

HALO-(AC)³ – 2022/03/20 – Polar6 research flight RF01

Objectives:

During RF01 with Polar 6 we focused on low level cloud and aerosol in-situ measurements over the open ocean and over the sea ice by performing stair case patterns. Vertical structure of the boundary layer was sampled as a function of the distance to the sea ice edge.

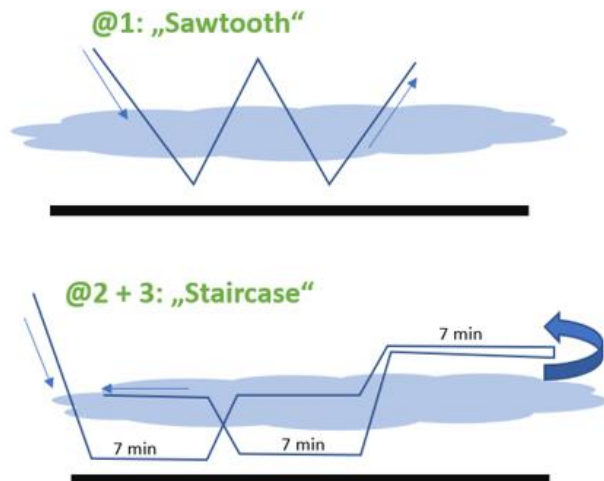
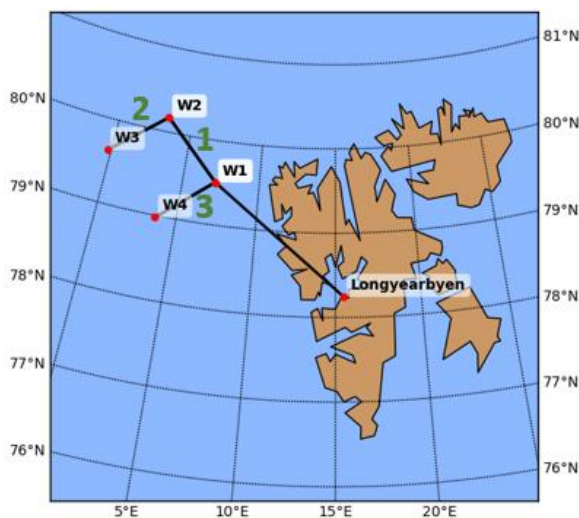
Mission PI P6:

Manuel Moser (manuel.moser@dlr.de)

Polar 6 Crew	
Mission PI	Manuel Moser
Basis Data Acq.	Martin Gehrmann
CVI	Stephan Mertes
ALABAMA/Trace gas	Hans-Christian Clemen
Microphysics	Johannes Lucke
HERA/Aerosol	Sarah Grawe

Flight times:

