Seasonal contrasts in clouds and aerosols during ACE-ENA

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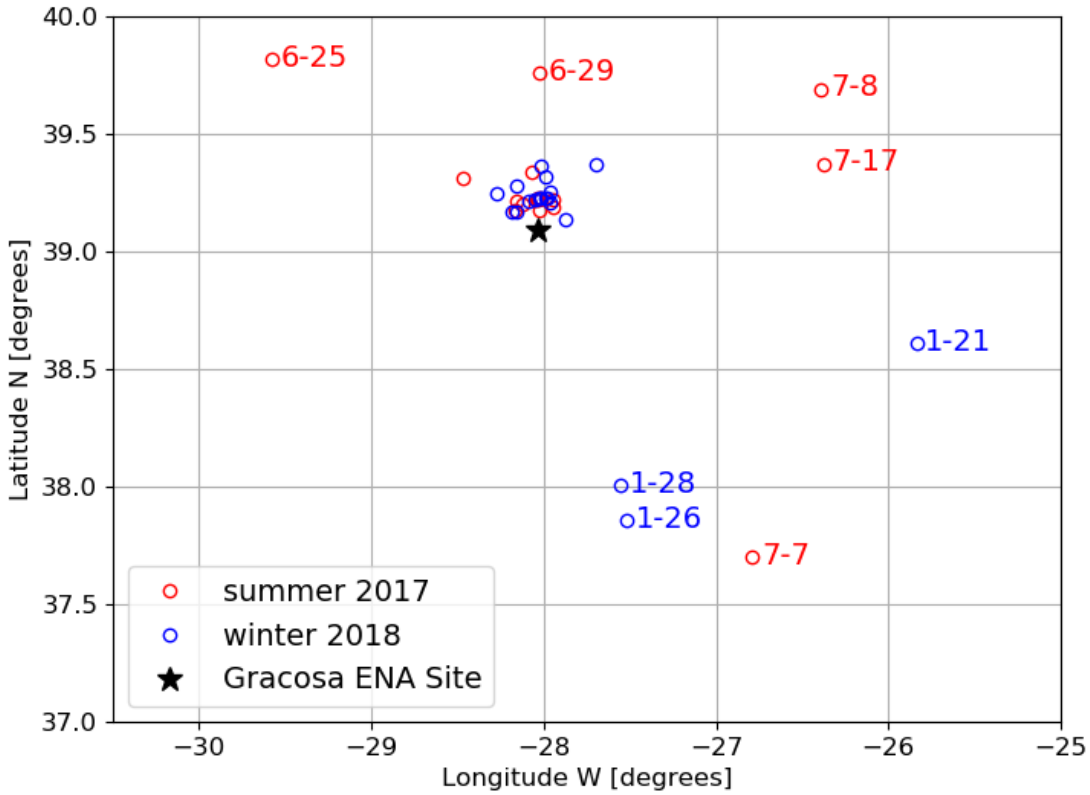
Key points

- Summer has 2-3 times more aerosols and CCN than winter near the surface
- Summertime N_d is only about 20-40% higher than winter N_d.
- Difference in aerosol activation efficiency related to:
  - Weaker PBL decoupling in winter
  - Stronger turbulence in winter

