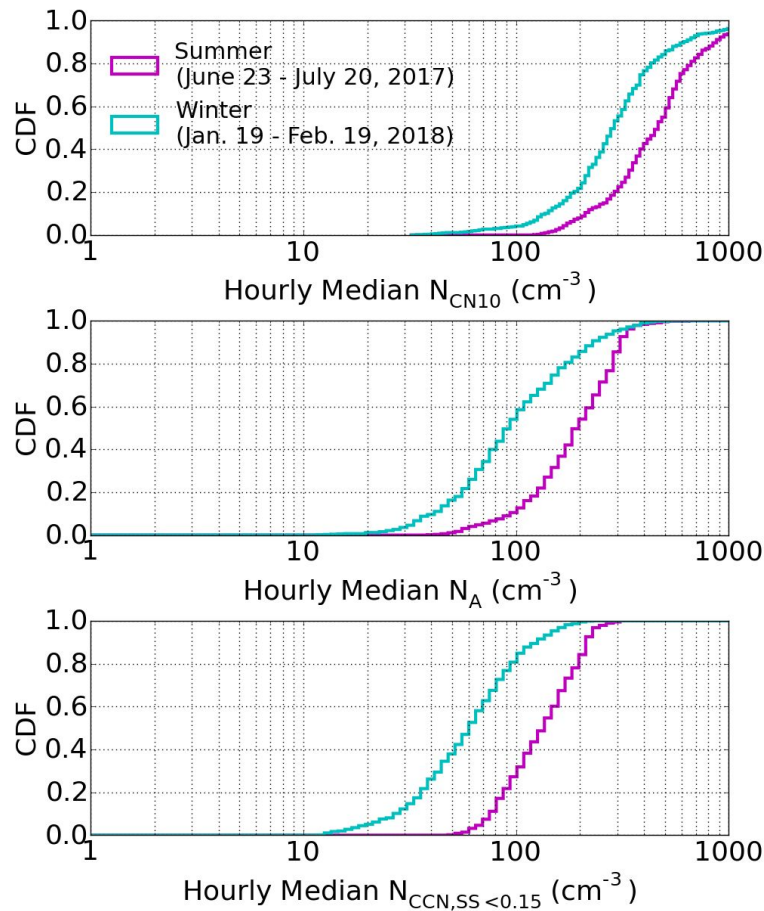
Multiple scales of variability

Some high spikes likely still from local pollution



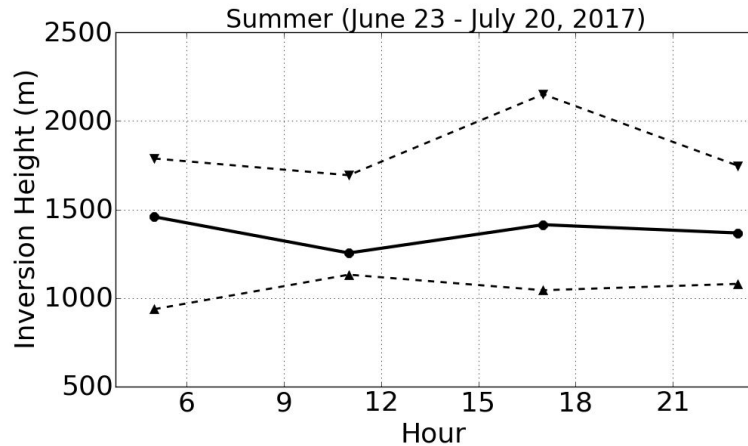
Same data as CDFs but in time series, also including daily medians

