HALO-(AC)³ – 2022/04/05 – Polar6 research flight RF10

Objectives:

Collocated flight with Polar 5. At the beginning of the flight a wing-to-wing comparison of the noseboom measurements. Followed by in-situ cloud and aerosol measurements over sea ice and the open ocean. Two positions for racetrack patterns at different height levels were selected. Polar 5 flies above the main flight track of Polar 6.

Mission PI P6:

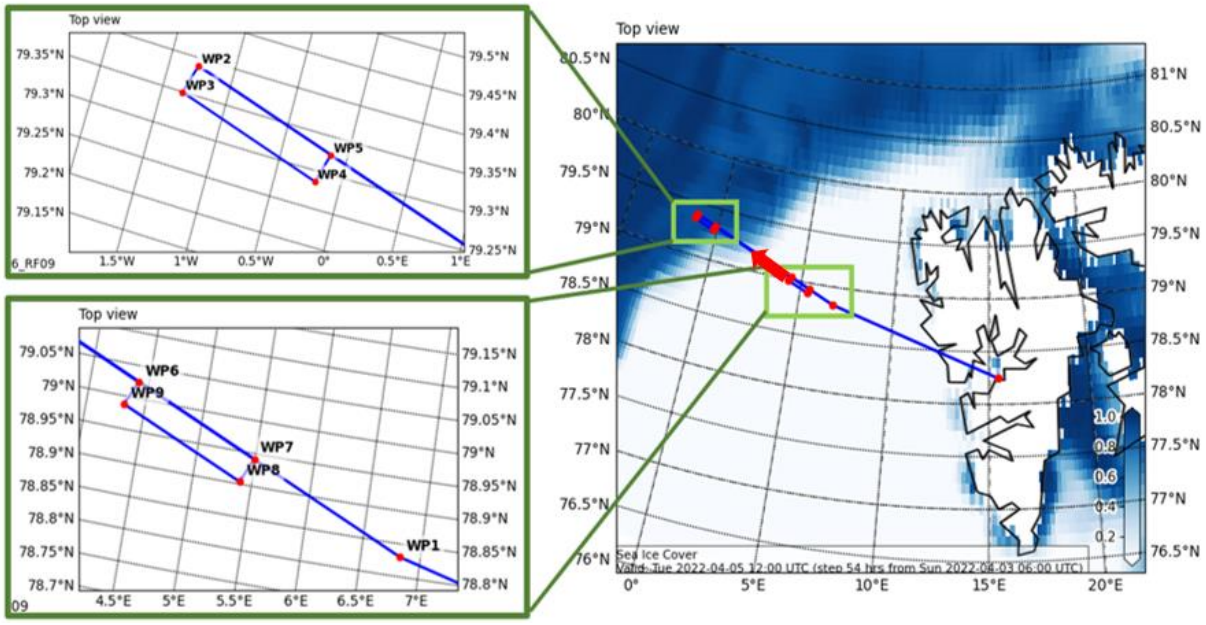
johannes.schneider@mpic.de

manuel.moser@dlr.de

Polar 6 Crew	
Mission PI	**Johannes Schneider/ Manuel Moser**
Basis Data Acq.	**Cristina Sans Coll**
CVI/Aerosol/HERA	**Sarah Grawe**
ALABAMA/Trace gas	**Alexander Gerst**
Microphysics	**Alexander Gerst**
Camera	**Jonas Sichert**

Flight times:

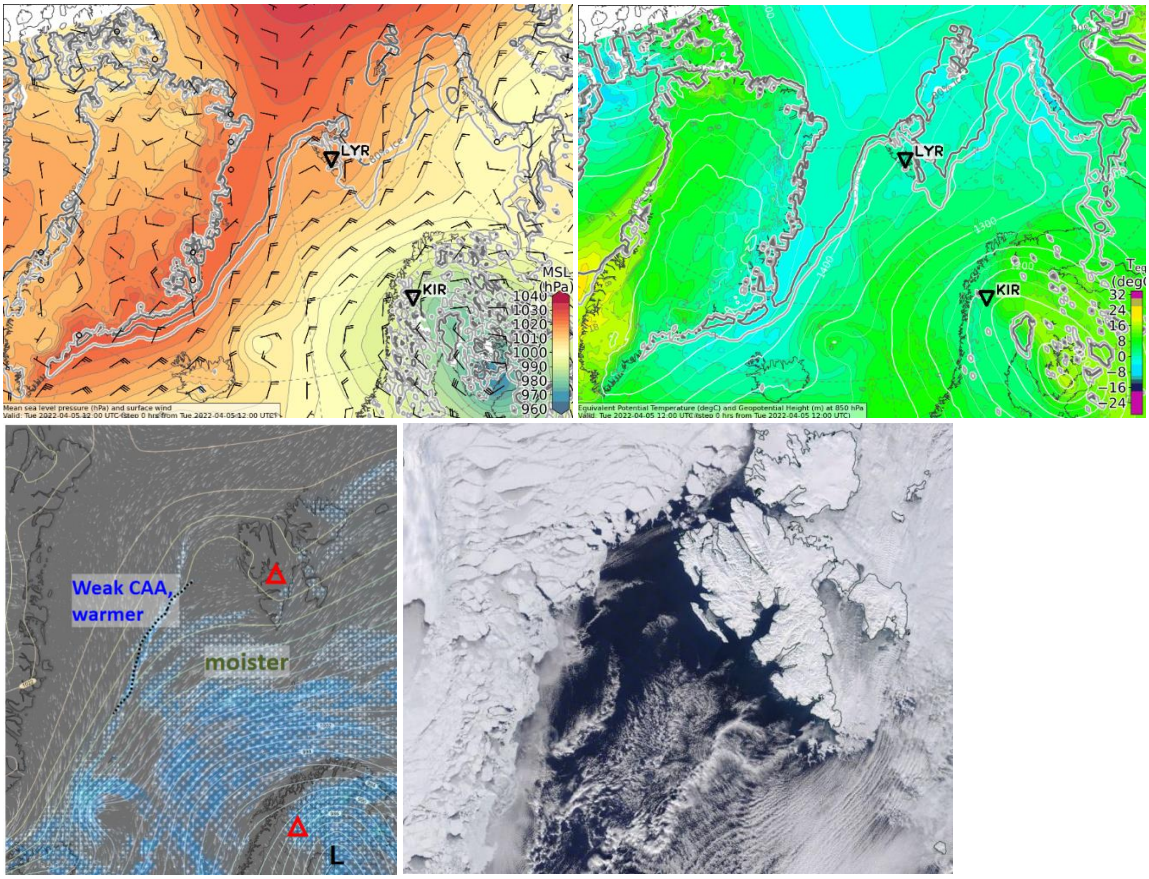
Polar 6	
Take off	**09:41 UTC**
Touch down	**14:11 UTC**



Weather:

Weather Situation 2022-04-05 (by Johanna Mayer)

The large-scale weather pattern was characterized by low pressure systems over Finland and the Northwest of Russia and by a ridge of high pressure systems ranging from the central Arctic to the East of Greenland. These two pressure regimes are associated with northerly winds in the western region of Fram Strait and easterly winds in the South and East of Fram Strait. Near the West coast of Svalbard winds are calm and the area is cloud-free, presumably due to lee effects downwind of the mountains in the Northwest. The wind flows converge in a line west of Svalbard close to the sea ice edge. Clouds form over ocean in the areas of converging flows. The temperature in Fram Strait increased and the Cold Air Advection is weaker compared to the last days. The Cold Air Advection stays mainly over the sea ice and the area of marginal sea ice. The easterly flow between Norway and Svalbard brings moist air with clouds and precipitation.