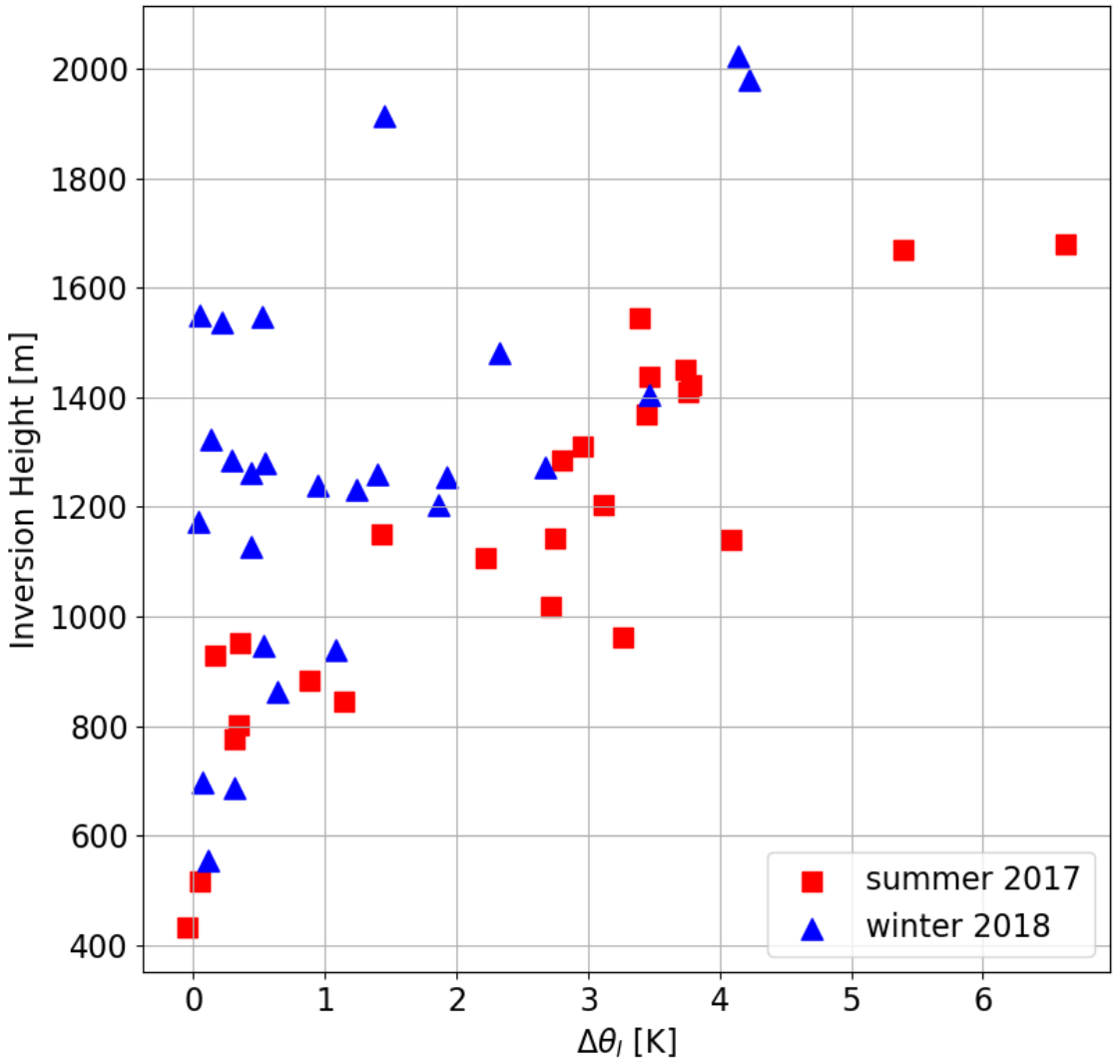
G-1 Flight Data

- Two periods: June-July 2017, Jan-Feb 2018
- About 20 flights each period
- ~10am – 2pm local time
- Mostly near the ENA site