Polar 6	
Take off	11:19 UTC
Touch down	15:59 UTC

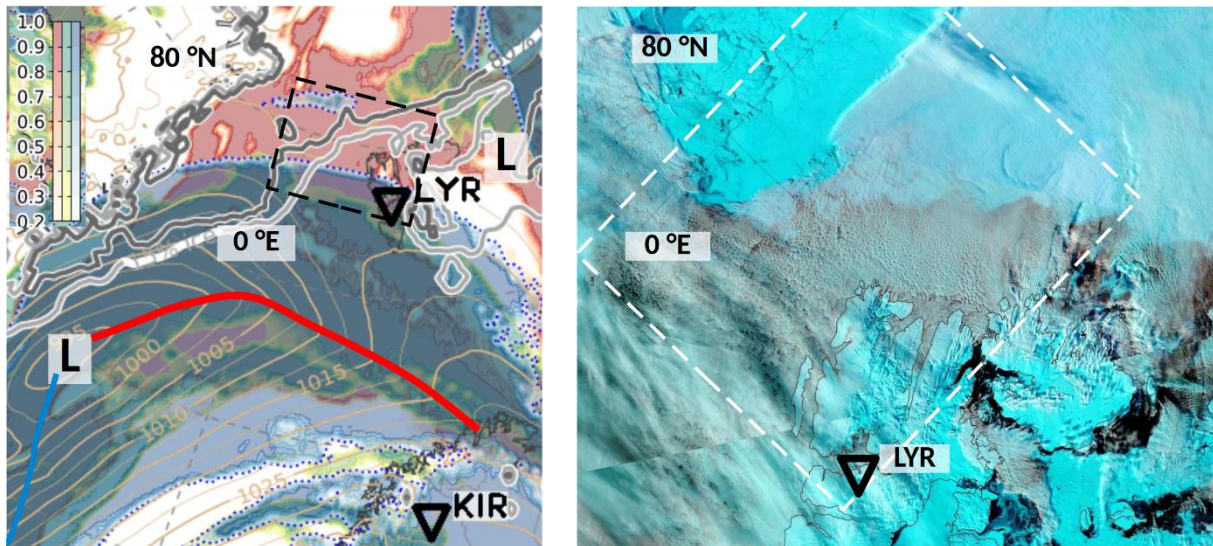


Weather situation:

Weather situation 2022-03-20 (by Janosch Michaelis):

In the morning, a weak northwesterly flow was present in the measurement area due to a small low-pressure system located over the northeastern part of Svalbard, which has also caused some snowfall over the island. The influence by this low weakened during the day and instead a high-pressure system moved towards the measurement area causing calm winds with varying direction.

Over open water, a layer of low-level clouds was present in the entire area. Over sea ice, a cloud free area was present approximately West of 4 °E (more pronounced than in the ECMWF forecast). Towards the afternoon, high-level clouds more and more penetrated into the area from the South. This was connected to a strong low-pressure system over the southern Greenland Sea, which had then further intensified and reached Svalbard in the late evening.



Left: Total cloud cover from ECMWF for 2022-03-20, 12 UTC (forecast from 2022-03-20, 00 UTC) with high-level (blue), mid-level (green), and low-level clouds (red). Right: Satellite picture (Terra MODIS, corrected reflectance) for Sunday around noon. Retrieved from: <https://worldview.earthdata.nasa.gov/>

Cloud situation observed during the flight:

On the way to the measurement area, a dense low level cloud layer was observed from above. While proceeding more to the north, thin cirrus clouds formed on the western part next to our flight track. Over the ocean, cloud top of the low level cloud structure was observed at 1000m and cloud bottom at 300m. While moving closer to the sea ice edge, cloud top was decreasing down to 500m. 13NM before reaching northern most waypoint W2 the low level cloud structure dissolved completely. Some small thin low level clouds were observed west of waypoint W3 but have not been sampled.

Overview:

This science flight with Polar 6 was focusing on in-situ measurements of aerosols and cloud particle measurements. Mein goal was to sample the low level cloud structure over the sea ice and the open ocean. In the transition zone from the open ocean to the sea ice the focus was on vertical profiles of the boundary layer.

The research flight has been performed as planned, starting with sawtooth pattern @1 followed by staircase pattern @2. Each leg at constant altitude was chosen to be long enough for receiving good aerosol measurements. Upper leg at the end was performed two times

above the boundary layer in opposite direction for noseboom calibration. @3 leg to direction W4 was performed as planned with one leg below the cloud, one inside the cloud and one above. On the way back to W1 aerosol measurements were finished earlier than planned, so we added additional legs inside the clouds for cloud in-situ measurements, including one short leg at the very top inside the cloud. While heading back to Longyearbyen, a 5min leg at 12000ft was conducted for trace gas measurements. During landing icing appeared.

Instrument Status:

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

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

Comments: for ALABAMA there was not enough time to get prepared; Bad connection for the Polar nephelometer to data acquisition system. Both instruments did not record data for this flight.