Top Left: Mean sea level pressure from ICON for 2022-04-05, 12 UTC (forecast from 2022-04-05, 12 UTC). Top Right: Equivalent Potential Temperature at 850 hPa from ECMWF for 2022-04-05, 12 UTC (forecast from 2022-04-05, 12 UTC). Bottom Left: surface winds and precipitation from ECMWF for 2022-04-05, 12 UTC (forecast from 2022-04-04, 00 UTC, retrieved from: https://www.windy.com/). Bottom Right: Satellite picture for Tuesday around noon (Terra MODIS, corrected reflectance, retrieved from: https://worldview.earthdata.nasa.gov/)

Cloud situation observed during the flight:

As observed in previous flights, clouds over ice were generally much thinner than forecasted. The first racetrack was performed in almost cloud-free air. The second racetrack was shifted along the flight path due to information of Polar5 who reported the best location for the cloud measurements. At the originally planned position no clouds were present.

Overview:

Flight strategy: Collocated flight with Polar 5. At the beginning of the flight a wing-to-wing comparison of the noseboom measurements. In the second part cloud probing over sea ice and over open water. Two positions for racetrack pattern at different height levels were selected. Polar 5 flies above the main flight track of Polar 6.

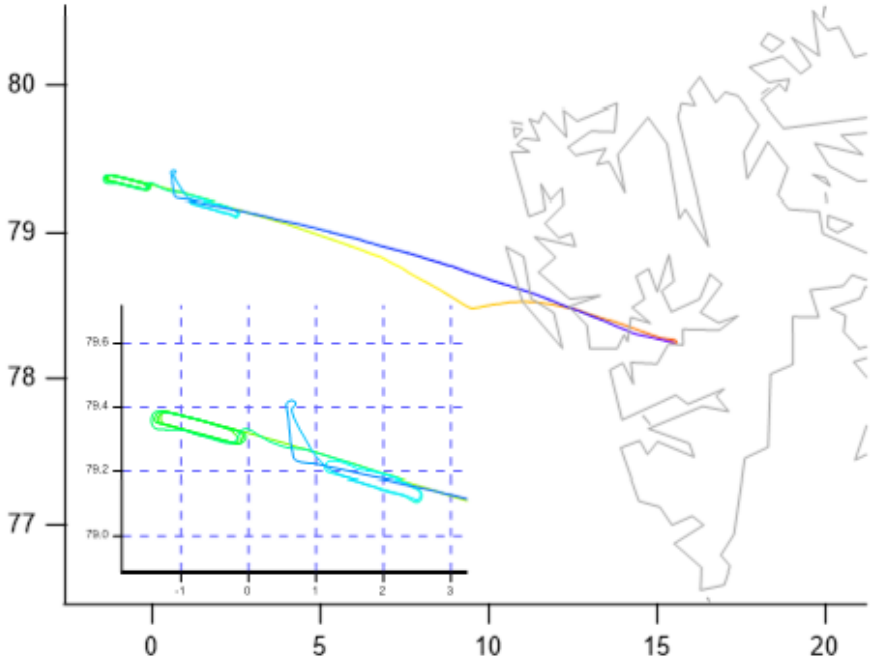
The clouds over sea ice were (again) thinner than forecasted, and also over the open water the clouds were not at the forecasted position. Thus, the second racetrack was shifted to better position based on information of Polar 5.

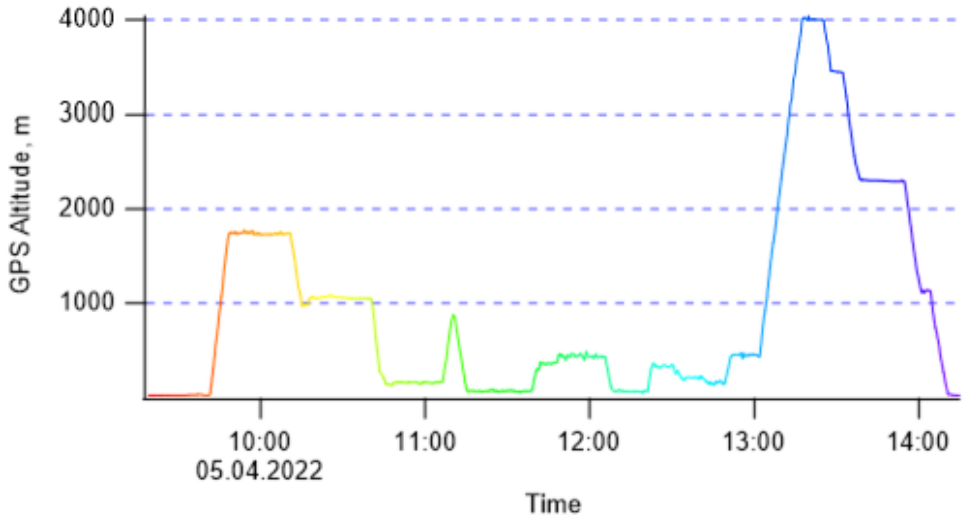
Special/remarkable points:

Special guest on this flight: Alexander Gerst, operating the CVI.

Picture: Alexander Gerst announcing “3…2…1…counterflow activated”

Flight pattern:





Instrument Status:

Polar 6	
Basis data acquisition	
Nose Boom	
CVI	
ALABAMA	
Trace gas	
Aerosol	
HERA	
Polar Nephelometer	
2D-S	
CCP	
PIP	
BCPD	

Table S5.1: Instrument status as reported after the flight for all instruments on Polar 6.

Comments: No problems were reported with any of the instruments.