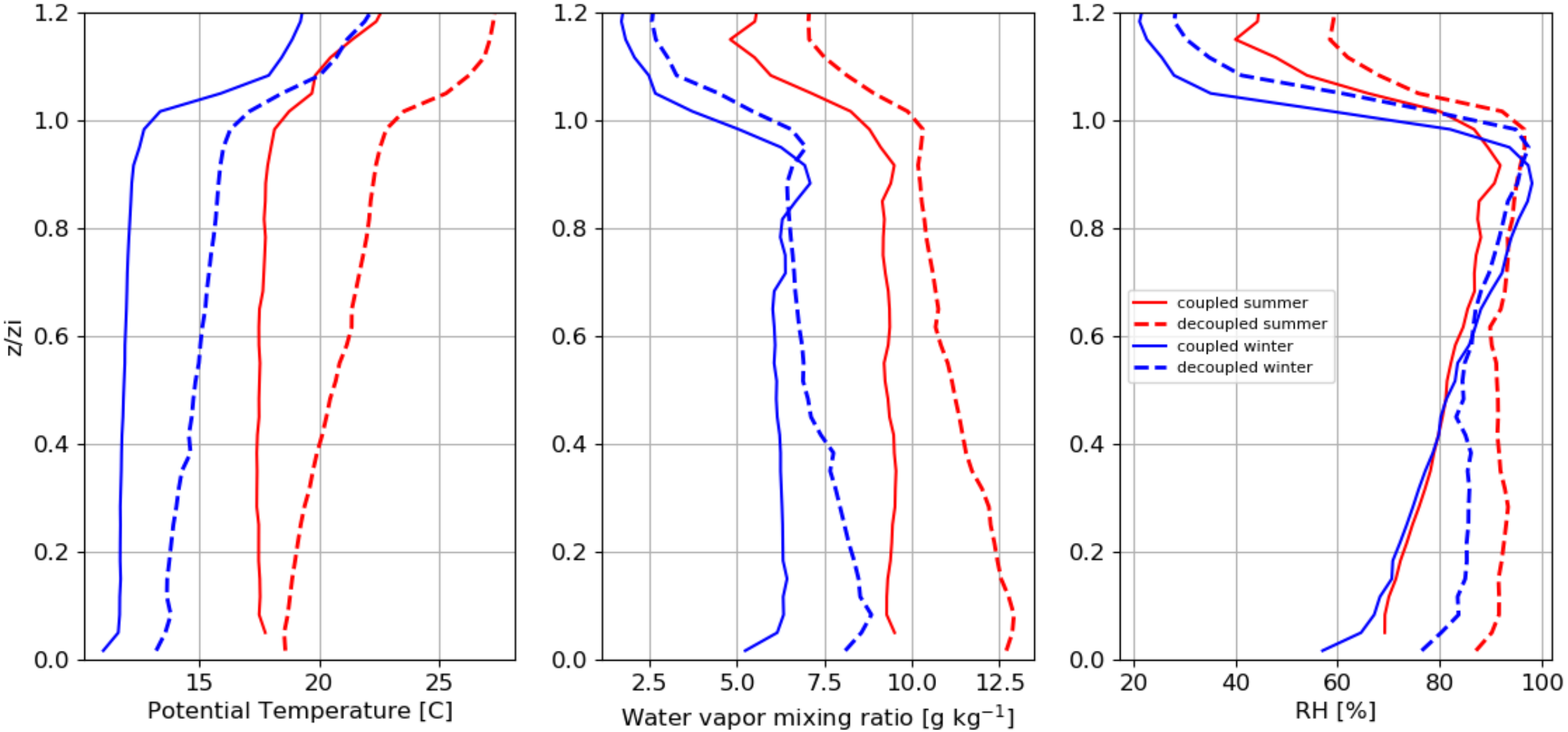


Decoupling Estimate

- Coupled and decoupled boundary layers are common in both seasons.
- Winter 2018 had more deep well-coupled cases.

