

HALO-(AC)³ – 2022/04/10 – Polar6 research flight RF13

Objectives:

During RF13 with Polar 6 we focused on low level cloud and aerosol in-situ measurements over the sea ice and over the open ocean by performing stair case patterns. Vertical structure of the boundary layer was sampled as a function of the distance to the sea ice edge. The main track was collocated with Polar 5. Cloud situation was partly influenced by line convection.

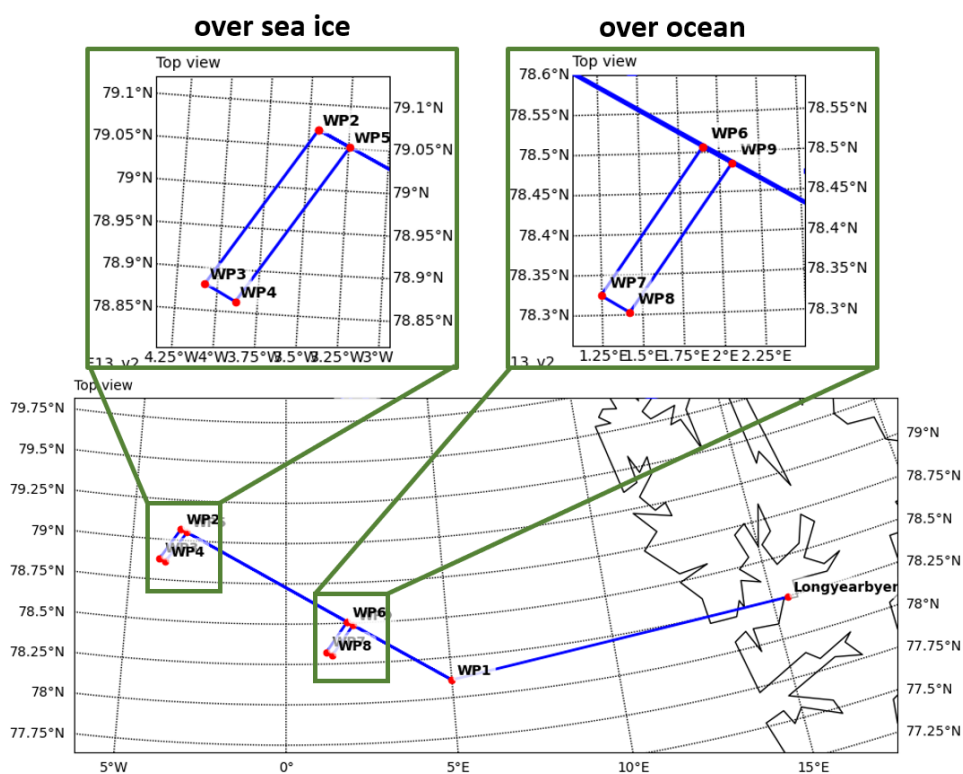
Mission PI P6:

Manuel Moser (manuel.moser@dlr.de)

Polar 6 Crew	
Mission PI	Manuel Moser
Basis Data Acq.	Dennis Ludwig
CVI	Stephan Mertes
ALABAMA/Trace gas	Philipp Joppe
Microphysics	Johanna Mayer
HERA/Aerosol	Jonas Schäfer

Flight times:

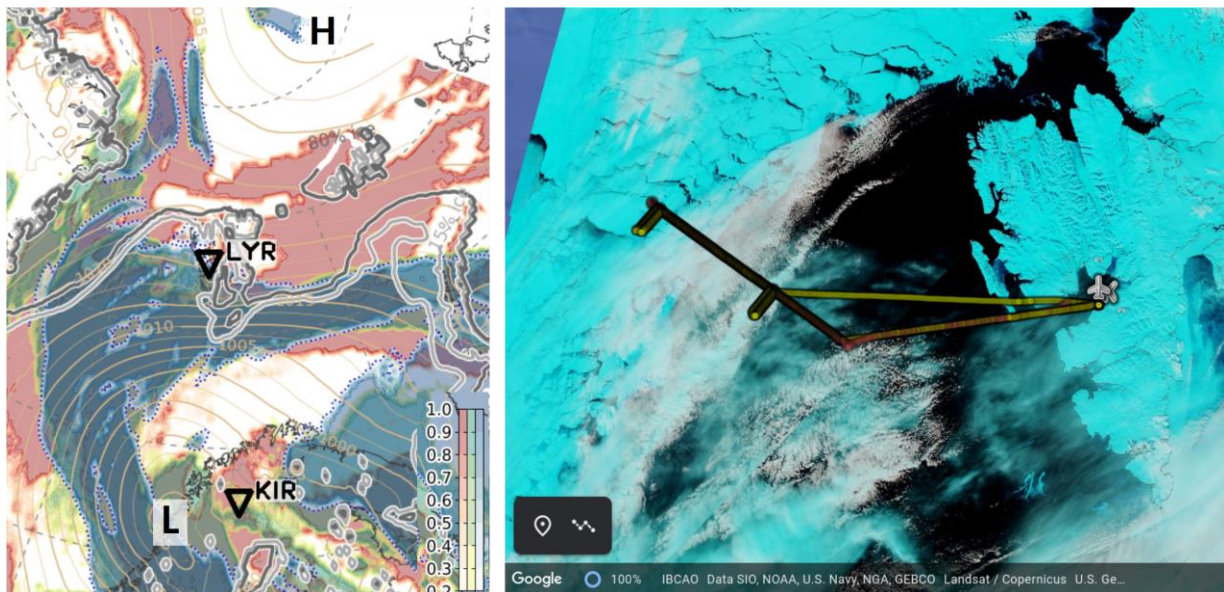
Polar 6	
Take off	09:09 UTC
Touch down	14:07 UTC



Weather situation:

Weather situation 2022-04-10 (by Janosch Michaelis):

As in the days before, the large-scale weather pattern was characterized by a high pressure system over the central Arctic Ocean and a low pressure system over Northern Scandinavia. This caused easterly to northeasterly winds over Svalbard and in the Fram Strait region west of the island. In the measurement area, low-level clouds are visible from the satellite picture over both open water and sea ice. In the afternoon, higher-level clouds approached from the south. These were connected with a frontal system of the above-mentioned low pressure system, and the upper-level flow from the South forced these clouds to move over Fram Strait towards the Arctic Ocean.