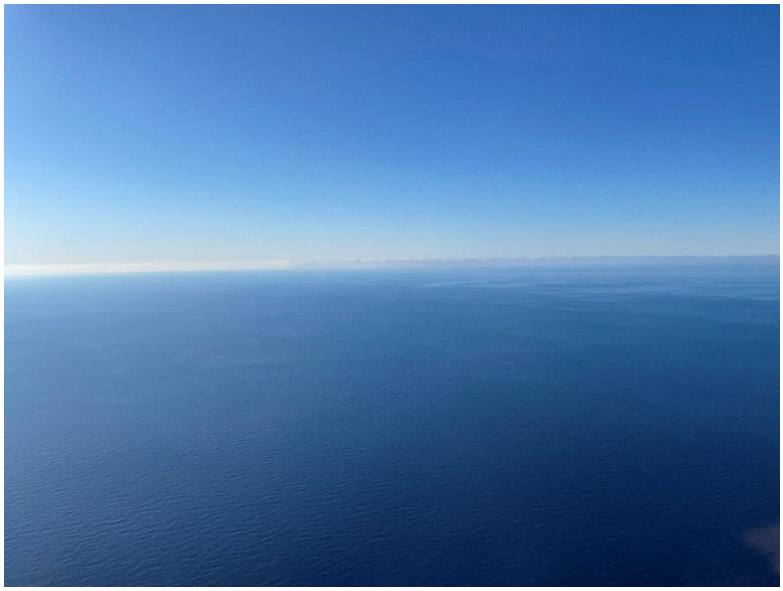
Detailed Flight Logs (Time in UTC):

LYR – W1:

- **09:35** UTC: Start taxi
- **09:41** UTC: Take off shortly after Polar 5
- **09:46** UTC: SP2 laser not on yet
- **10:00** UTC: Wing-to-wing with Polar 5 for noseboom calibration

- **10:15** UTC: cloud top 3300, Counterflow on (short) because short cloud passage, then CF off again because above clouds
- **10:19** UTC: cloud field disappears
- **10:20** UTC: looks like no clouds at W1

- **10:24** UTC: Arrived W1 → blue sky, no clouds at WP1, continue to WP2, stay at 3500 ft until cloud appears
- **10:28** 3500 ft, still no cloud
- **10:33** UTC: In a cloud hole, no clouds on our track, but clouds are observed next to us



- **10:40** UTC: Low-level clouds on the horizon; we start to descent first to 700 ft, ca. cloud top, descent further to 600 ft
- **10:45** UTC: we are hitting our first cloud

- **10:46** UTC: in thin clouds now; @1500ft; we ask the pilots to stay just below cloud top
- **10:49** UTC: Polar 5 right behind us, we are at 400 ft, Counterflow on
- **10:50** UTC: reaching the marginal ice zone

- **10:54** UTC: out of clouds

- **11:06** ascend to 3000 ft
- **11:08** UTC: now @W2;
- **11:10** UTC: from vertical profile: Inversion height @400m
- **11:11** UTC: We now decent to 200ft; no clouds
- **11:16** UTC: @200ft, we now stay here for 25 min for aerosol measurements

- **11:17** UTC: now at W5, go to W2, 200 ft, CO ca. 135 ppb
- **11:19** UTC: no clouds visible outside, but CIP sees pristine ice crystals
- **11:39** UTC: @W2, now climb to 1100ft; do a leg at the inversion height
- **11:41** UTC: climb to 1200 ft (inversion height)
- **11:49** UTC: climb to 1500 ft, above inversion
- **12:06** UTC: on way back, at 200 ft
- **12:09** UTC: open water
- **12:11** UTC: We change waypoints from the racetrack over the ocean as no clouds are reported by Polar 5. (W10: 79°14’05’’N, 001°22’51’’E; W11: 79°11’46’’N, 001°17’58’’E; W12: 79°07’29’’N, 002°24’55’’E; W13: 79°09‘42‘‘N, 002°30‘03‘‘)
- **12:20 UTC:** Counterflow on
- **12:21 UTC:** climb to 1000 ft, cloud top at 900 ft, climb to 1200 ft, CF off

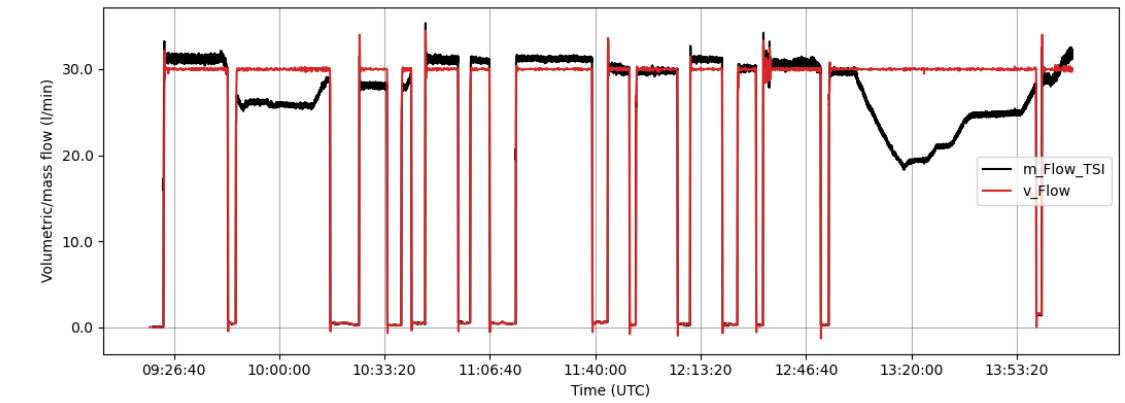
- **12:27** UTC: Leg W12-W11 @1200ft
- **12:31** UTC: Leg W10 – W13 @700ft

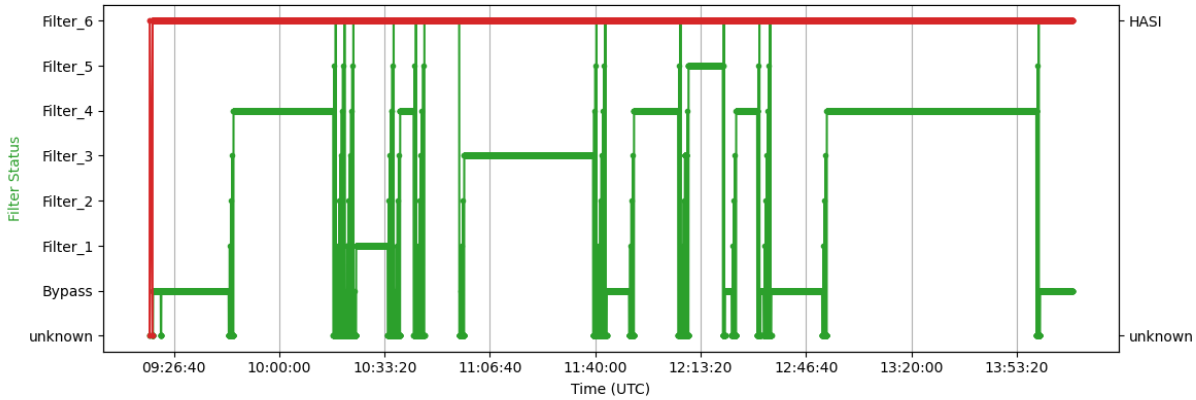
- **12:42** UTC: Leg W12-W11 @500ft
- **12:49** UTC: Finished with leg @500ft
- **12:51** UTC: Noseboom calibration leg @1500ft

