CLOUD Flight #17 – Polar 6 – 170614

Mission PI: Manfred Wendisch

Objectives: Measure turbulent fluxes below, in and above clouds over sea ice and open water.

Crew:

Polar 6	
PI	Manfred Wendisch
Basis Data Acq.	Cristina Sans i Coll
Aerosol 1	Udo Kästner
Aerosol 2	Franziska Köllner
Trace Gases	Oliver Eppers
PMS 1	Guillaume Mioche

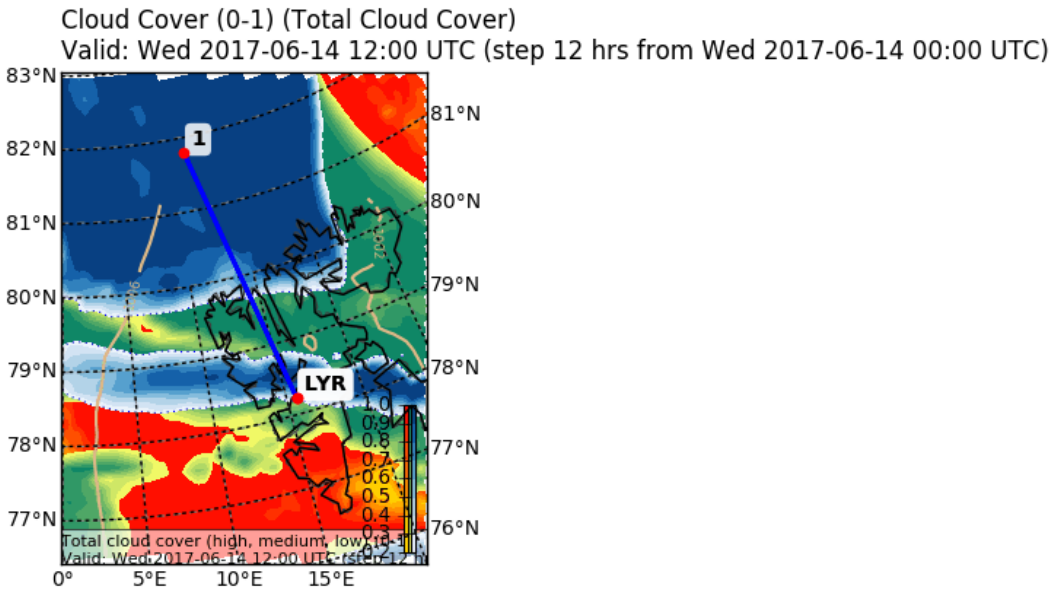
Flight times:

Polar 6	
Take off	12:54 UTC
Touch down	17:37 UTC

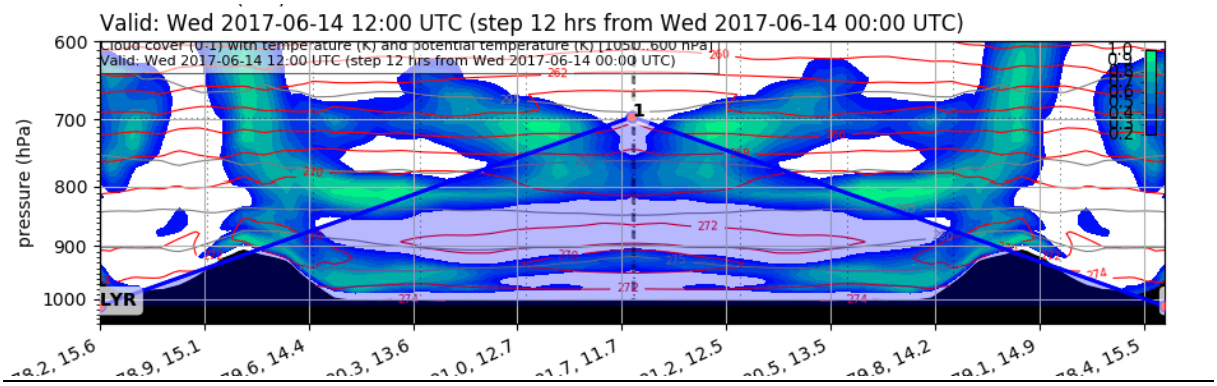
Weather situation as observed during the flight (compare to forecast)