Left: Total cloud cover from ECMWF for 2022-04-10, 12 UTC (forecast from 2022-04-09, 00UTC) with high-level (blue), mid-level (green), and low-level clouds (red), as well as the sea level pressure (yellow isolines). Right: Extract from Google Earth with a satellite picture (Terra MODIS, Corrected Reflectance [Bands 7-2-1], from <https://wvs.earthdata.nasa.gov/>) for Sunday around noon and with the flight tracks of Polar 5 (red) and Polar 6 (yellow). White clouds denote low-level clouds, whereas blueish colours refer to more upper-level clouds.

Cloud situation observed during the flight (reported from Polar 6):

During the racetrack pattern over the sea ice only very thin clouds were observed in low altitude. Cloud particles were measured between 200 – 600ft. More cloud particles were observed in the northern part of the racetrack. On the way to the racetrack pattern over the ocean, stratiform mixed-phase clouds were found, getting thicker the less the ocean is covered with sea ice. At the position of the second racetrack pattern two different cloud structures were touching. The north-western part was dominated by stratiform mixed-phase clouds, the south-eastern part by a line convection resulting from a convergence line. Our racetrack pattern was parallel to this overlap cloud region.

Overview:

This science flight with Polar 6 was focusing on in-situ measurements of aerosols and cloud particle measurements. Main 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 collocated cloud measurements with Polar 5 above our flight track. Over the sea ice we have performed a racetrack pattern with two legs inside the boundary layer (200ft and 400ft), one leg at the temperature inversion (600ft) and two legs above the boundary layer height (800ft and 1600ft). Highest leg has been flown twice for the noseboom calibration. On our way to the racetrack pattern over the ocean, several sawteeth were flown. Over the ocean flightlegs inside precipitation, clouds and above clouds were performed at altitudes 200ft, 1000ft, 2000ft, 3000ft and 4000ft. On our way back trace gas measurements at FL140, FL120, FL100 and FL80 were conducted.

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: The INS did not work during this research flight.

Detailed Flight Logs (Time in UTC):

Note: Take off shortly before Polar 5 to be collocated between W1 – W2

LYR – W1:

- **09:09:44** UTC: Take Off
- **09:34** UTC: Broken low-level clouds below us, some thin cirrus on top



- **09:37** UTC: These clouds are only observed on the left side of our track, on the right no low-level clouds
- **09:48** UTC: Haze layer just slightly higher than us, seen in distance
- **09:50** UTC: Descending to be @4000ft @W1



W1 – W2: here Polar 5 flying above Polar 6

- **09:59** UTC: @W1 clouds just below us
- **10:01** UTC: Now @3200ft in cloud top: clouds are very thin



- **10:03** UTC: Thickness of cloud, approx. 100-200ft
- **10:09** UTC: Clouds still very thin
- **10:15** UTC: From P5: cloud bottom at 500m; cloud top at 1000m
- **10:20** UTC: Overflying @W6: cloud base at 3000ft cloud top at 4600ft
- **10:23** UTC: Clouds disappear at 3000ft, now we go down to lower cloud layer
- **10:28** UTC: Too much icing, we leave the cloud



- **10:39** UTC: Over the sea ice now; thick clouds disappear, now we can go again into the thin clouds
- **10:40** UTC: Very thin cloud @1700



- **10:49 UTC:** Now at 200ft

Racetrack over the sea ice: (W2, W3, W4, W5)

- **10:52 UTC:** Start with 200ft leg
- **11:04 UTC:** Leg at 400ft
- **11:08 UTC:** Now at 600ft, clouds are only in the northern part of the racetrack pattern; we are right in the inversion height
- **11:22 UTC:** Nearly finished with leg at 800ft
- **11:25 UTC:** A second inversion is observed @400m



- **11:42 UTC:** End of racetrack pattern + noseboom calibration leg at 1600ft

W5 – W6: Sawtooth pattern

- **11:43 UTC:** Start sawtooth pattern
- **11:51 UTC:** Cloud cover gets thicker and closer to the surface
- **11:59 UTC:** Textbook mixed phase clouds



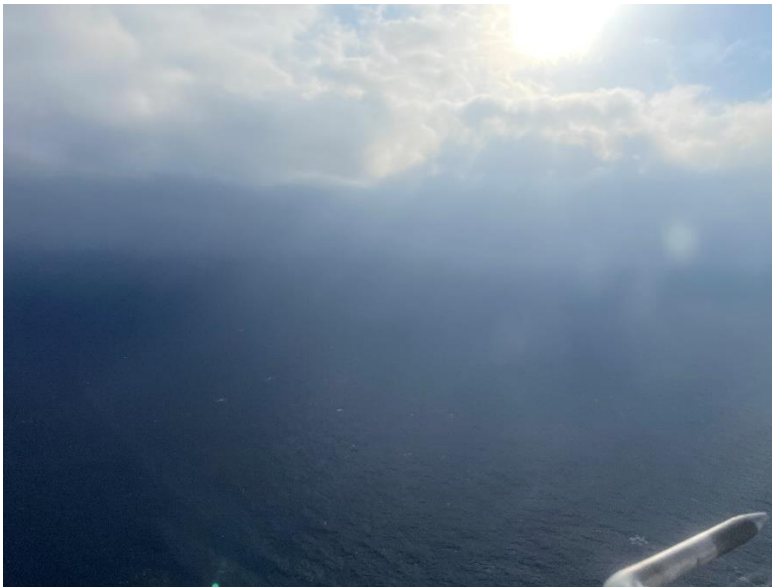
- **12:02** UTC: Cloud bottom: 800ft; cloud top: 2300ft
- **12:03** UTC: Clouds are getting thicker
- **12:07** UTC: Cloud situation reported from Polar 5 at position of W6: Cloud top 720m, bottom 580m
- **12:10** UTC: Cloud top @4600ft
- **12:12** UTC: Stop sawtooth, too much ice
- **12:14** UTC: We found a cloud hole – now we go down to 200ft; Cloud top estimated to 4000ft

Racetrack over the ocean: (W6, W7, W8, W9)

- **12:20** UTC: Leg @200ft – we are now flying parallel to a line convergence: Clouds from a line convection with heavy precipitation on our left side (south-east direction); No cloud base can be estimated due to the precipitation.