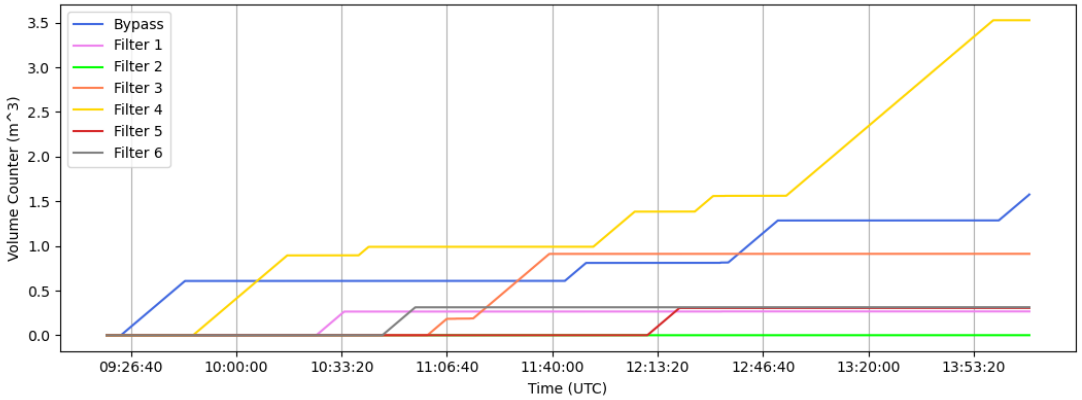
- **12:55** UTC: Procedure turn for Noseboom calibration
- **13:xx** UTC: Climb to 14000 ft (w/o pre—warning -> CO2 calibration during ascent)
- **13:18** UTC: 14000ft, CO & CO2 calibration
- **13:28** UTC: 12000ft, CO & CO2 calibration
- **13:39** UTC: 8000ft, CO & CO2 calibration
- **13:44** UTC: ALABAMA filter at 8000 ft
- **13:50** UTC: done with 8000ft leg; head back to Longyearbyen
- **13:55** UTC: 16 min to landing
- **14:11** UTC: Landing

Quicklooks:

