Pacific Northwest
NATIONAL LABORATORY

Ultrafine Particles Observed during the CACTI Campaign

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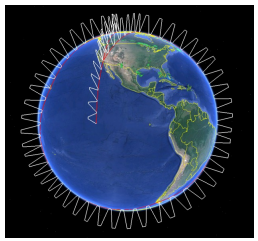
Integrated Cloud, Land-Surface,& Aerosol System Study
ICLASS

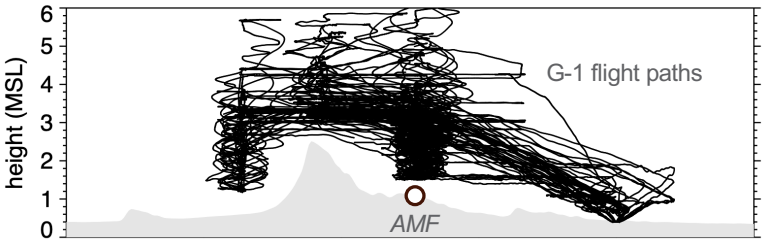
Motivation

- The CACTI campaign was conducted in Argentina between October 2018 and April 2019 to better understand the **role of thermodynamics, topographic forcing, and aerosols on the lifecycle of convective clouds**.
- The extensive data provides an opportunity to better understand **interactions between aerosols and convective clouds that are highly uncertain**.
- The southern hemisphere is a **data sparse region.**