- **12:24 UTC:** Now doing a leg at 1000ft flying inside this cloud front; In precipitation
- **12:27 UTC:** Quite bumpy
- **12:37 UTC:** Now leg @2000ft



- **12:48 UTC:** Now leg @3000ft
- **12:50 UTC:** Reached W9; We now go to 4000ft
- **12:52 UTC:** Now at 4000ft - just in the outflows of the clouds (inside cloud)



- **12:55** UTC: Stop the leg at 4000ft - too much icing
- **13:02** UTC: Leg above cloud @6700ft
- **13:06** UTC: Finished with racetrack over the ocean – we now head back to LYR

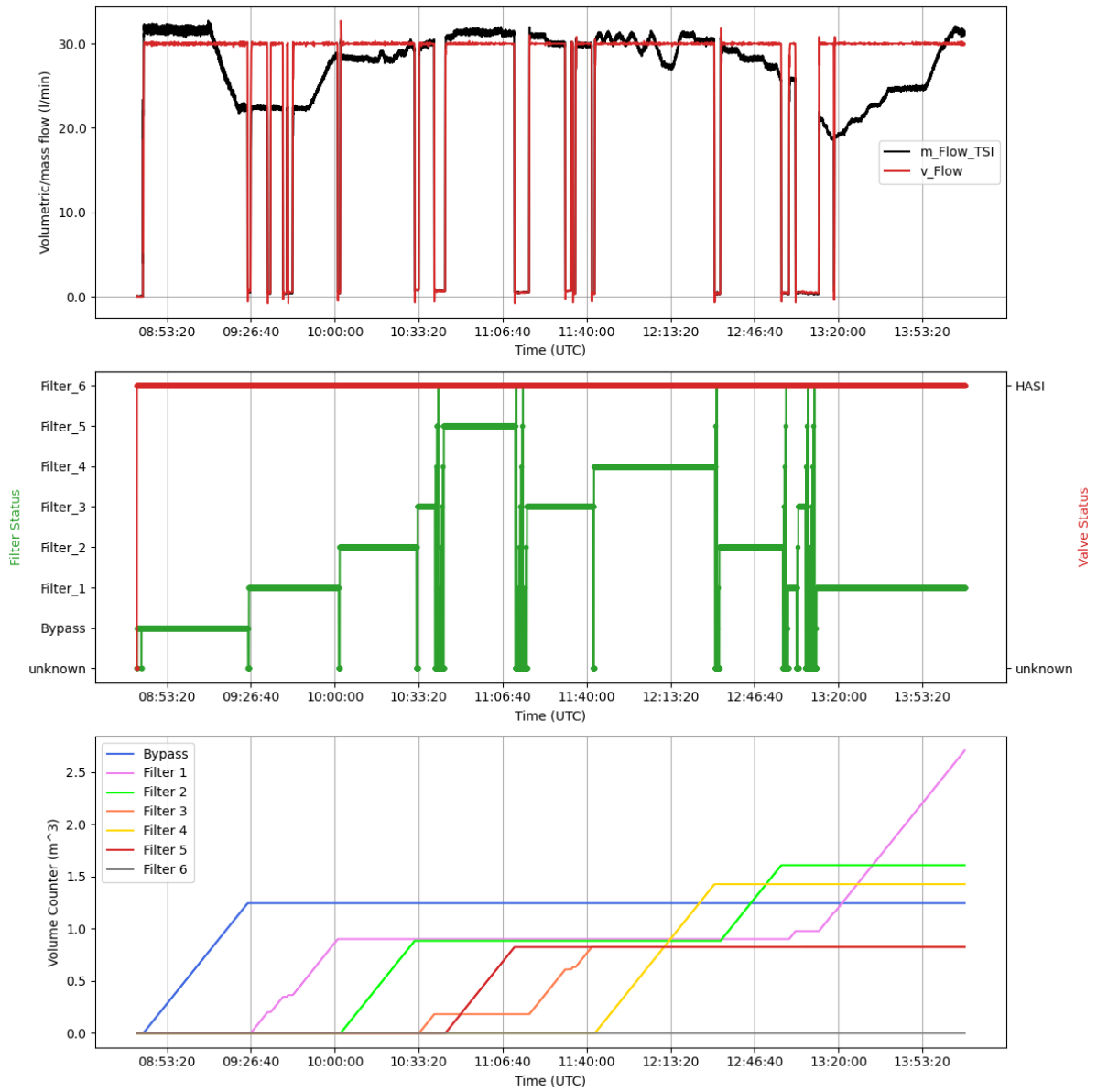
W9 – LYR:

- **13:07** UTC: Climb to 140 000ft
- **Xx:xx** UTC: Did more 5min legs @FL120, FL100, FL80
- **13:38** UTC: Head back to LYR