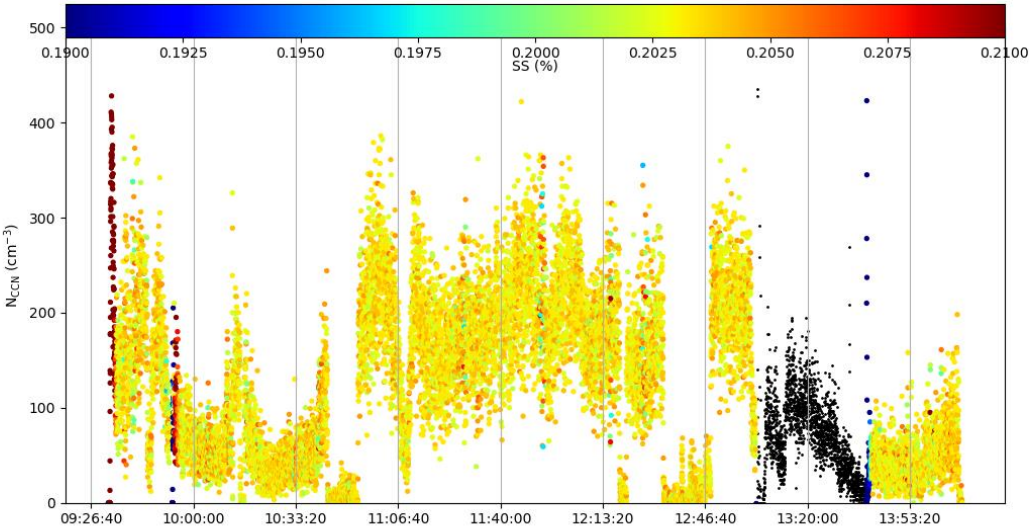
HERA



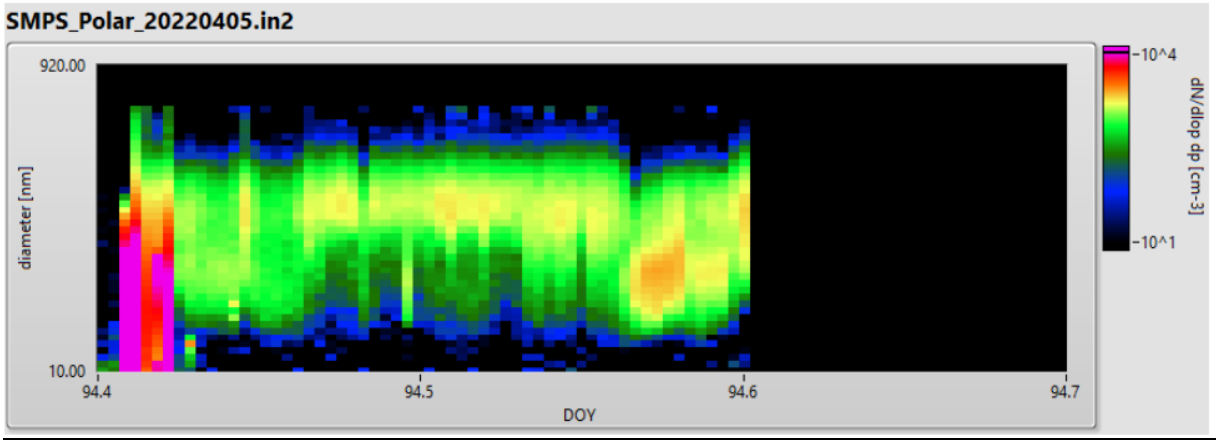


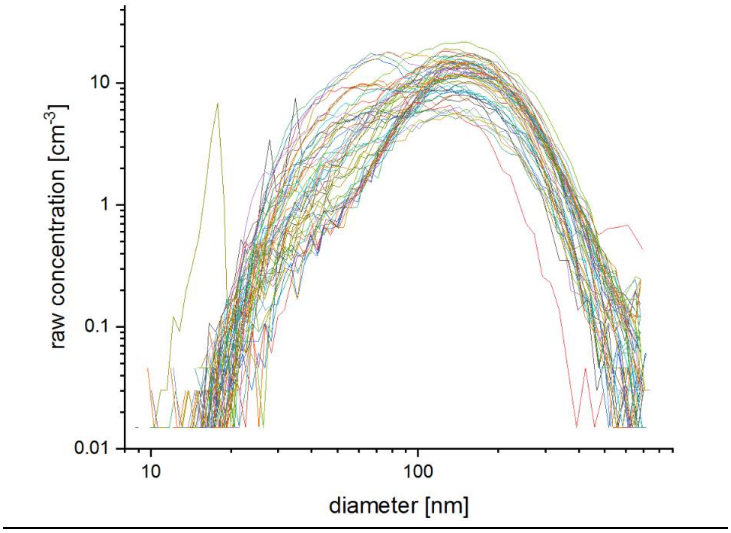


mCCNC

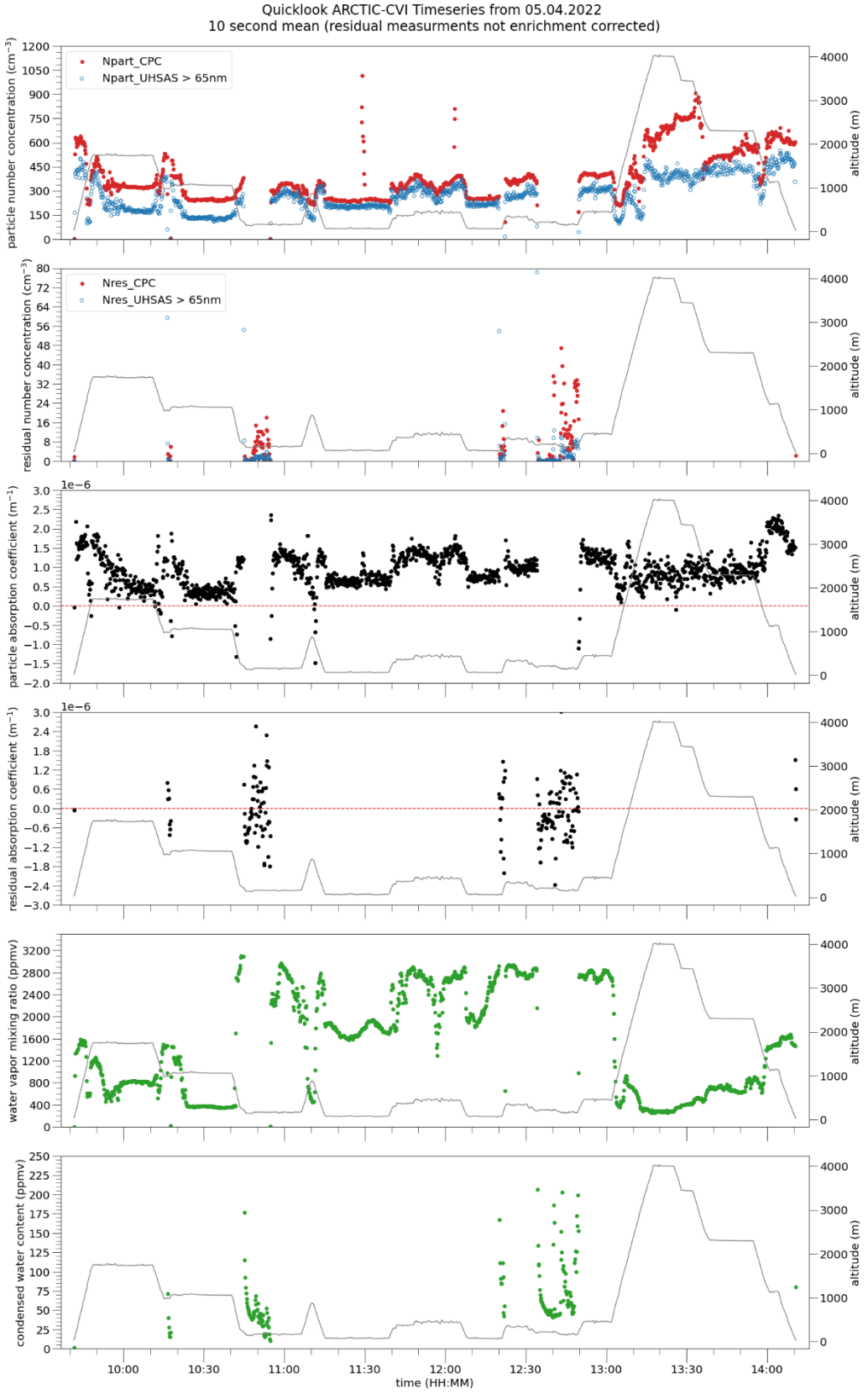

SS (%)
0.1900
0.1925
0.1950
0.1975
0.2000
0.2025
0.2050
0.2075
0.2100
N_{CCN} (cm^{-3})
0
100
200
300
400
500
09:26:40
10:00:00
10:33:20
11:06:40
11:40:00
12:13:20
12:46:40
13:20:00
13:53:20

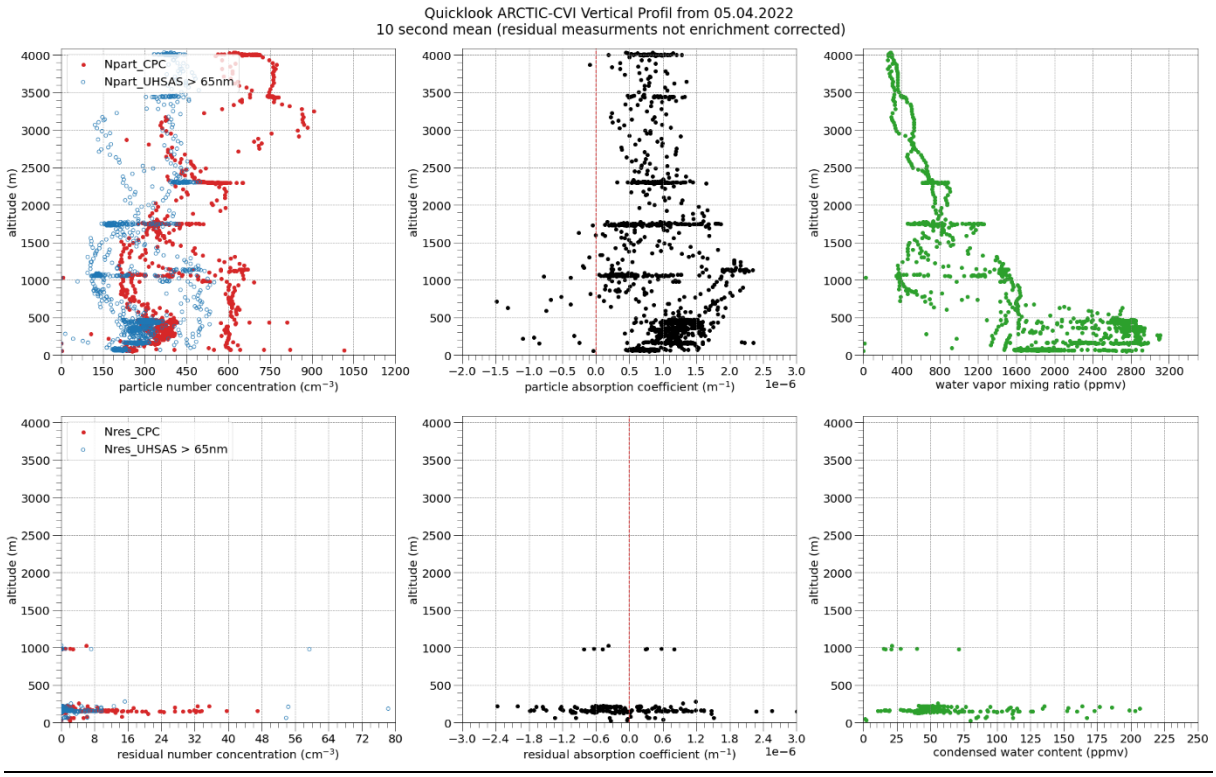
SMPS


SMPS_Polar_20220405.in2
920.00
10.00
diameter [nm]
94.4
94.5
94.6
94.7
DOY
10^4
10^1
dN/dlop dp [cm-3]