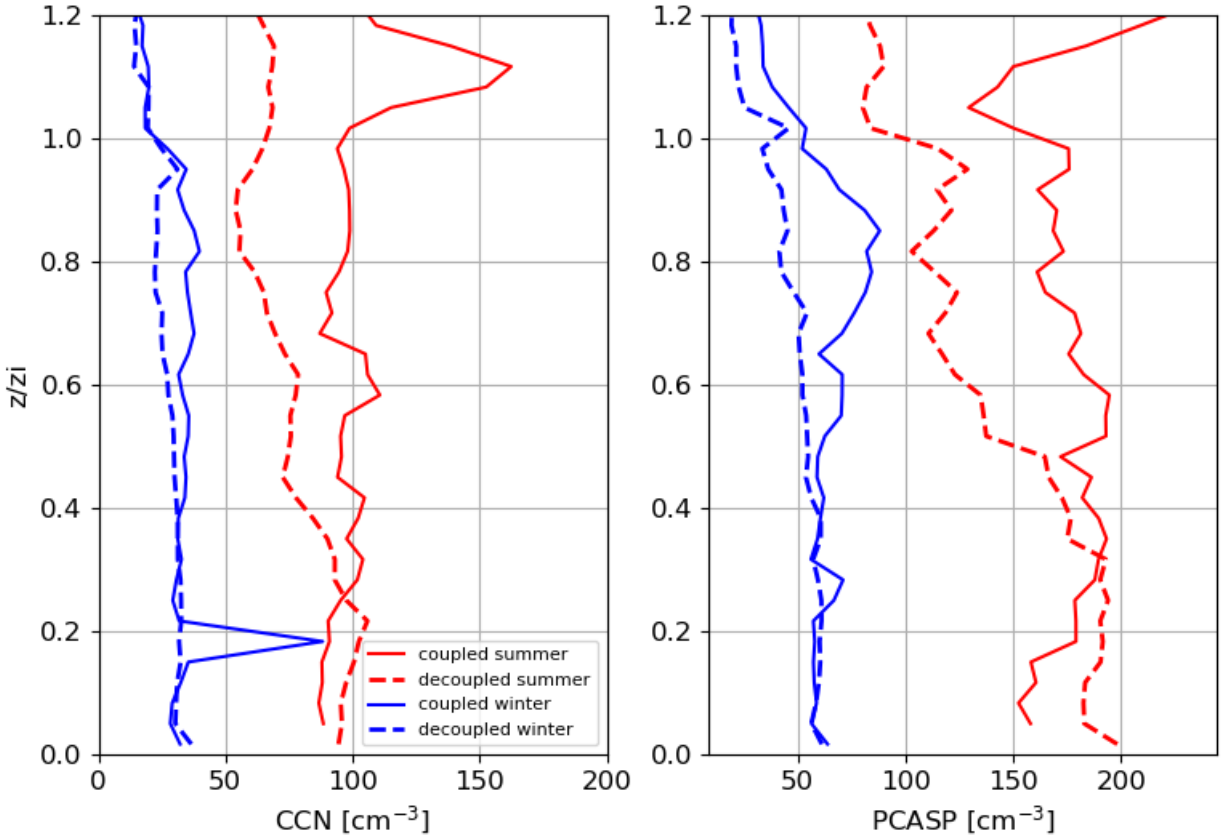


Seasonal sounding contrasts

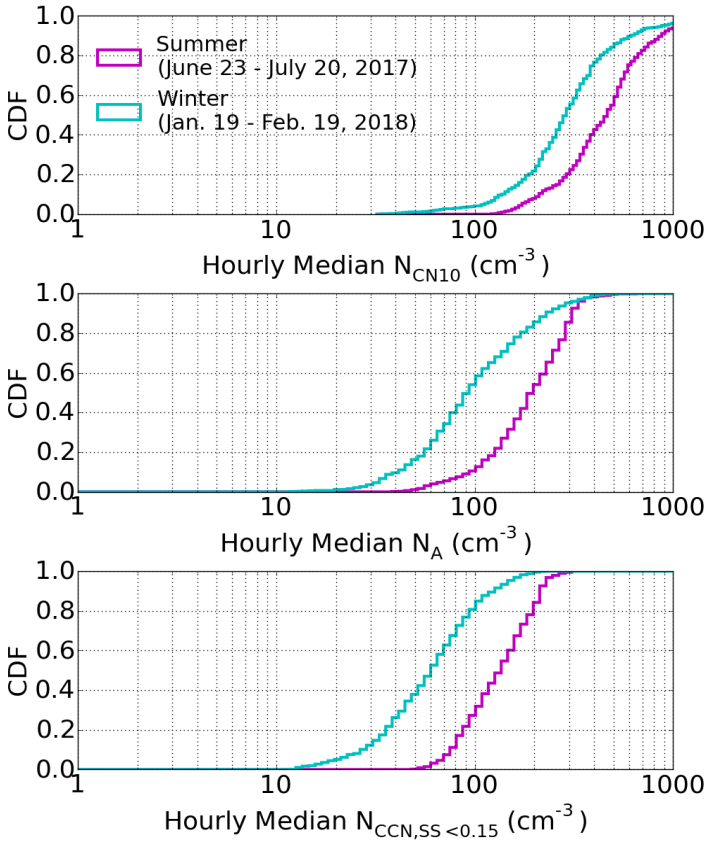


Aerosol contrasts

G-1 Flights



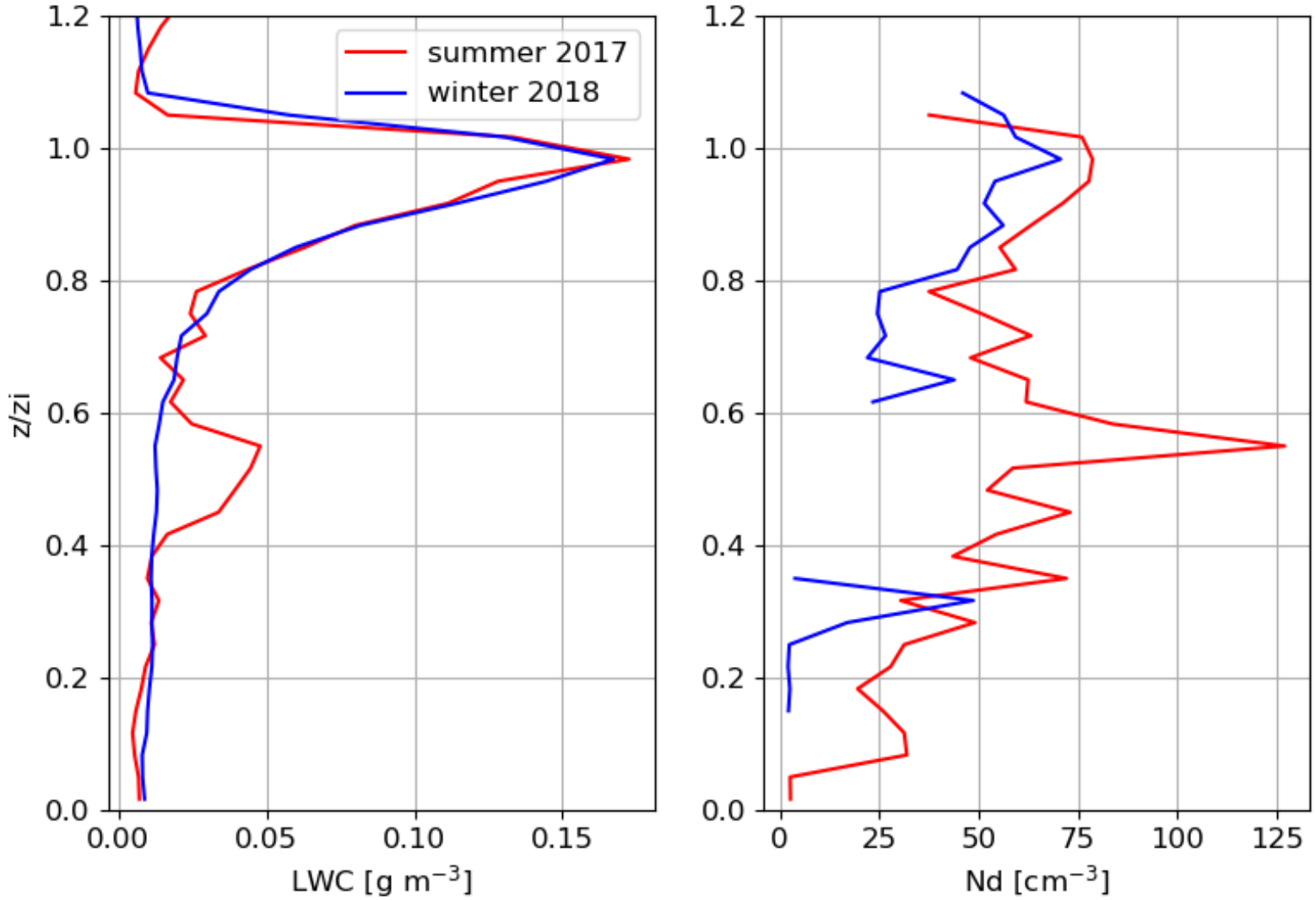
ENA Site



- CCN and accumulation mode aerosol concentrations 2-3 times higher near the surface during summer; seasonal contrasts weaker in upper PBL