Atom (4, 2016-2018) and HIPPO (5, 2009-2011) global snapshot coverage



Focus on one region, November 4 – December 8, 2018

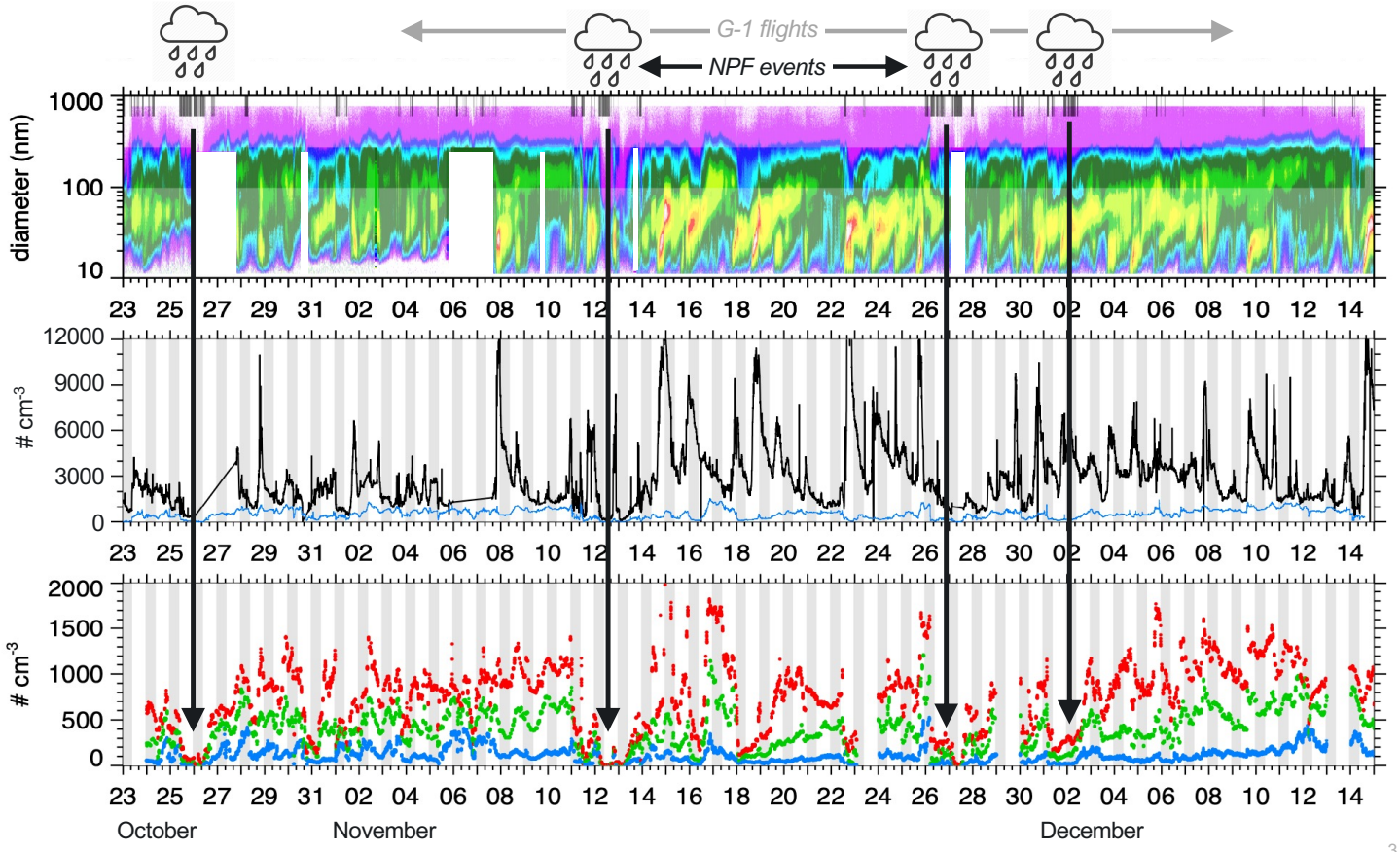


Multiday Variations at the Ground Site

Size Distribution
SMPS+UHSAS

Total # Concentration
SMPS (> 10 nm)
UHSAS (> ~100 nm)

CCN Concentration:
0.1%, 0.2%, and 0.4%
supersaturation



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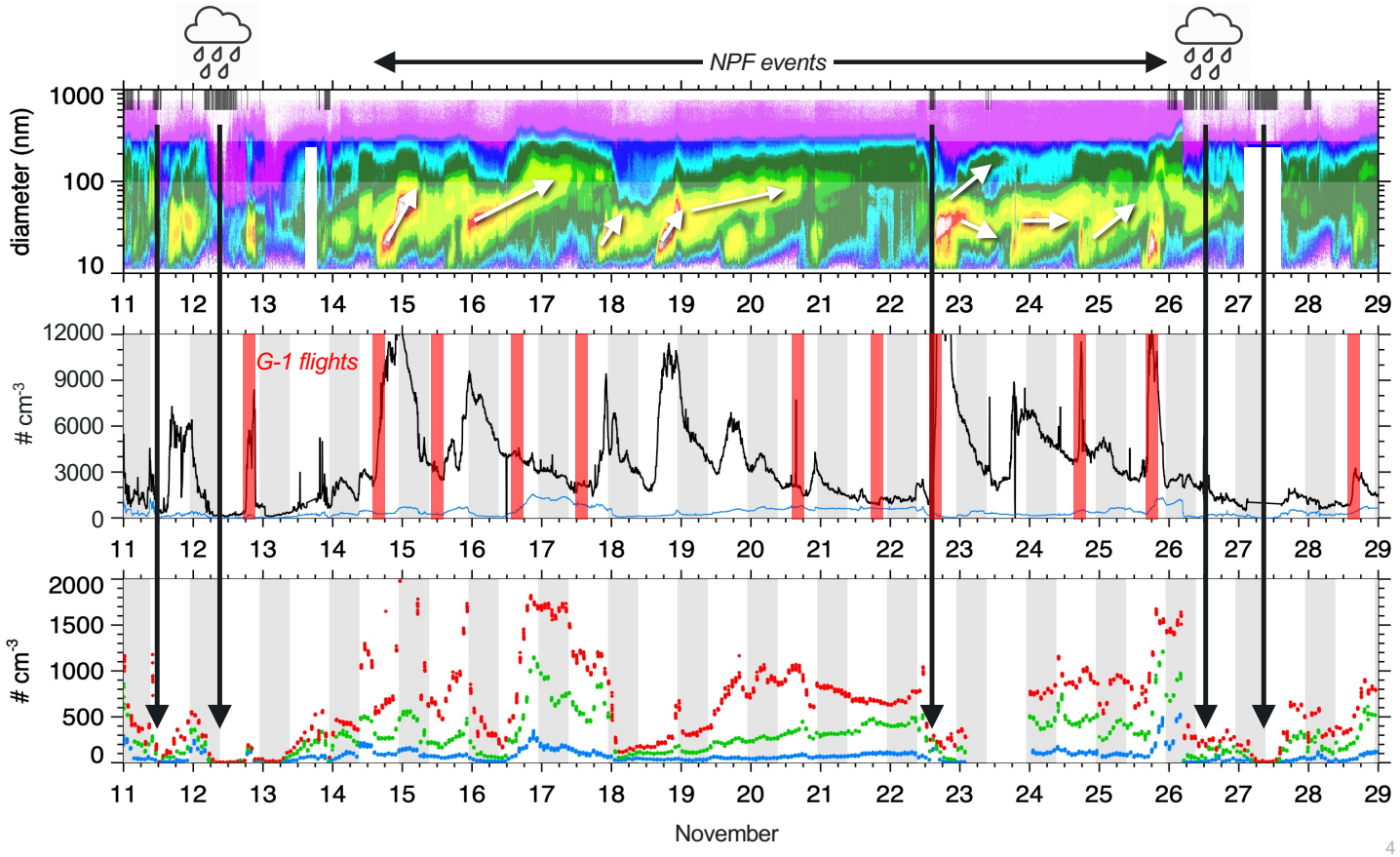