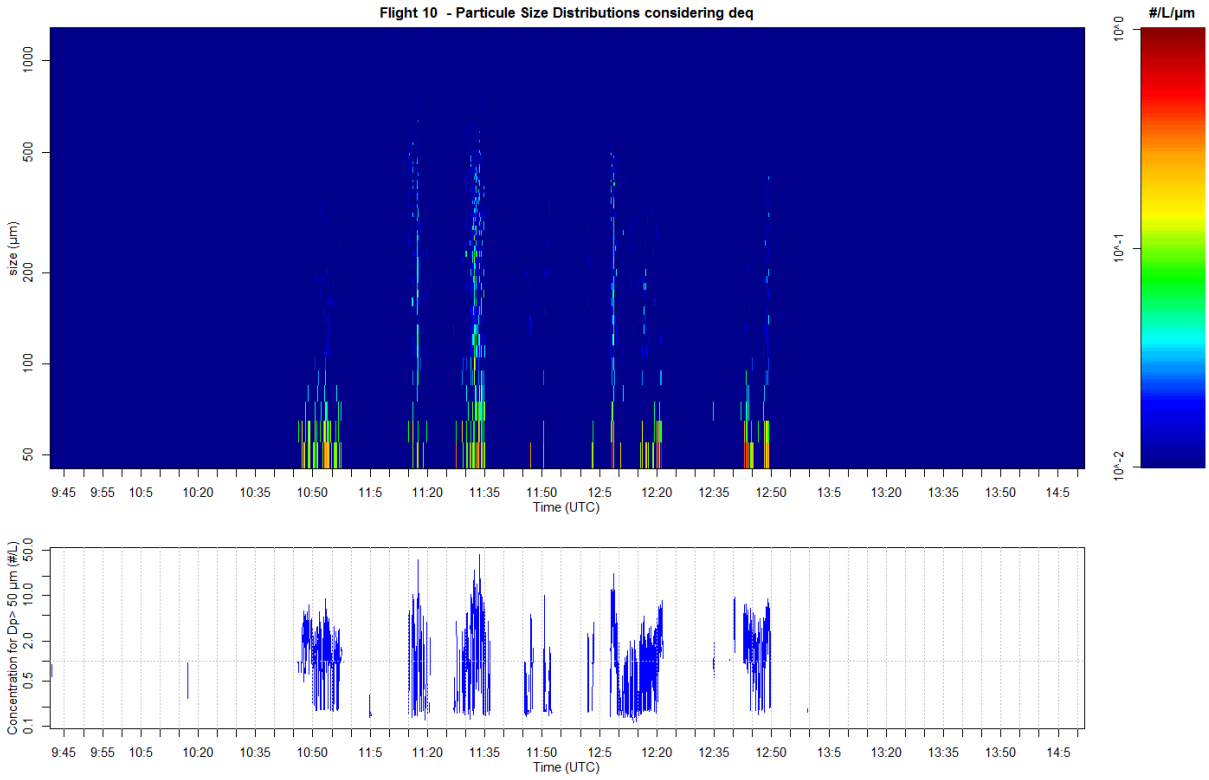

raw concentration [cm-3]
10
1
0.1
0.01
10
100
diameter [nm]

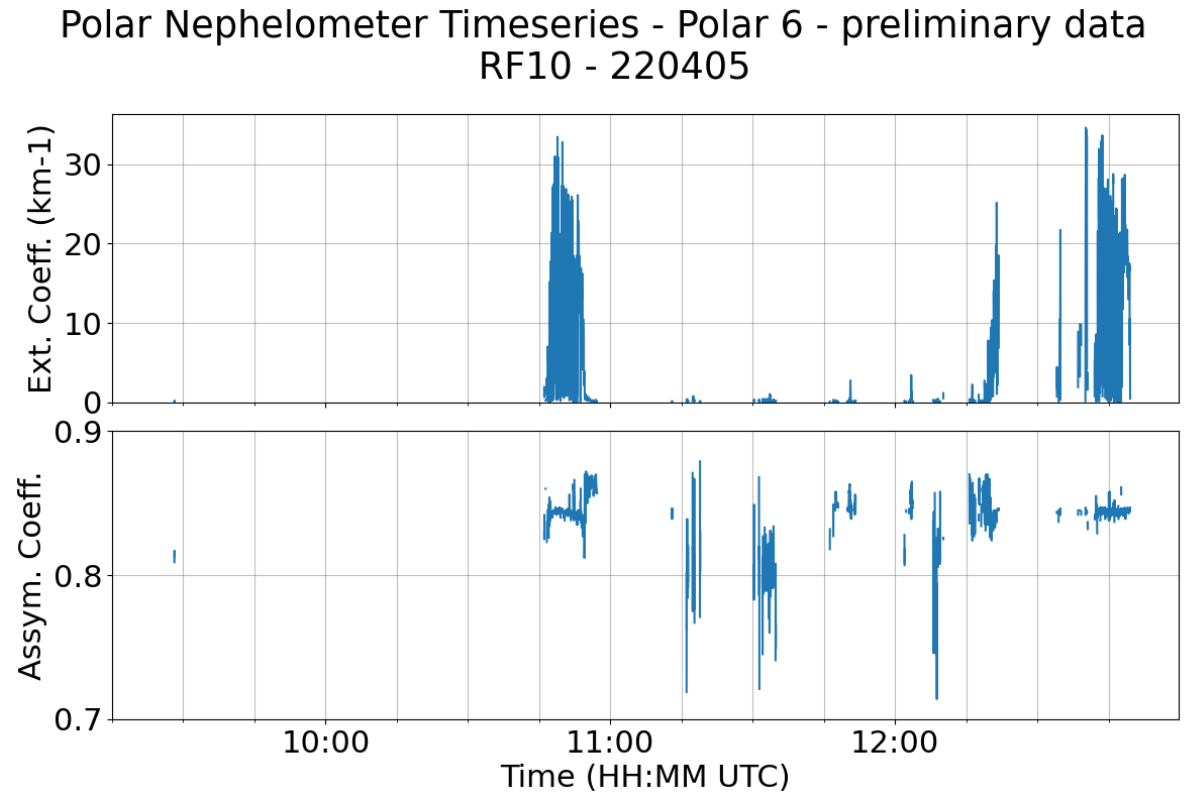
CVI


Quicklook ARCTIC-CVI Timeseries from 05.04.2022
10 second mean (residual measurments not enrichment corrected)
Npart_CPC
Npart_UHSAS > 65nm
particle number concentration (cm⁻³)
Nres_CPC
Nres_UHSAS > 65nm
residual number concentration (cm⁻³)
particle absorption coefficient (m⁻¹)
residual absorption coefficient (m⁻¹)
1e−6
water vapor mixing ratio (ppmv)
condensed water content (ppmv)
altitude (m)
10:00
10:30
11:00
11:30
12:00
12:30
13:00
13:30
14:00
time (HH:MM)