Detailed Flight Logs (Time in UTC):

LYR – W1:

- **11:38** UTC: 25 min to W1; before W1 we want to descent at 1000ft/m to 2300ft cloud top expected at 2300ft
- **11:51** UTC: thick cloud layer on the way to W1, clear sky above, some cirrus in the west visible



- **11:57 UTC:** start descent at 1000ft/min to cloud top
- **12:00 UTC:** Cloud top seems to be higher than expected
- **12:02 UTC:** slowing down to 120kn

W1 – W2: Sawtooth

- **12:05 UTC:** start sawtooth at a rate of 600ft/min
- **12:06 UTC:** hitting cloud from the top 3000ft; cloud bottom at 1000ft; going below cloud
- **12:11 UTC:** while ascend, cloud bottom at 1500ft
- **12:14 UTC:** (descend) 2200ft cloud top; boundary layer at 1400 ft wide ocean (looks like we are flying parallel to sea ice edge)
- **12:16 UTC:** (descend) cloud bottom at 900 ft



- **12:20 UTC:** (ascend) 1200ft cloud base (First sawtooth was over the ocean, second over the MIZ and open ocean was visible parallel to our flight track)
- **12:22 UTC:** (descent) cloud top at 1700
- **12:23 UTC:** (descent) cloud bottom 900ft
- **12:34 UTC:** (ascent) cloud bottom 1000ft
- **12:25 UTC:** (ascent) cloud top 1600ft
- **12:26 UTC:** (descent) cloud top 1600 ft; thin cloud
- **12:28 UTC:** (ascent) now more sea ice; cloud slowly dissolves; cloud bottom 1000ft
- **12:29 UTC:** (ascend) reaching cloud top; 13NM before W2 cloud disappears completely
- **12:31 UTC:** go to W2

W2 – W3: Staircase back and forth

- **12:38 UTC:** 200ft leg; broken sea ice, in between ocean is frozen; no open water; no water vapor escapes from the ground; clear sky
- **12:54 UTC:** 15min leg for aerosol measurements; no clouds; ascent to get out of boundary layer



- **13:00** UTC: at w3 small overshoot; calibration leg for noseboom
- **13:04** UTC: some clouds behind W3 - doing procedure turn above clouds (no time to get in-situ cloud data)
- **13:14** UTC: descent to 1800ft for another aerosol leg (no clouds); we are in the upper edge of the boundary layer
- **13:26** UTC: descent to leg 800ft – aerosol measurements, no clouds

W2 – W1: Sawtooth

- **13:41** UTC: start sawtooth; descent to 200ft
- **13:42** UTC: ascent at 1000ft/min (fast rate as there are no clouds)
- **13:44** UTC: now descent rate 600ft/min in clouds (hitting cloud top)
- **13:45** UTC: (ascent) cloud top 1600ft
- **13:48** UTC: (descend) cloud bottom 1200ft
- **13:51** UTC: (ascent) cloud top 2000ft
- **13:54** UTC: (descent) cloud bottom 1100ft
- **13:56** UTC: (ascent) cloud top 2300ft





- **14:01** UTC: (descent) cloud top 1900ft; open ocean now; looks like sea ice edge
- **14:03** UTC: (ascent) 1200ft cloud bottom; cloud top @3000ft; cloud bottom 1400ft
- **14:08** UTC: reaching W1 and descent to 200ft

W1 – W4: Staircase back and forth

- **14:12** UTC: Beginning of 200ft leg; below cloud; over the ocean; no floes/sea ice visible; very calm ocean



- **14:19** UTC: ascent to leg @ 2100 ft (inside cloud)
- **14:25** UTC: ascent to leg @ 3600ft (above cloud)
- **14:30** UTC: at W4 cirrus above us; procedure turn



- **14:42** UTC: descent to 200ft at 1000ft/min; clouds top at 2700ft; bottom 1400ft

- **14:55** UTC: go to 2100ft start cloud leg - some icing
- **14:58** UTC: change altitude because cloud base is rising 2400ft and aerosol measurements are done
- **15:02** UTC: short cloud top measurement for Nevzorov some icing possible to hear on props