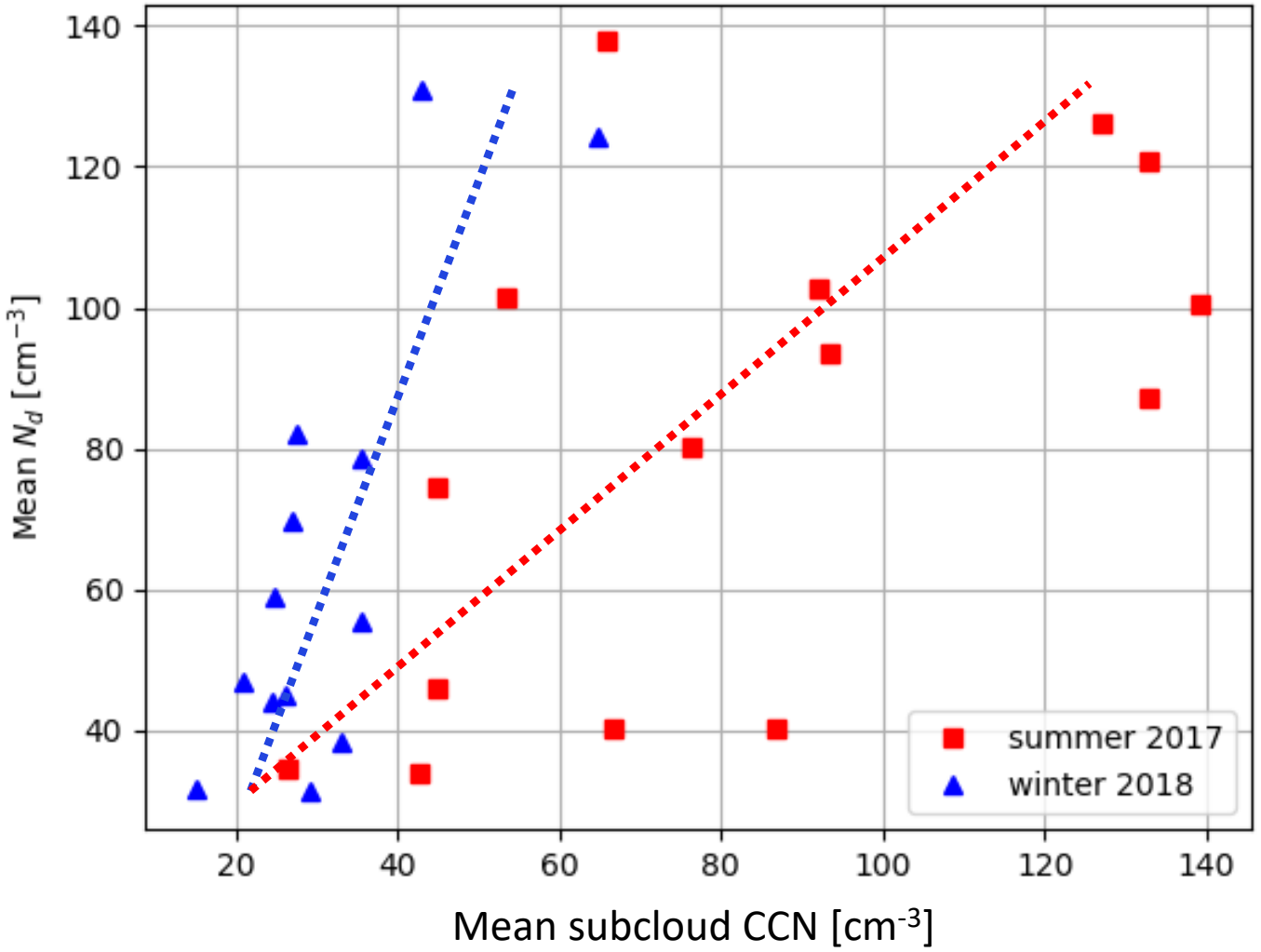
Mean cloud properties

- Mean LWC profiles (and LWP) very similar in summer and winter
- Cloud droplet concentrations are 20-40% higher in summer