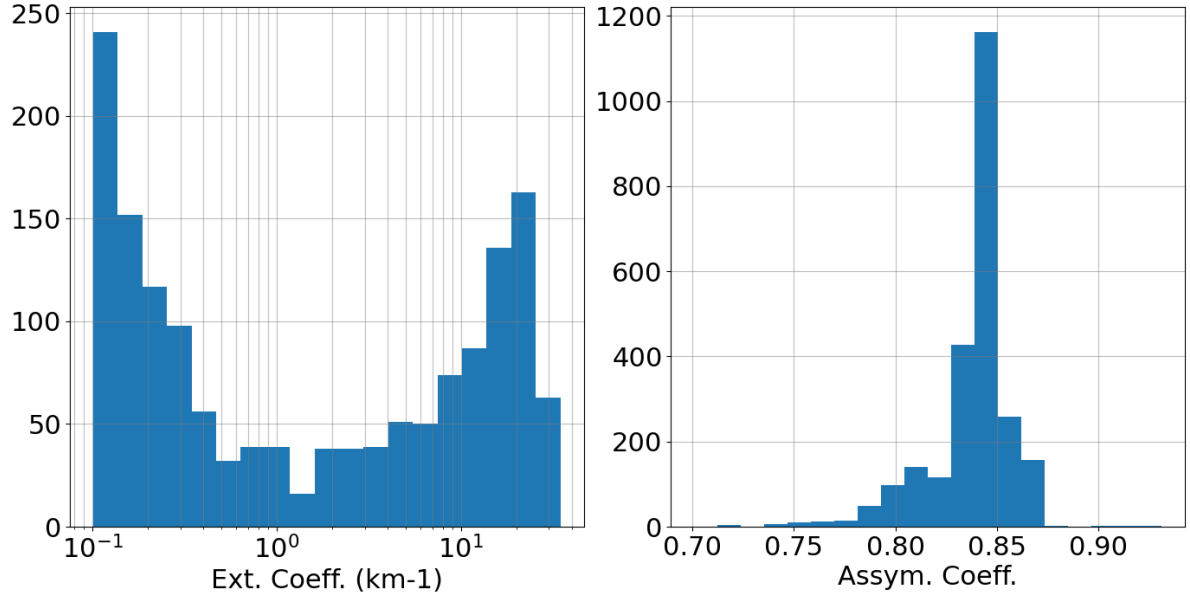

Quicklook ARCTIC-CVI Vertical Profil from 05.04.2022
10 second mean (residual measurments not enrichment corrected)
Npart_CPC
Npart_UHSAS > 65nm
altitude (m)
particle number concentration (cm⁻³)
particle absorption coefficient (m⁻¹)
1e−6
water vapor mixing ratio (ppmv)
Nres_CPC
Nres_UHSAS > 65nm
residual number concentration (cm⁻³)
residual absorption coefficient (m⁻¹)
condensed water content (ppmv)

PMS-LaMP

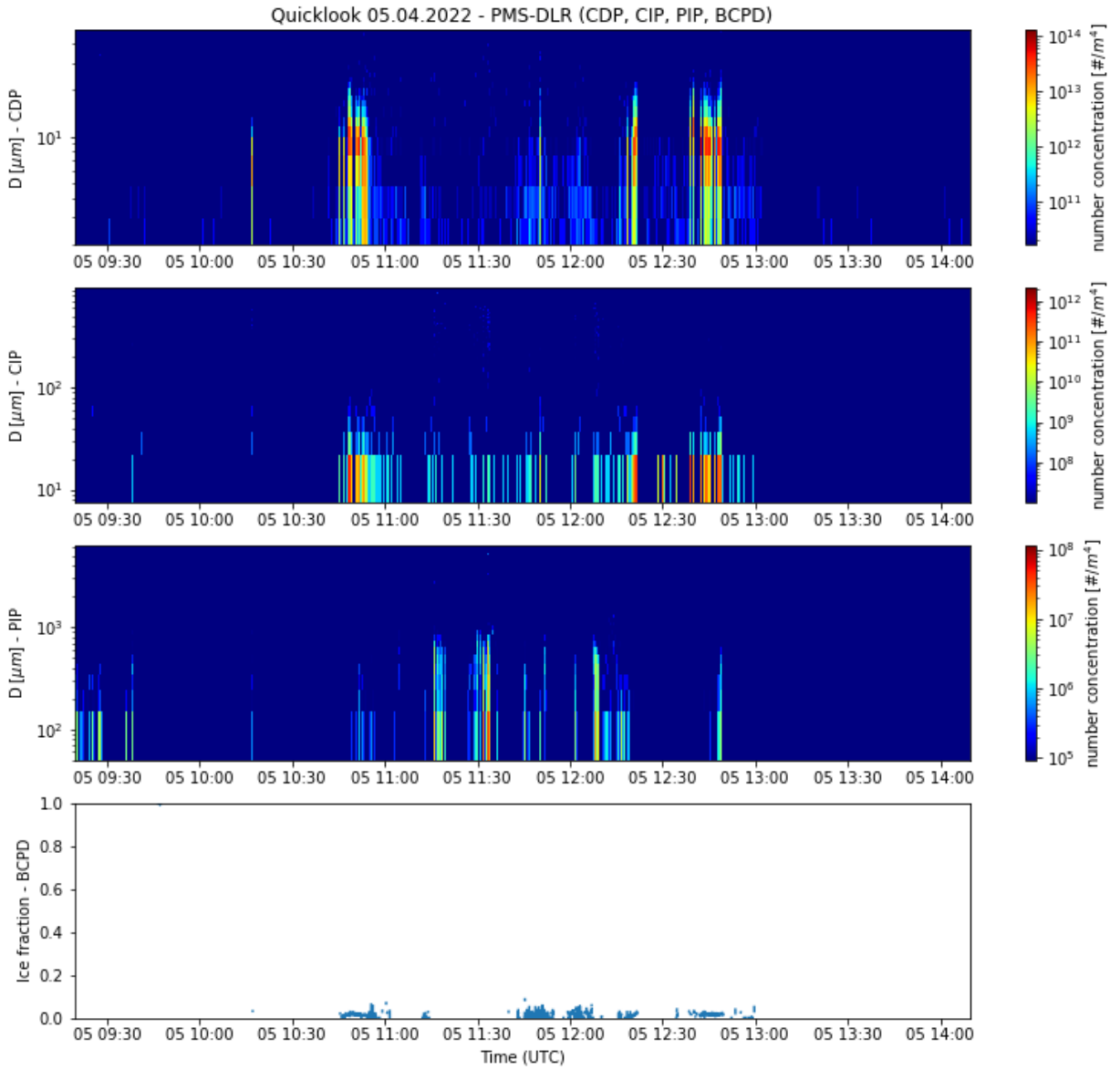

Flight 10 - Particule Size Distributions considering deq
#/L/µm
size (µm)
Time (UTC)
Concentration for Dp> 50 µm (#/L)
Time (UTC)