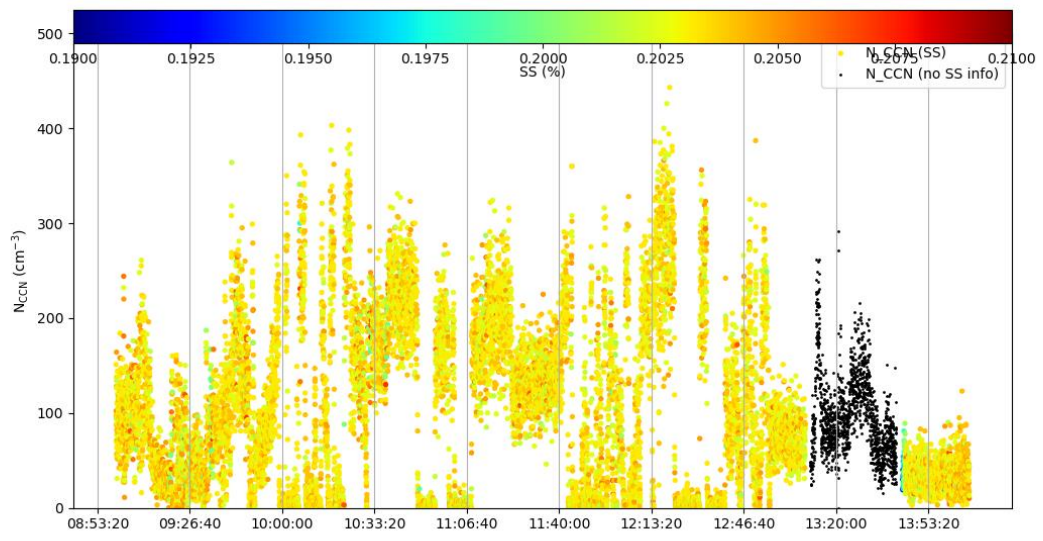


Quicklooks:

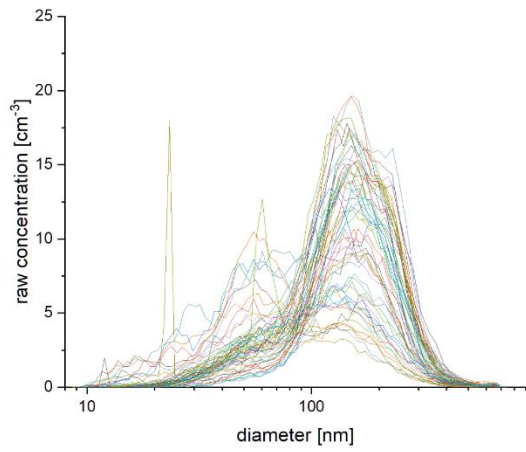
HERA



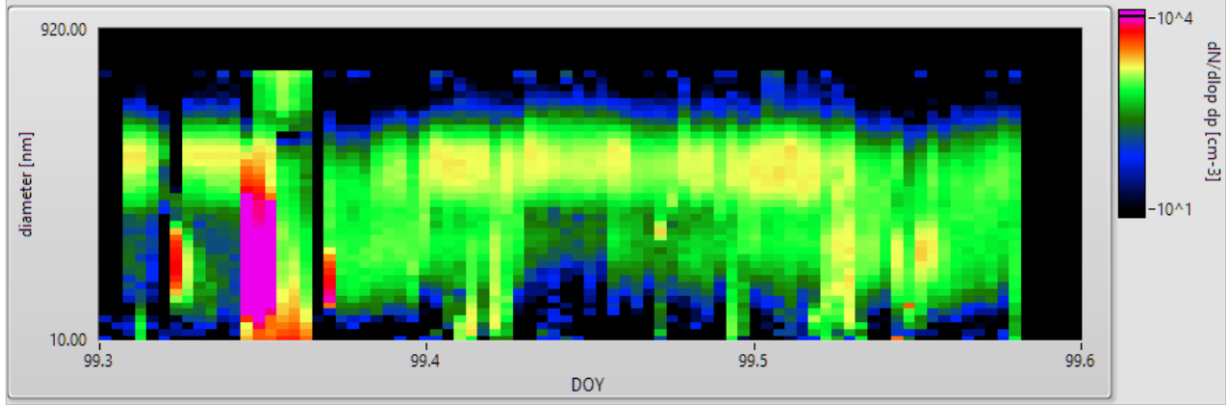
mCCNC



SMPS

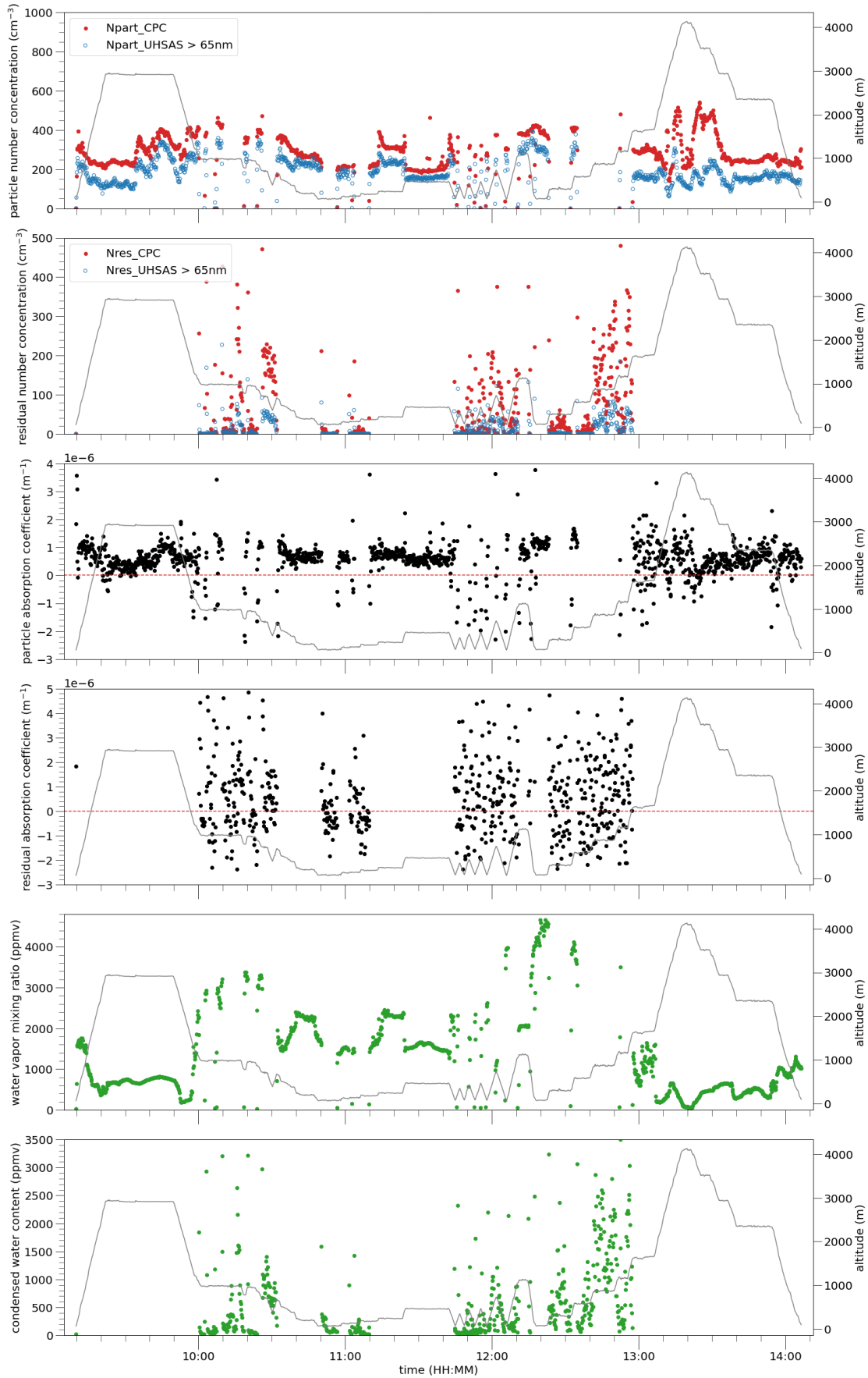


SMPS_Polar_20220410.in2

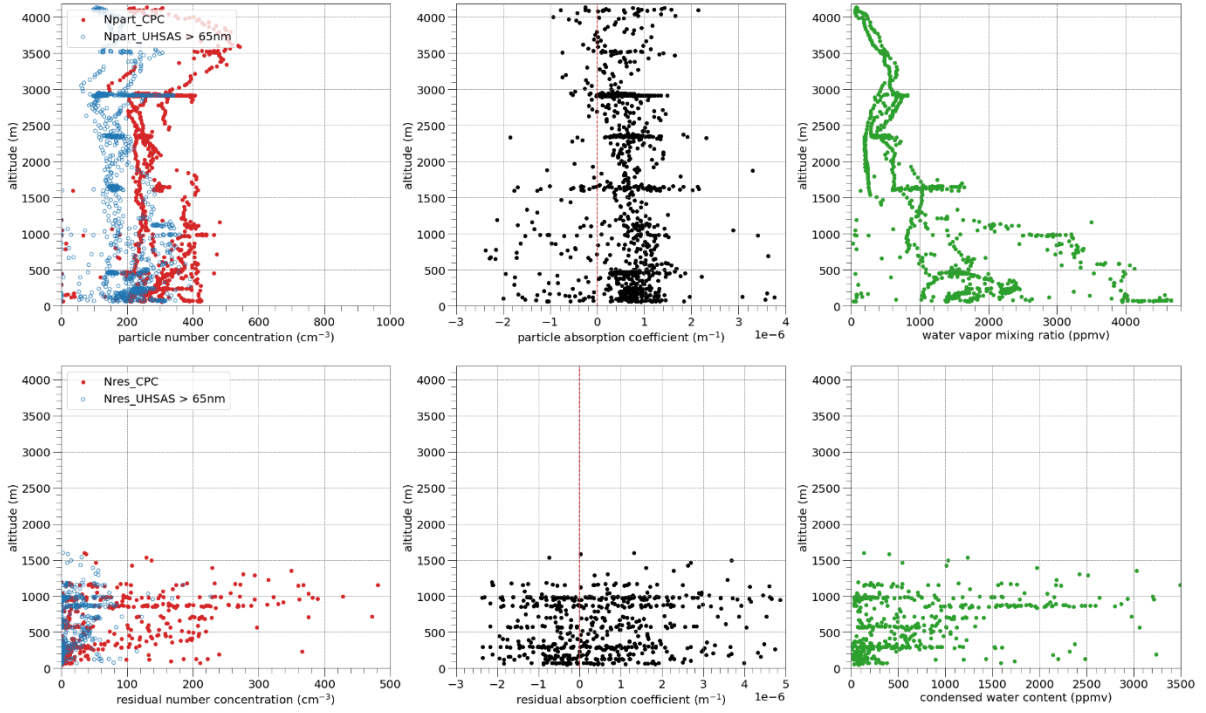


CVI

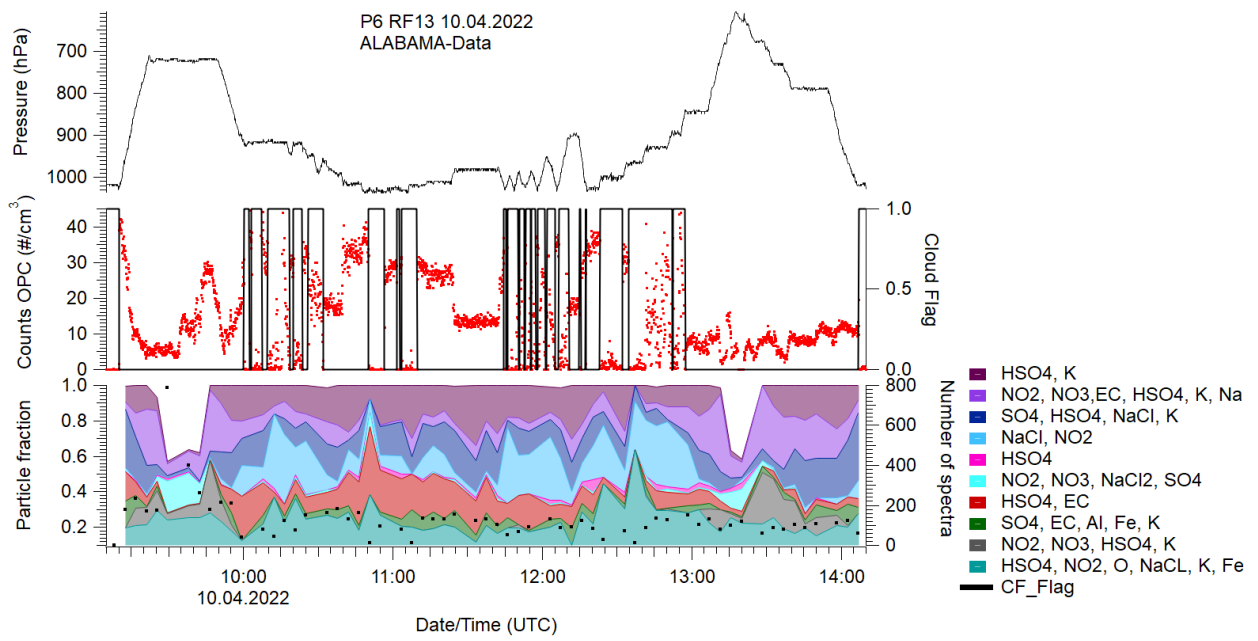