- Higher CN, N_A (accumulation mode, > 100 nm) and CCN during summer

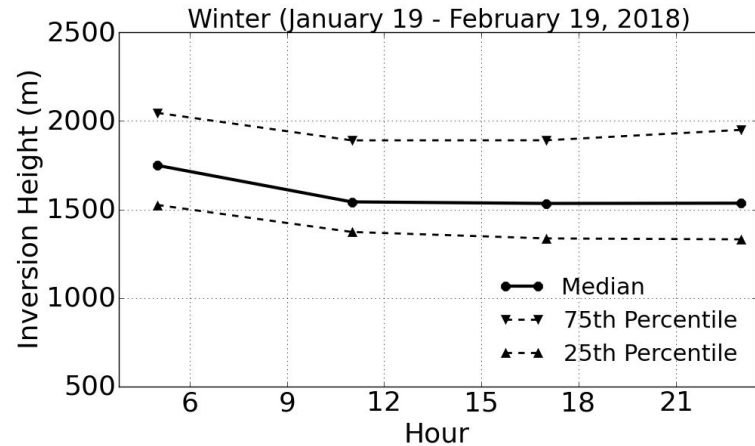


Vertical PBL structure

PBL height estimates from ENA soundings



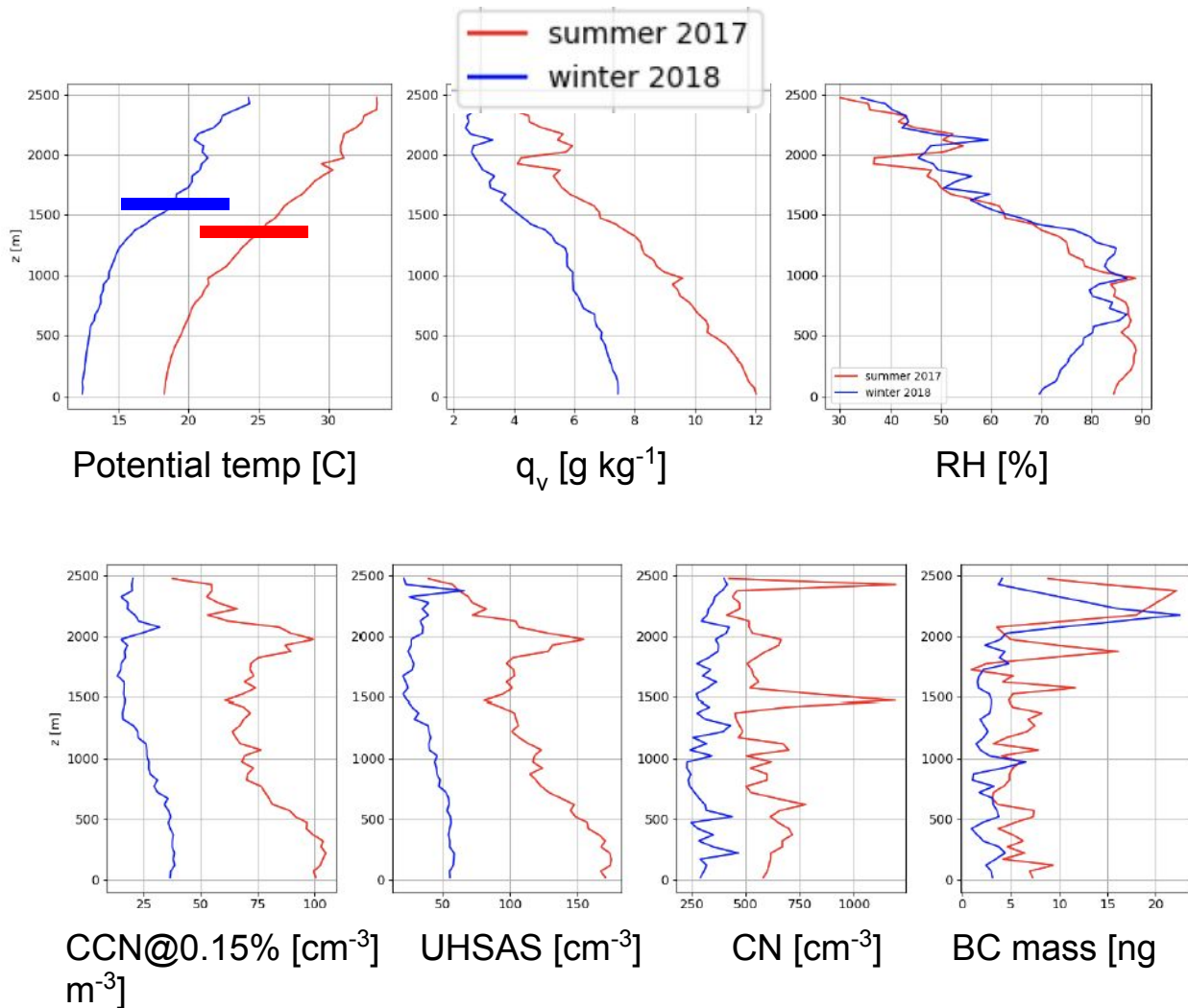
Simple estimate of inversion height as height of maximum dT/dz between 500 m and 3 km in 4x/daily ENA soundings.