An occlusion front was approaching from north east towards Svalbard. Ahead northerly winds and multi-layer clouds with a defined low-level cloud dominated the area close to Polarstern. This situation was used to extensively probe the boundary layer along the northerly flow at different latitudes. The flight was very successful although problems with the heating system of the CVI inlet occurred after 2/3rd of the flight. In total, the cloudy boundary layer was profiled at 5 locations what was only possible by operating Polar 5 & 6 jointly and because both were equipped with identical noose booms using the new heating systems that allowed longer flights in cloud layers. At the same time balloon borne measurements of turbulent and radiative flux profiles were conducted on the ice floe close to Polarstern.

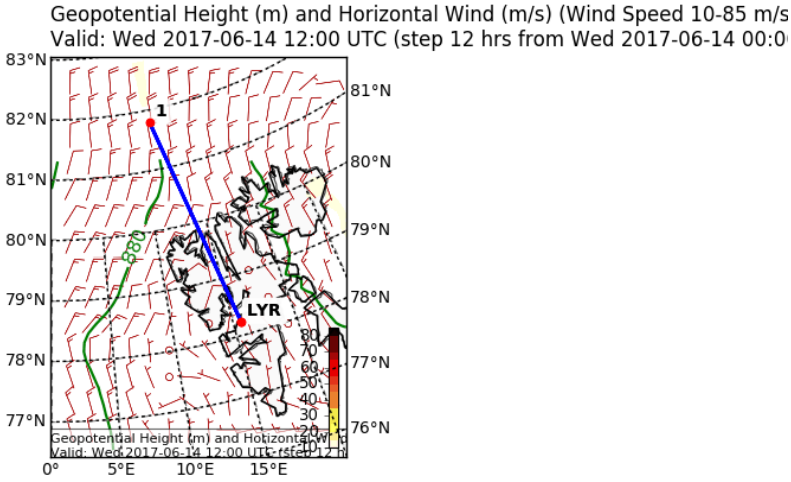
ECMW prediction of clouds—horizontal



ECMW prediction of clouds—vertical



ECMW prediction of wind 950 hPa



EPSG:77790000

Overview of flight

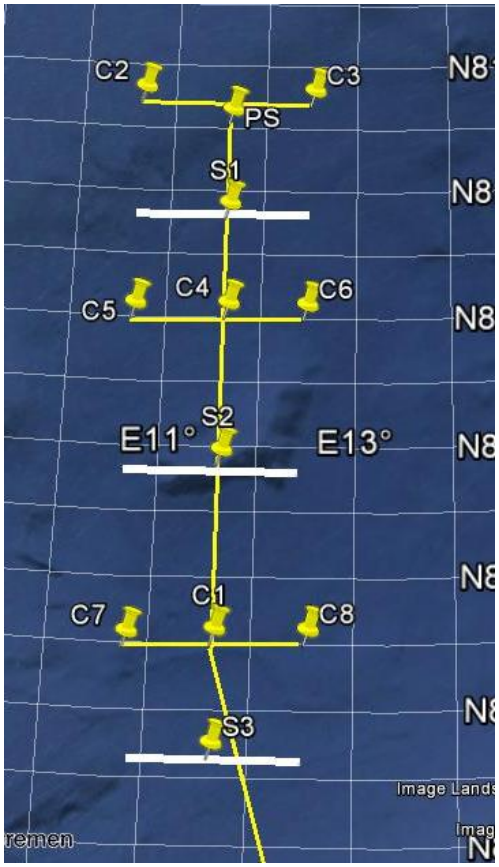
Horizontal flight pattern and profile for P6