Quicklook ARCTIC-CVI Timeseries from 10.04.2022
10 second mean (residual measurements not enrichment corrected)



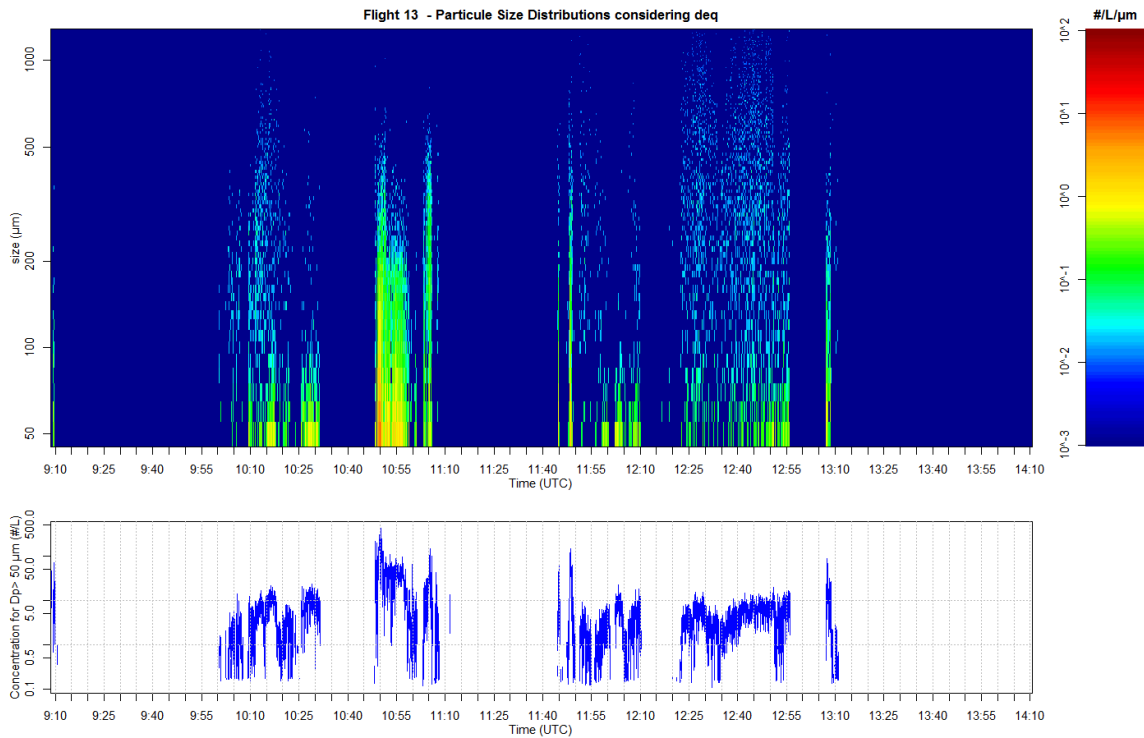
Quicklook ARCTIC-CVI Vertical Profile from 10.04.2022
10 second mean (residual measurements not enrichment corrected)