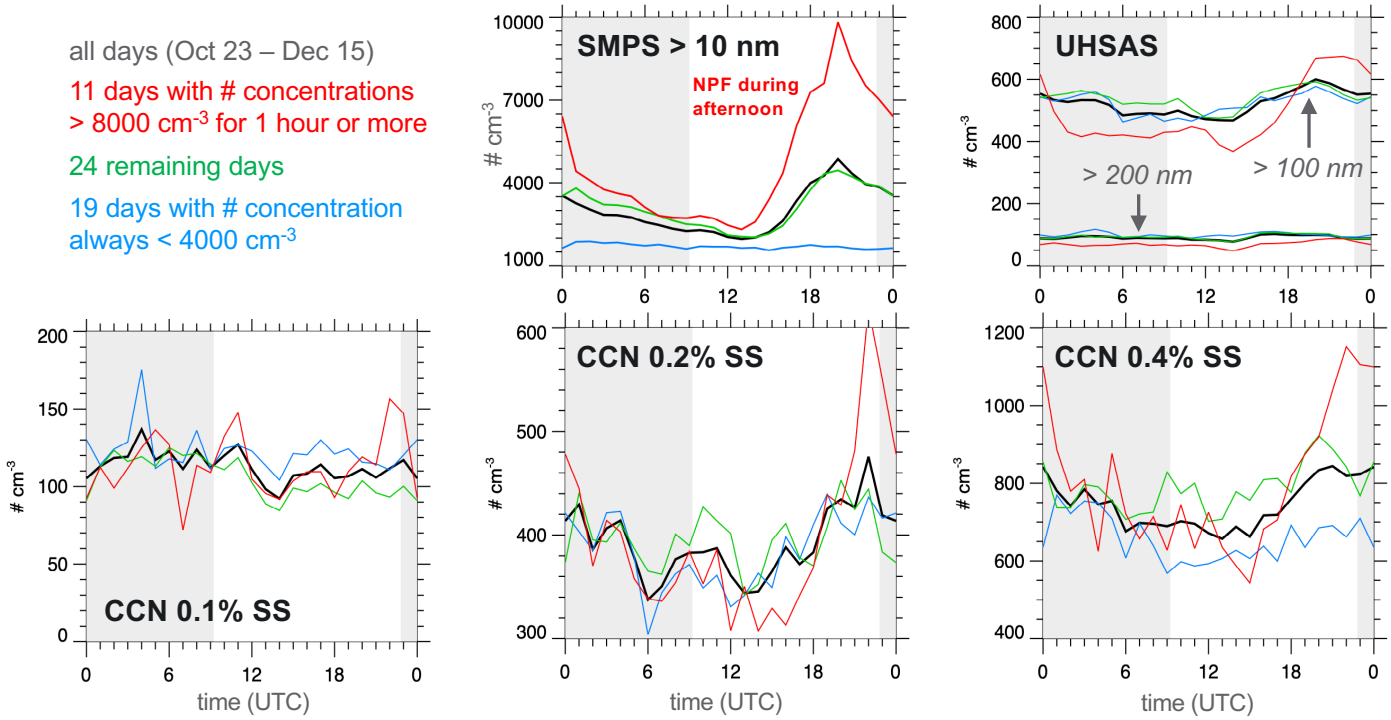
Average Diurnal Variability

all days (Oct 23 – Dec 15)

11 days with # concentrations > 8000 cm^{-3} for 1 hour or more

24 remaining days

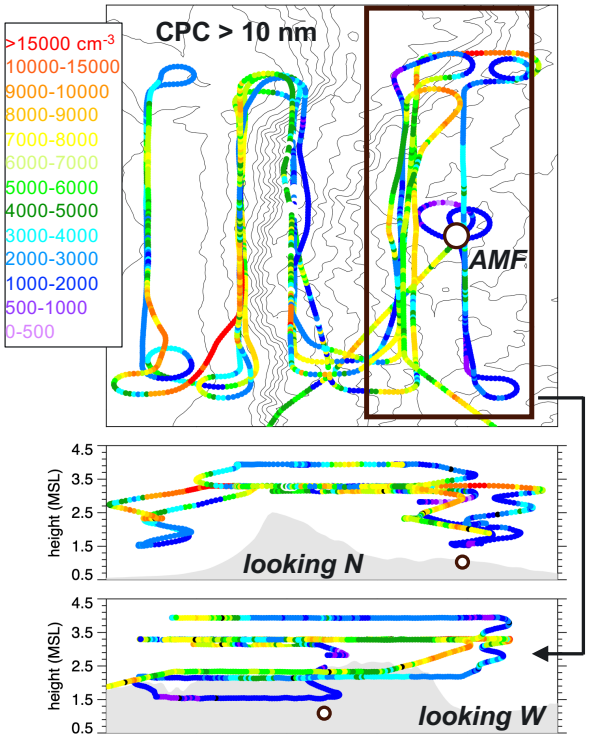
19 days with # concentration always < 4000 cm^{-3}