- Winter statistics show deeper inversion on average
- Both show some evidence for weak diurnal cycle (deeper in early morning)
 - Weaker in winter, solar radiation differences?

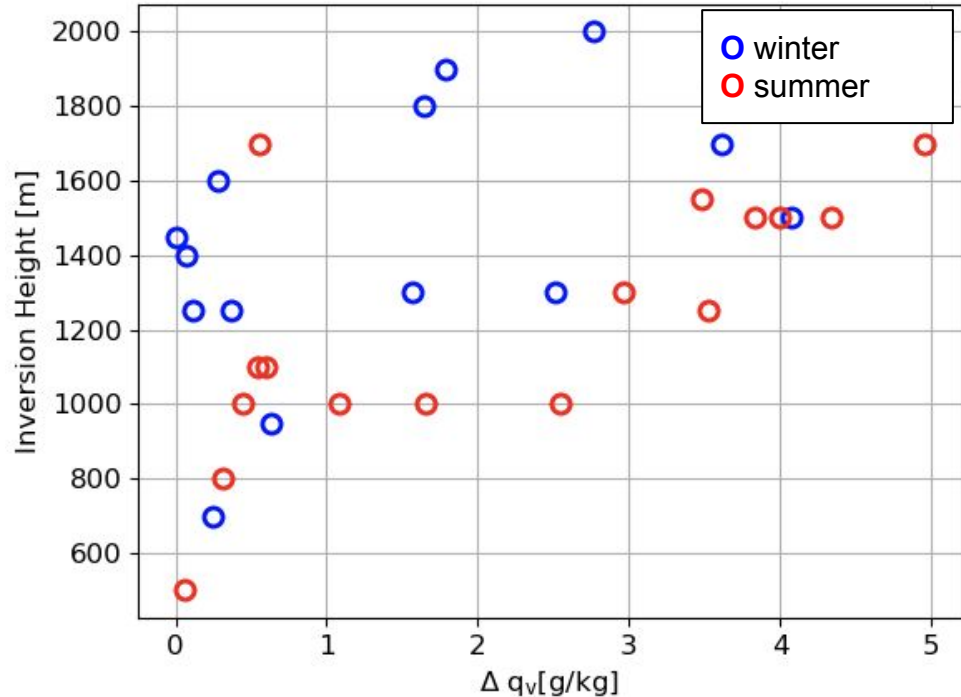
Mean G-1 profiles

- PBL is deeper and more well mixed during winter
- Evidence for persistent very clean layer near the top of the PBL and lower FT in winter
- BC aerosol levels low, slightly higher in summer