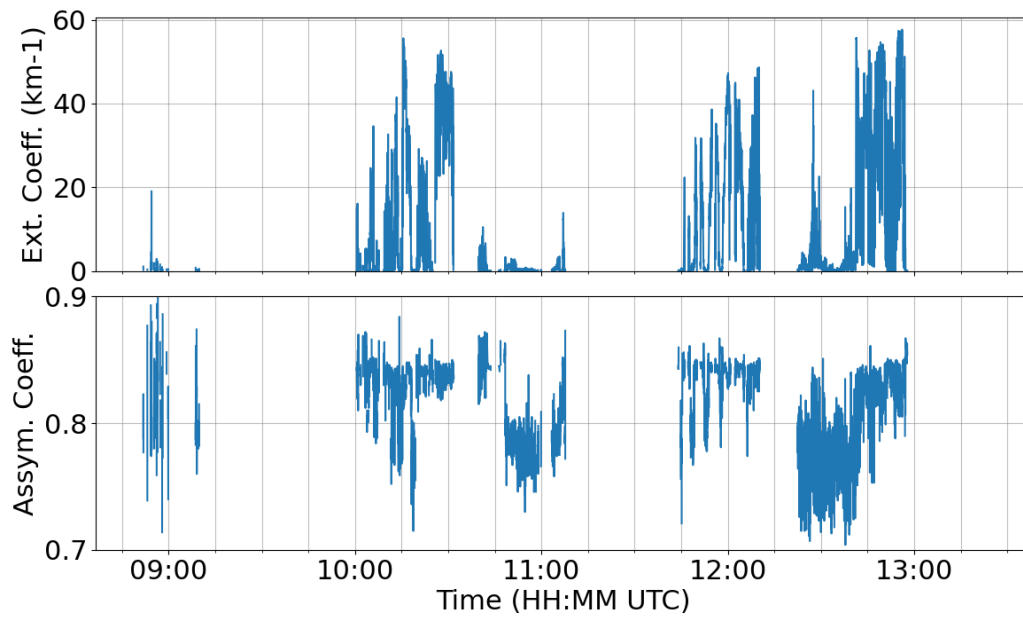
ALABAMA



PMS-LaMP

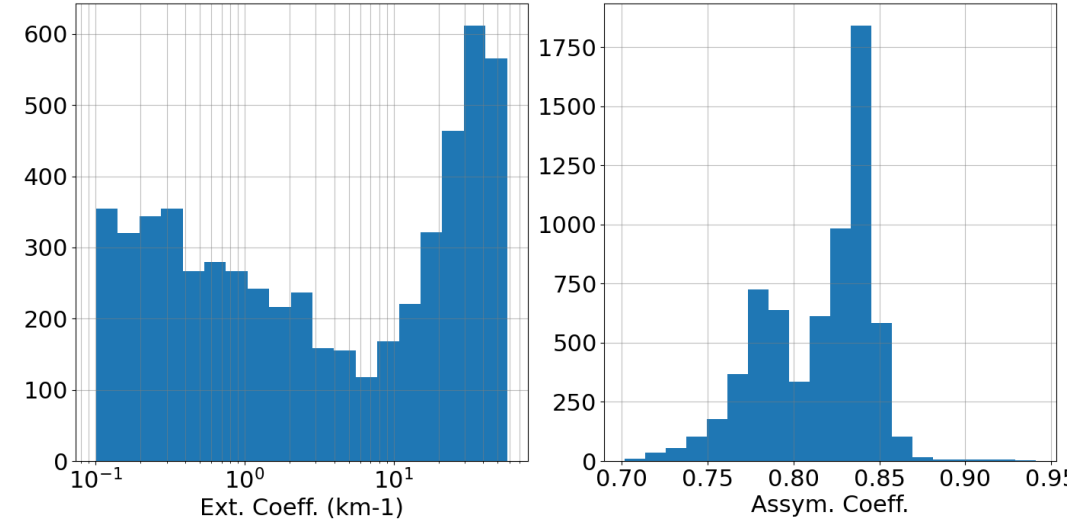


Polar Nephelometer Timeseries - Polar 6 - preliminary data
RF13 - 220410

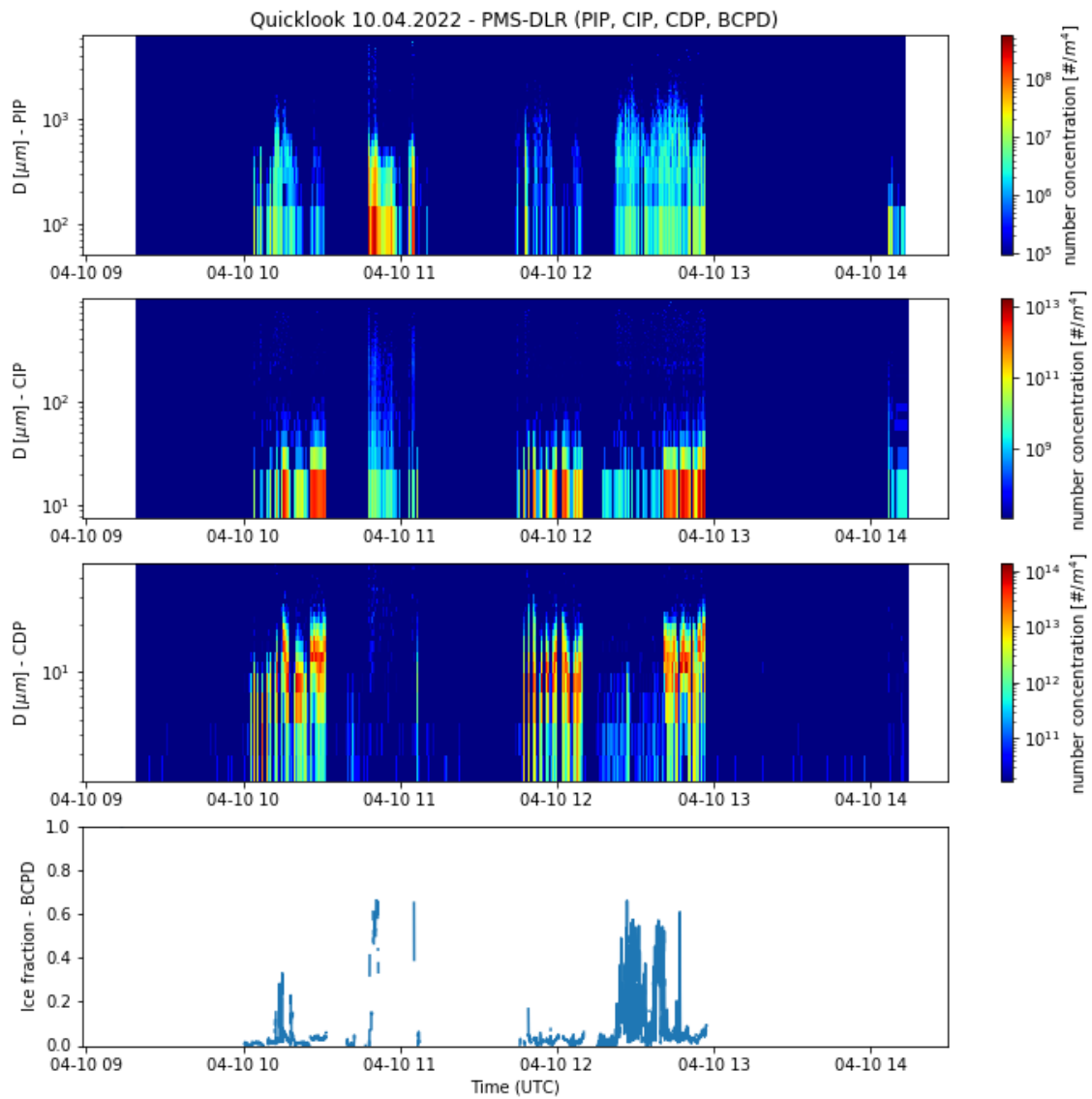


Polar Nephelometer Histogram - Polar 6 - preliminary data

RF13 - 220410