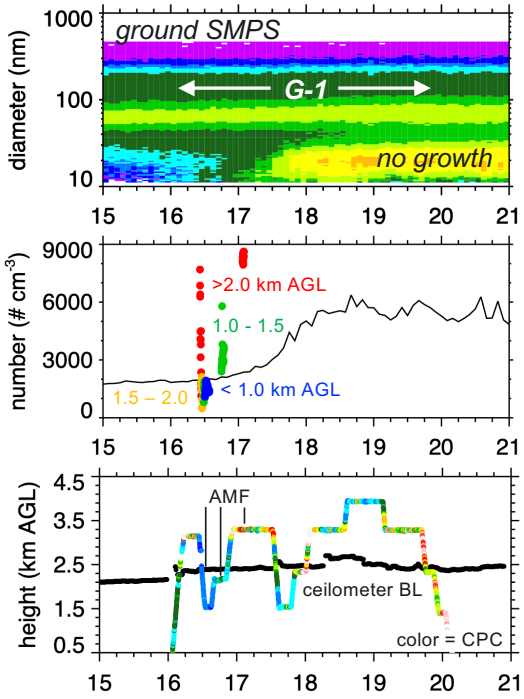


- Peak CCN at 0.2 and 0.4% occurs ~2 h later than peak ultrafine concentrations
- What does the timing in CCN concentrations mean for the timing of convective clouds?

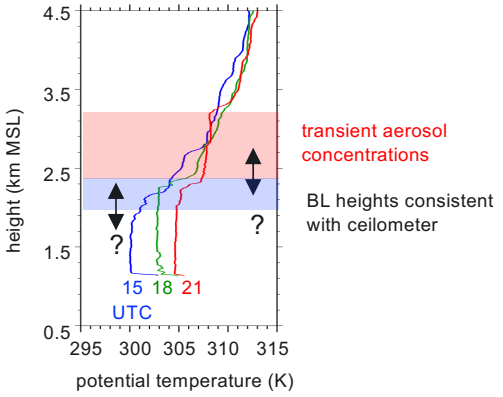
December 3 G-1 Flight

- Do NPF events originate in the boundary layer, or are UFP mixed downward to the ground from aloft?



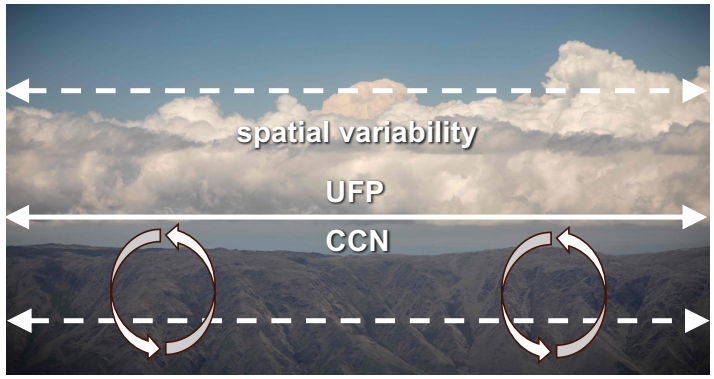


- Transient UFP aloft
- Aircraft flight paths not ideal to examine vertical mixing (get hints)
- Need a model to tease out relative role of boundary layer nucleation and vertical mixing

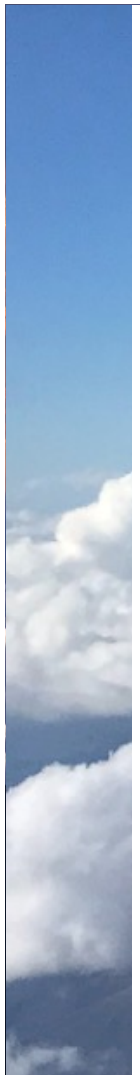


Open Issues

- UPF during CACTI is complex. Need a more careful analysis of aircraft data coupled with boundary layer growth to determine the role of downward UFP transport to the surface
- Modeling studies are needed to identify specific mechanisms responsible for UFP and growth as a function of height. Unfortunately, CACTI lacks measurements of key precursor trace gases to verify model predictions.
- Modeling is also needed to understand upwind sources of observed UFP in the free atmosphere
- How do variations in CCN resulting from NPF and growth affect convective clouds? This requires determining the complex intersection of CCN, cloud updrafts, entrainment.



- See Poster 2.24 for more details



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Questions?