Polar Nephelometer Timeseries - Polar 6 - preliminary data
RF10 - 220405
Ext. Coeff. (km-1)
Assym. Coeff.
Time (HH:MM UTC)

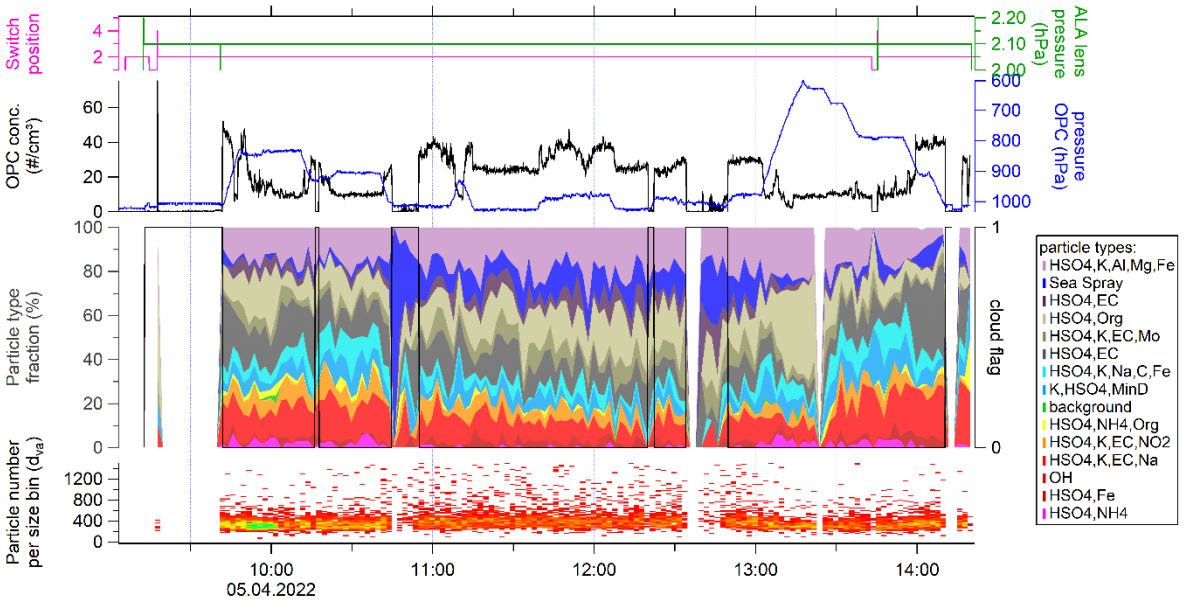
Polar Nephelometer Histogram - Polar 6 - preliminary data
RF10 - 220405

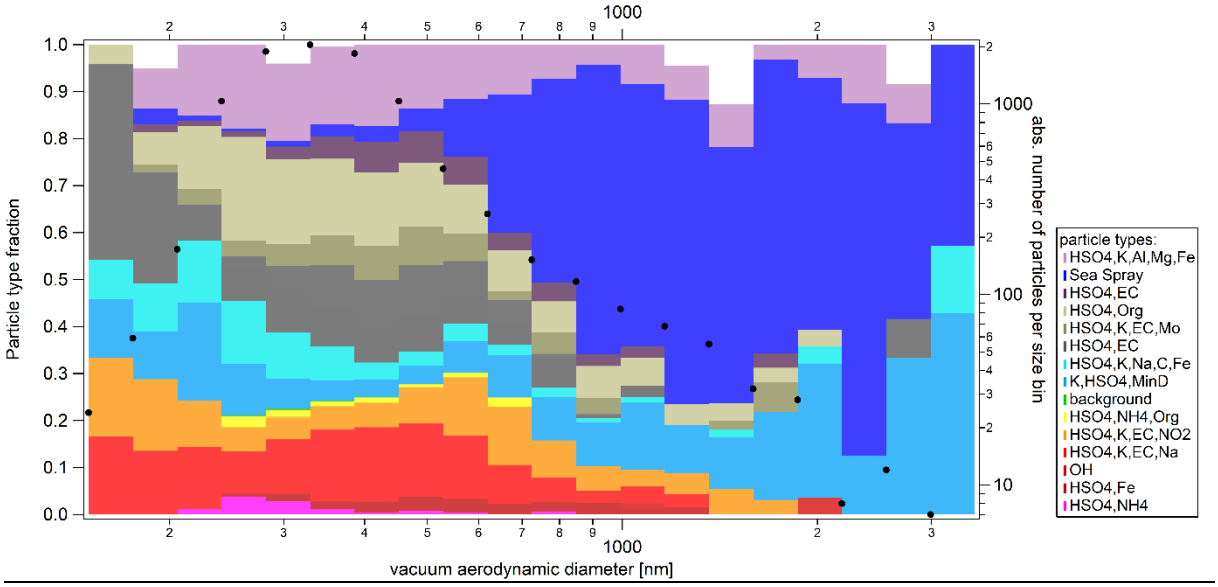


PMS – DLR


Quicklook 05.04.2022 - PMS-DLR (CDP, CIP, PIP, BCPD)
D [µm] - CDP
D [µm] - CIP
D [µm] - PIP
Ice fraction - BCPD
number concentration [#/m⁴]
05 09:30
05 10:00
05 10:30
05 11:00
05 11:30
05 12:00
05 12:30
05 13:00
05 13:30
05 14:00
Time (UTC)

ALABAMA:


Switch position
ALA lens pressure (hPa)
OPC conc. (#/cm³)
OPC pressure (hPa)
Particle type fraction (%)
cloud flag
Particle number per size bin (dva)
particle types:
HSO4,K,Al,Mg,Fe
Sea Spray
HSO4,EC
HSO4,Org
HSO4,K,EC,Mo
HSO4,EC
HSO4,K,Na,C,Fe
K,HSO4,MinD
background
HSO4,NH4,Org
HSO4,K,EC,NO2
HSO4,K,EC,Na
OH
HSO4,Fe
HSO4,NH4
10:00
05.04.2022
11:00
12:00
13:00
14:00


Particle type fraction
abs. number of particles per size bin
vacuum aerodynamic diameter [nm]
particle types:
HSO4,K,Al,Mg,Fe
Sea Spray
HSO4,EC
HSO4,Org
HSO4,K,EC,Mo
HSO4,EC
HSO4,K,Na,C,Fe
K,HSO4,MinD
background
HSO4,NH4,Org
HSO4,K,EC,NO2
HSO4,K,EC,Na
OH
HSO4,Fe
HSO4,NH4