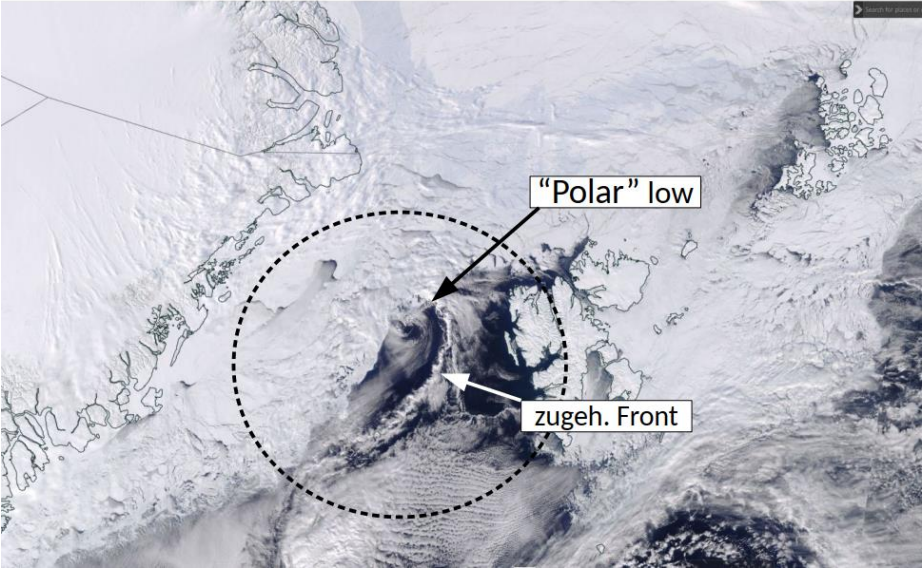


PMS – DLR

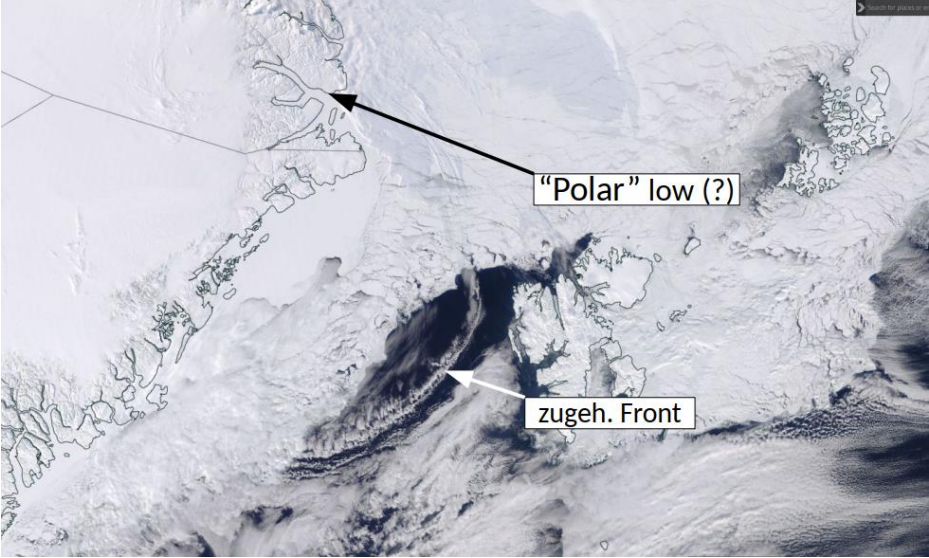


Appendix: Cloud Situation (by Janosch Michaelis)

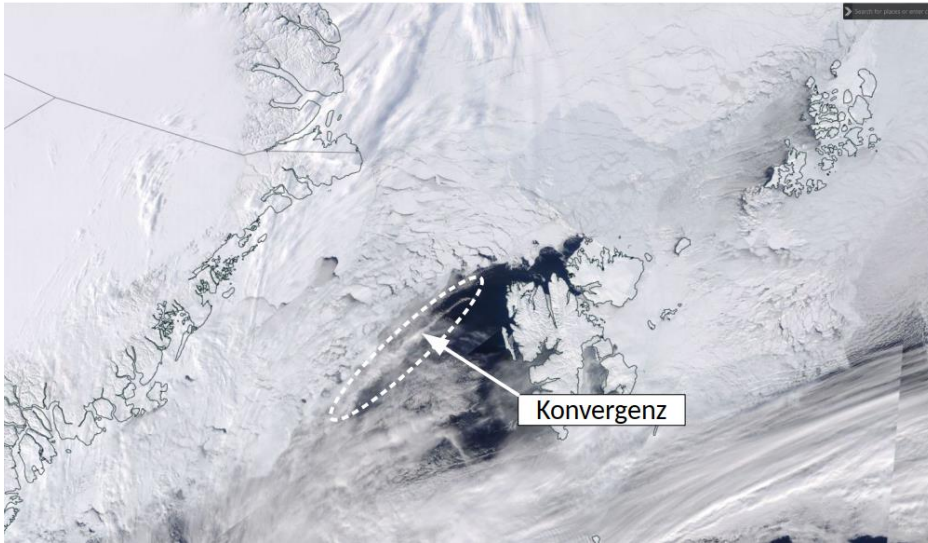
Satellitenbild 08.04.



Satellitenbild 09.04.



Satellitenbild 10.04.



Niederschlagssumme (3h) und Windrichtung, 10.04. 12 UTC