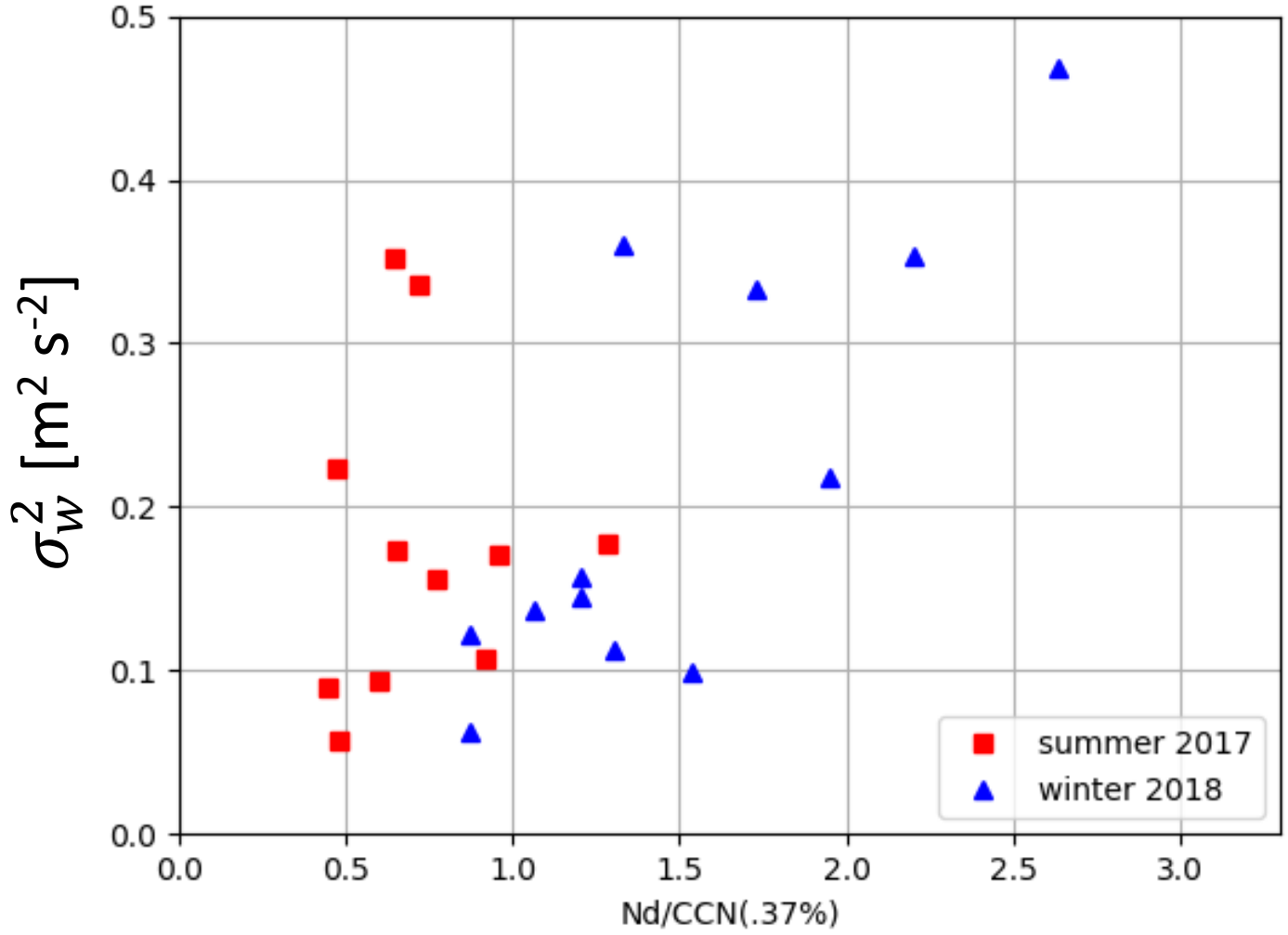
Differences in activation efficiency

- Higher N_d for a given CCN concentration in winter



Turbulence and aerosol activation

- Higher activation "efficiency" in winter partly explained by stronger updrafts



Key points

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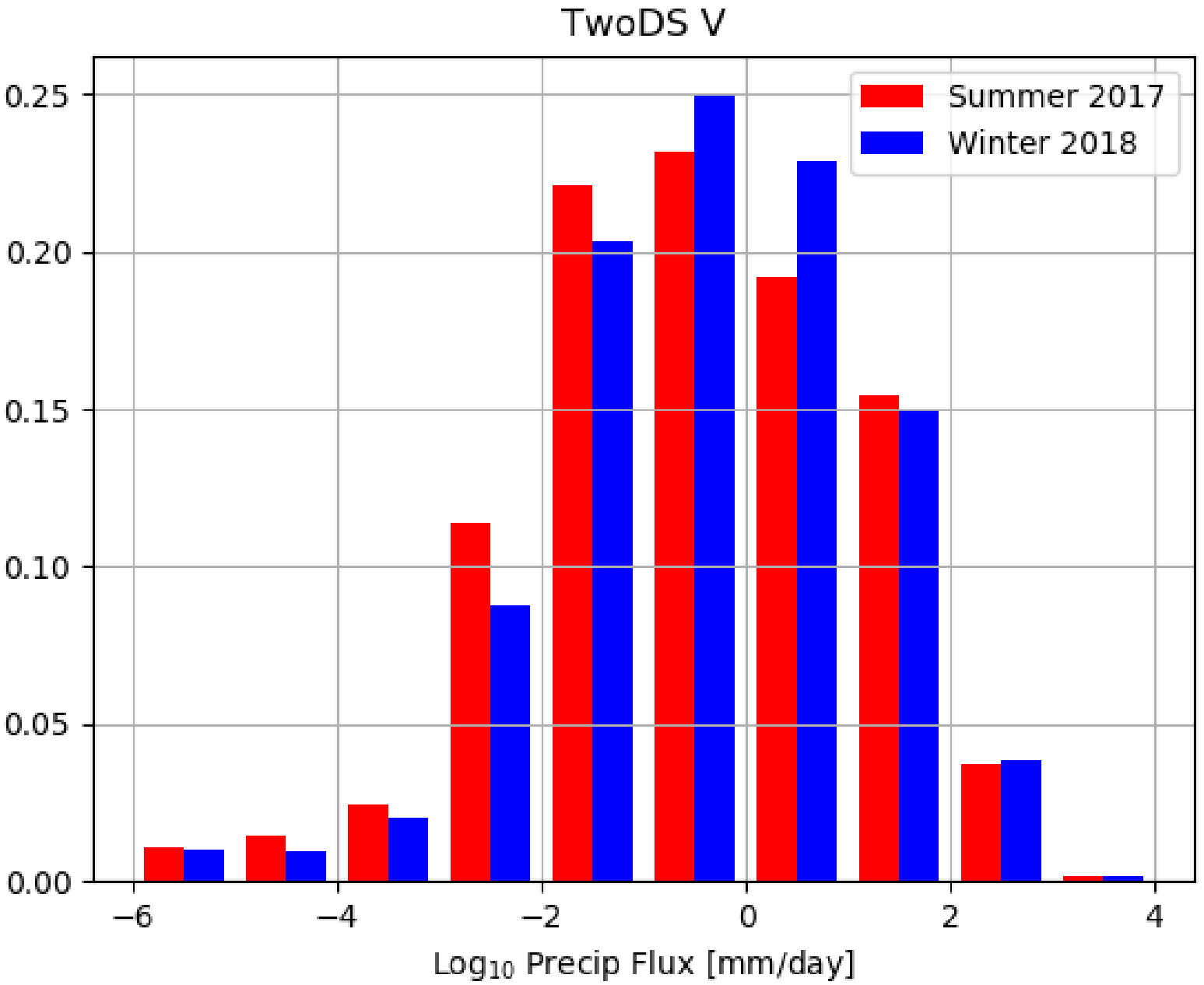