W1 - LYR

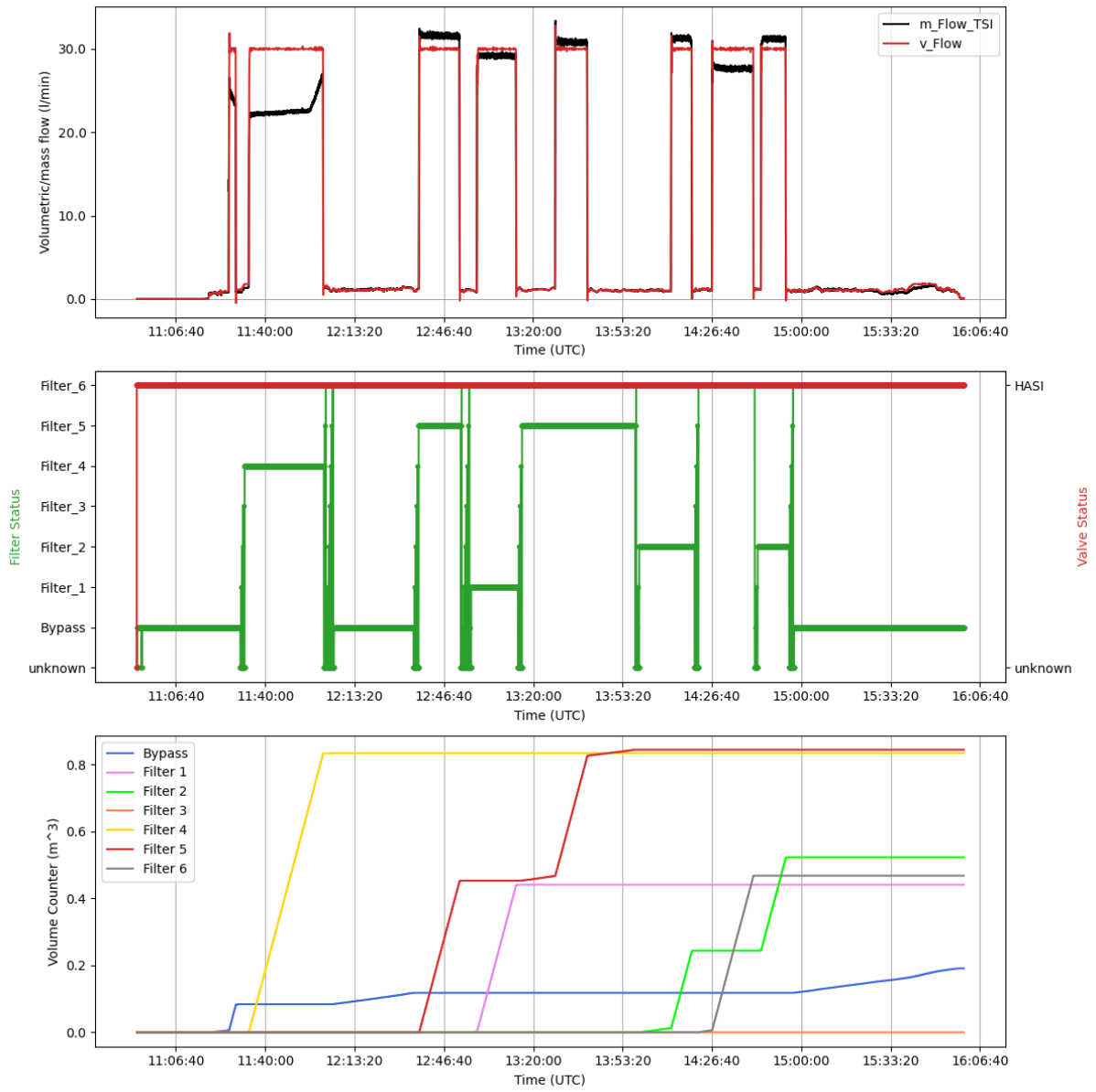
- **15:20** UTC: climb to 12000ft



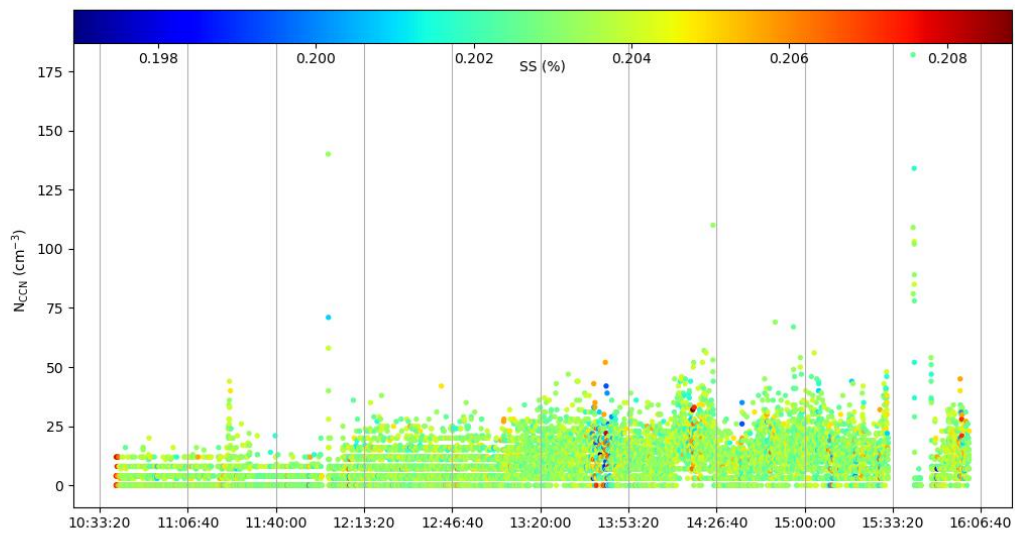
- **15:36** UTC: now at leg 12000ft for trace gas measurements
 - **15:39** UTC: done with science! :) head back to LYR
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Quicklooks:

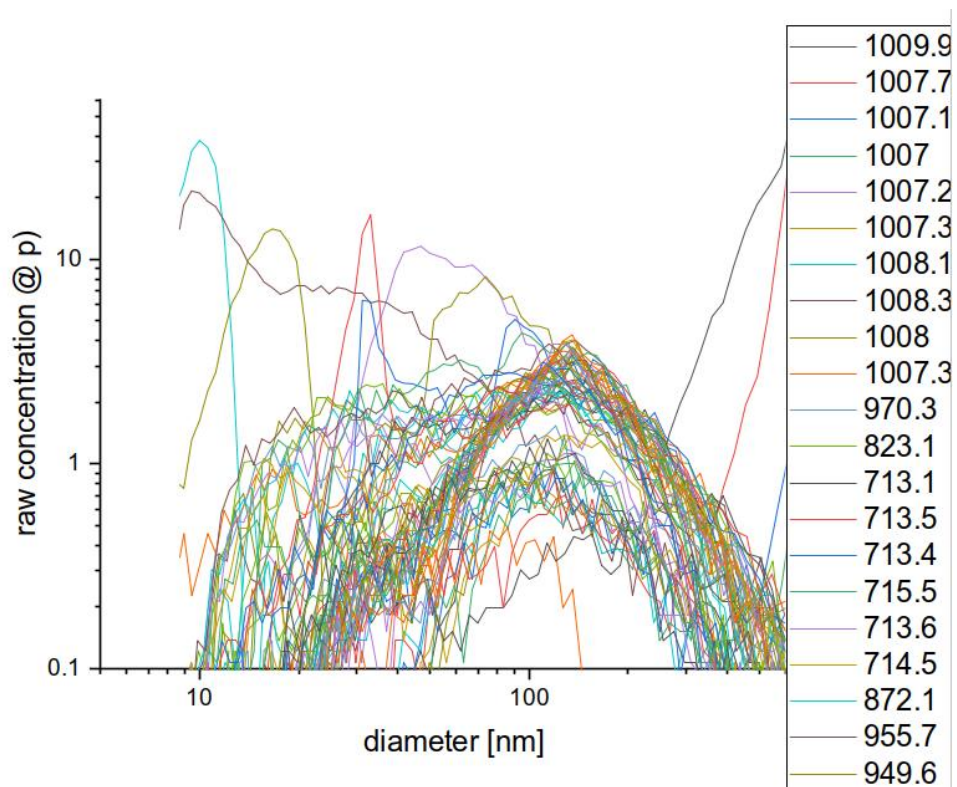
HERA