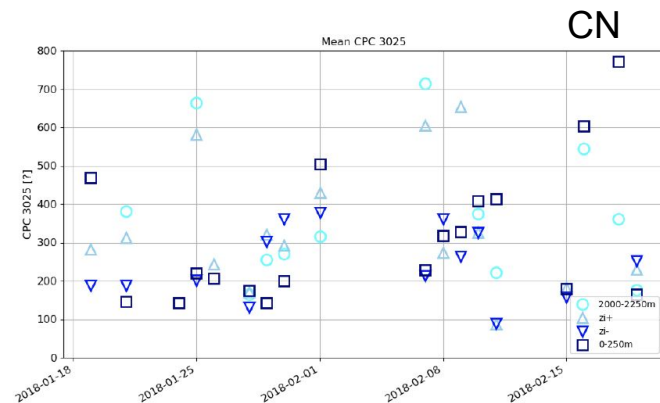
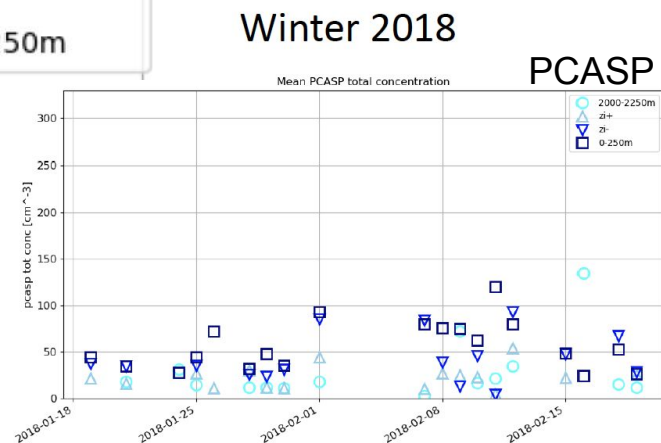
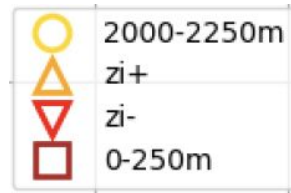
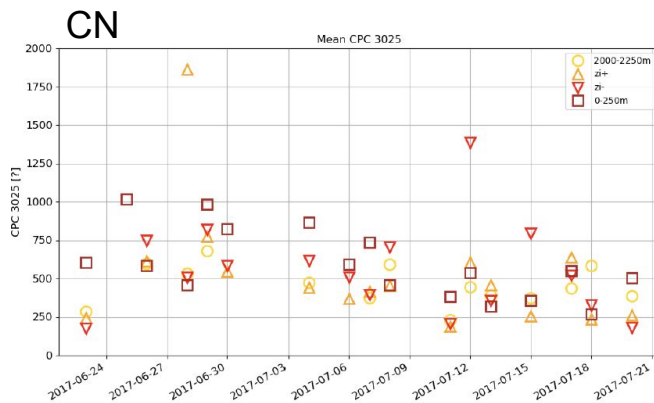
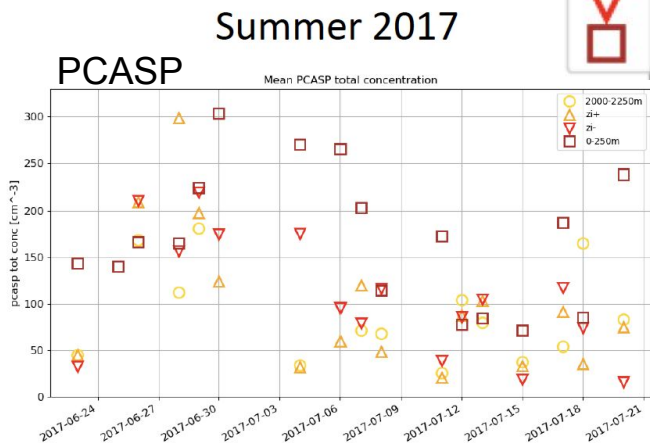
PBL decoupling

- Δq_v is difference between q_v at 100m - q_v just below inversion (Jones et al. 2011)
- Most PBLs shallower than 1000 m are quite well-mixed
- Wintertime deep PBLs typically more well-mixed than deep summertime PBLs



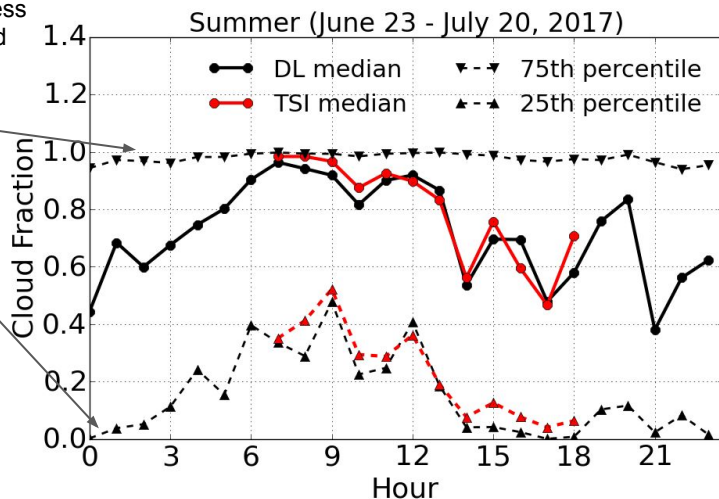
Near-surface PCASP concentrations mostly higher than those below or above MBL inversion during both summer and winter