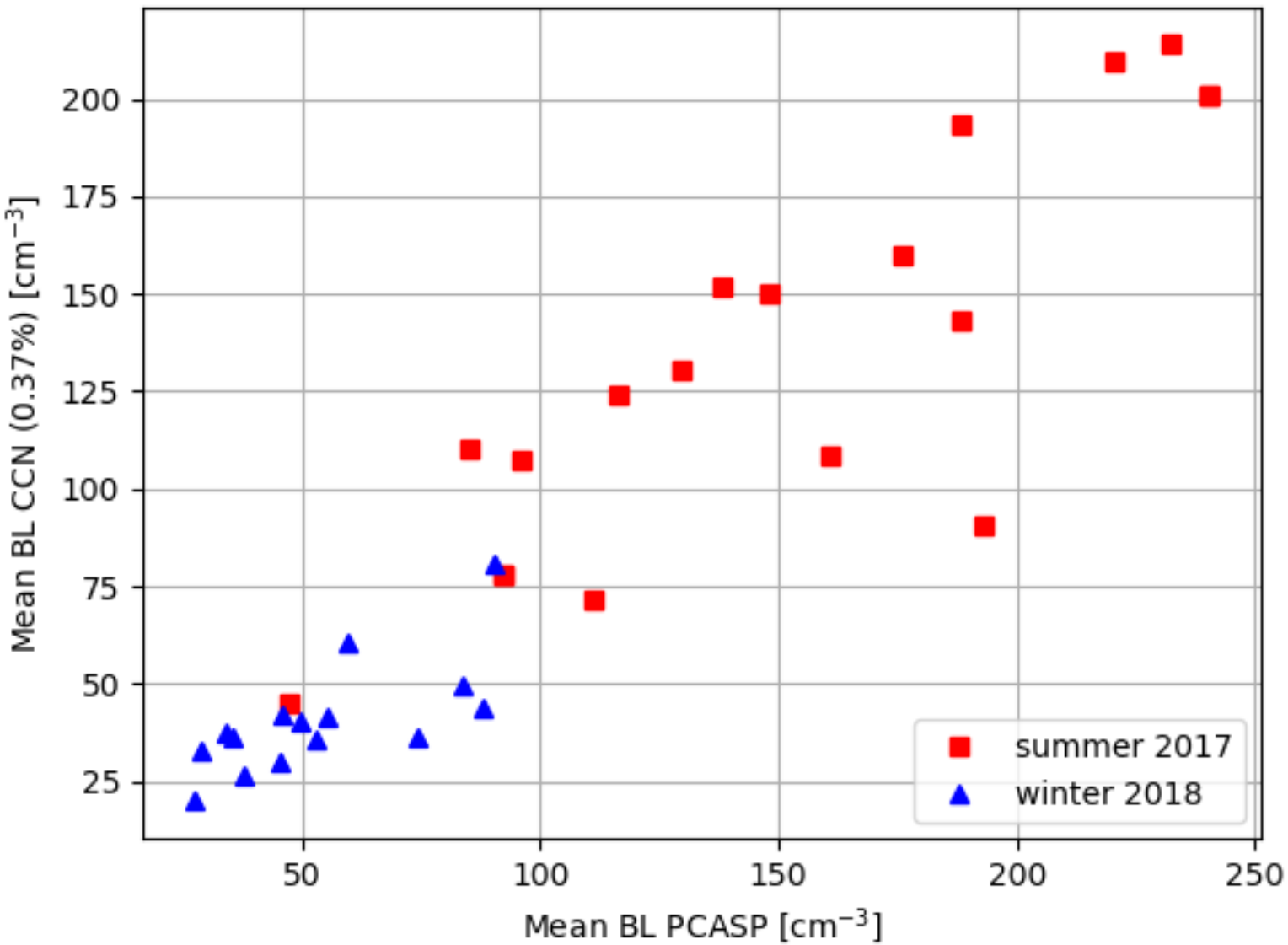
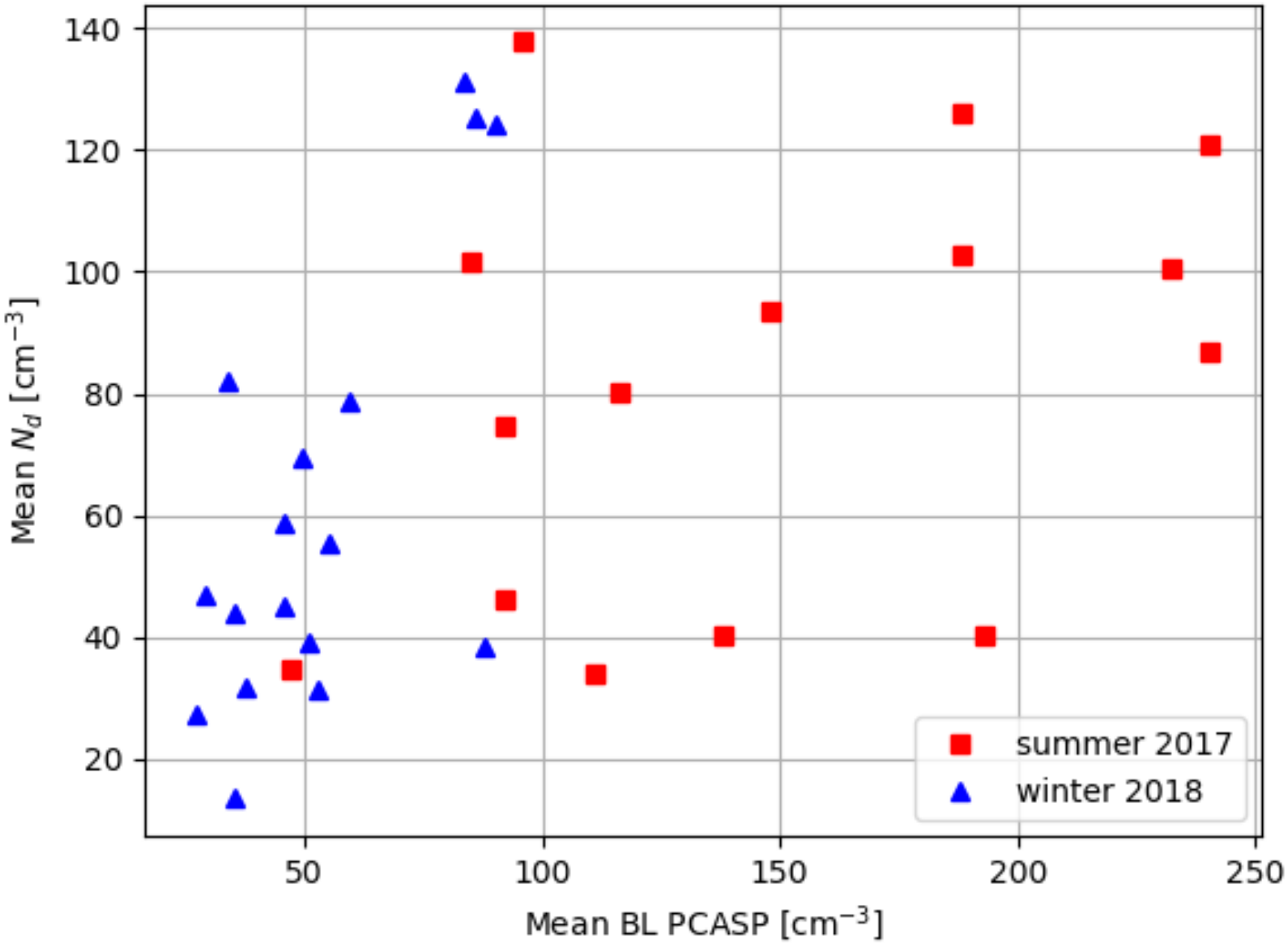
- Difference in aerosol activation efficiency related to:
  - Stronger turbulence in winter
  - Weaker PBL decoupling in winter
- Upcoming paper (Wyant et al., 2020) also investigates impacts on precipitation susceptibility

Extra slides


TwoDS V
Summer 2017
Winter 2018
0.25
0.20
0.15
0.10
0.05
0.00
−6
−4
−2
0
2
4
Log10 Precip Flux [mm/day]


Mean BL CCN (0.37%) [cm^{-3}]
Mean BL PCASP [cm^{-3}]
25
50
75
100
125
150
175
200
50
100
150
200
250
summer 2017
winter 2018


140
120
100
80
60
40
20
Mean N_d [cm^{-3}]
50
100
150
200
250
Mean BL PCASP [cm^{-3}]
summer 2017
winter 2018