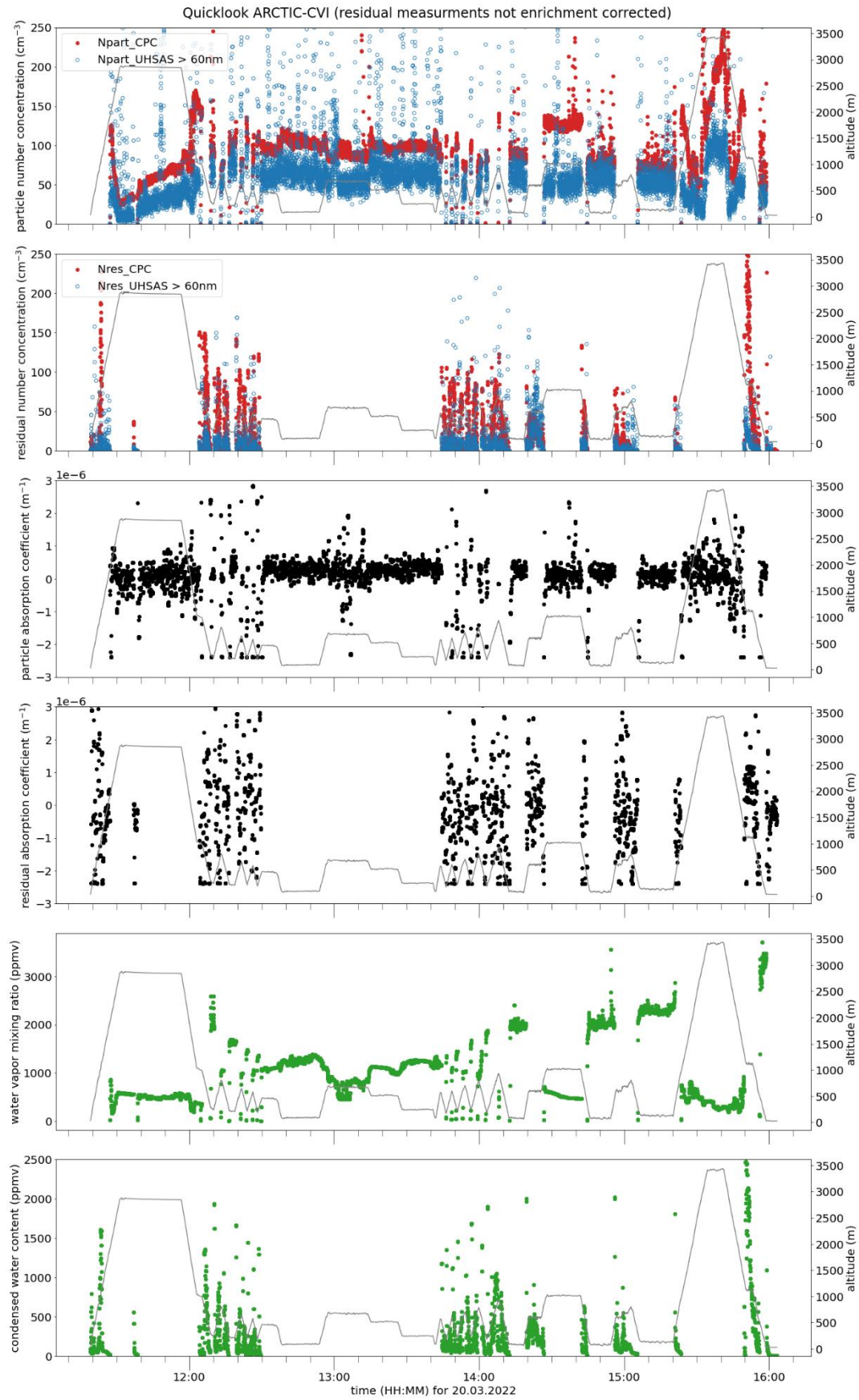
mCCNC



SMPS



CVI



DLR