Not as clear for CN, which is often higher below and above the inversion



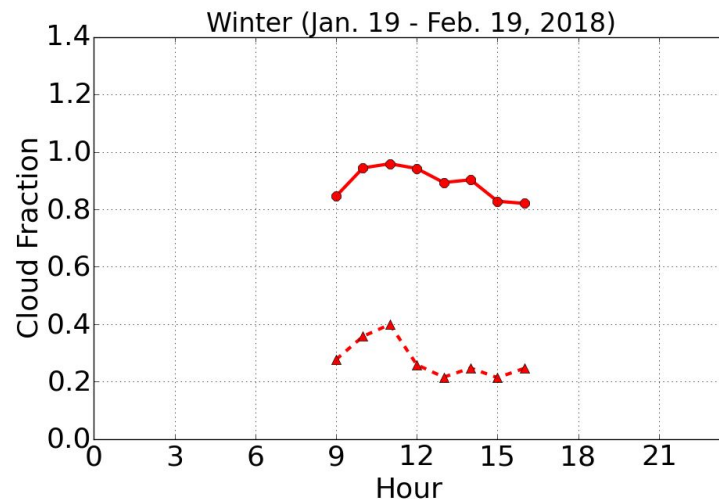
Cloud properties

Large range in cloudiness
across campaign period



Median and 25th percentile cloud fractions from zenith pointing Doppler lidar (DL, zenith pointing) and total sky imager (TSI, hemispheric) agree quite well in summer when both available

- Sharp increase through the morning hours, then decrease as sun comes up
- Summer period is mostly low clouds, but will need to be more diligent about throwing out data with deeper/high clouds at some point



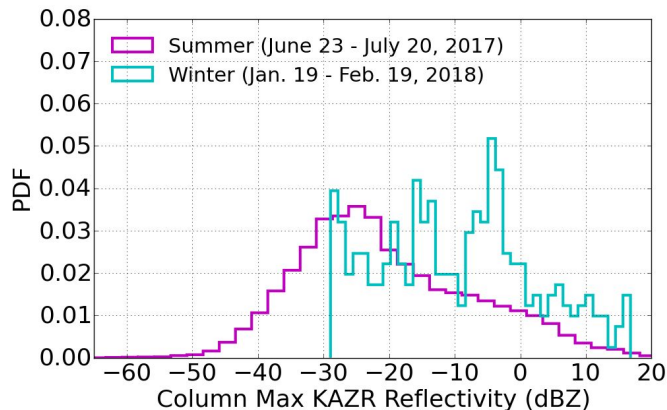
Median daytime CF tends to be higher in winter than summer

- Weaker solar radiation diurnal cycle?
 - More synoptic influence?
- will want to bring in active or passive CF when available to get nighttime

TSI includes both opaque and thin cloud classifications.

- *Do not appear to be mutually exclusive (?) so not showing >75th percentile since this can yield CF > 1; bulk of pattern coming from opaque (thin CF < 0.1 typically)*

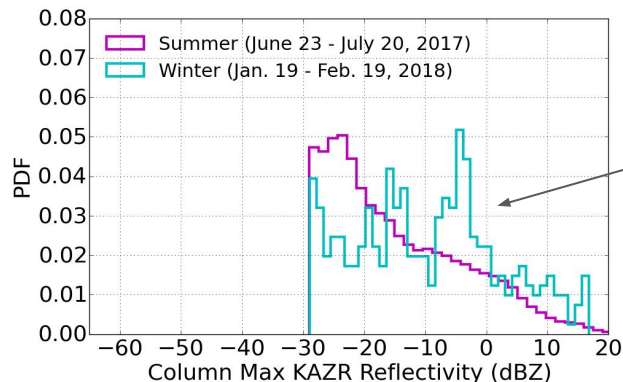
PDFs of Column maximum KAZR reflectivity



Summer pdf uses processed radar reflectivity product (clutter & non-significant returns removed); winter pdf restricted to -30 dBZ to clean up, but not an exact comparison, includes some noise.

Will use processed radar files once available for winter

- Preliminary indication of shift toward higher values in winter...more intense drizzle



If you apply
-30 dBZ
threshold
applied to
processed
data

Summary

- Surface meteorology
 - Summertime winds and pressure similar to climatology; wintertime affected by strong Azores high
- Aerosol
 - CN, UHSAS and CCN 50% higher in summer
 - Remarkable tracking of accumulation mode with total aerosol concentration in summer
 - Evidence for persistent ultraclean layer in upper PBL and lower FT during winter
- Vertical structure
 - PBL deeper in winter, and deeper PBLs remained more well-mixed in winter
- Cloud and Precipitation
 - Strong diurnal cycle in summer
 - Reflectivity pdf suggests more warm rain in winter than summer