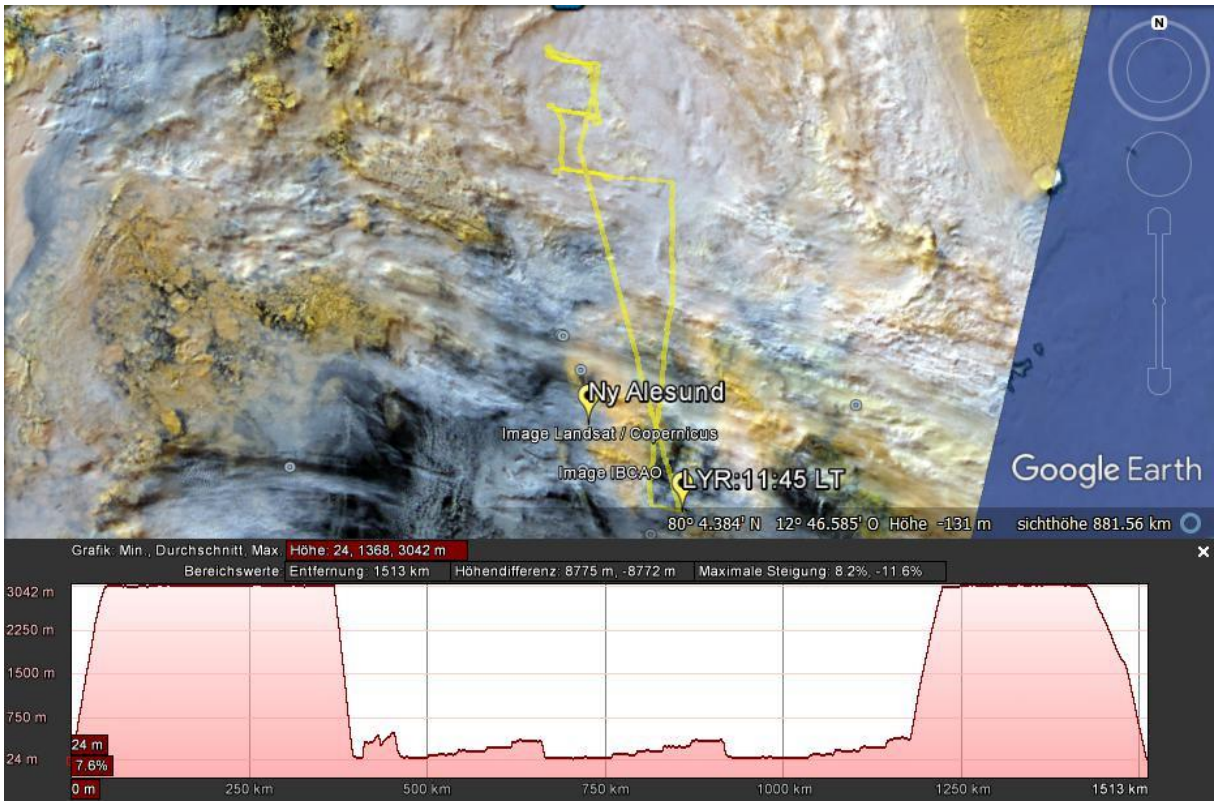
Polar 6

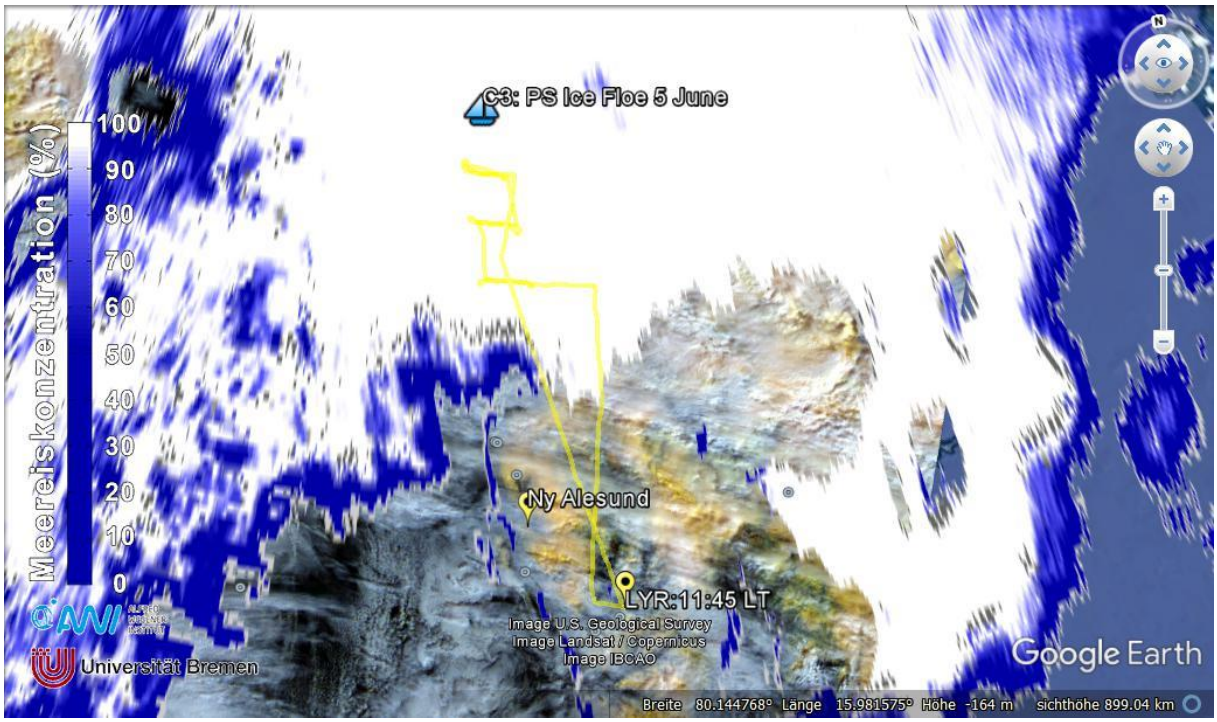
S1: 81° 39.174‘N 11° 18.746‘E

S2: 81° 16.205‘ N 11° 18.746‘E

S3: 80° 49.854‘ N 11° 18.746‘E




Ny Alesund
Image Landsat / Copernicus
Image IBCAO
LYR:11:45 LT
Google Earth
80° 4.384' N 12° 46.585' O Höhe -131 m sichthöhe 881.56 km
Grafik: Min., Durchschnitt, Max. Höhe: 24, 1368, 3042 m
Bereichswerte: Entfernung: 1513 km Höhendifferenz: 8775 m, -8772 m Maximale Steigung: 8.2%, -11.6%
3042 m
2250 m
1500 m
750 m
24 m
24 m
7.6%
0 m
250 km
500 km
750 km
1000 km
1250 km
1513 km


C3: PS Ice Floe 5 June
Meereiskonzentration (%)
100
90
80
70
60
50
40
30
20
10
0
Ny Alesund
LYR:11:45 LT
Image U.S. Geological Survey
Image Landsat / Copernicus
Image IBCAO
Universität Bremen
Google Earth
Breite 80.144768° Länge 15.981575° Höhe -164 m sichthöhe 899.04 km

Detailed Flight Log (all times in UTC)

12:28 Motor on
12:35 CVI ready
12:38 Alabama ready
12:40 Trace gas and Aerosol ready
12:40 Taxi
12:54 Take off

LYR –> C1 10,000 ft 175 Nm, 160 kn 63 min

13:00 We reach 4500 ft, cloud mixture, mid and low level clouds all over the place
13:04 8000 ft
13:05 Cloud penetration
13:06 9000 ft, very hazy
13:08 10,000 ft
13:15 We are inside clouds, some icing, we climb further to get rid of the ice
13:21 We are below a low-level cloud, ice vanishes

13:24 Out of cloud, still mostly below a cloud, precipitation from above, PMS records ice particles
13:28 Several cloud encounters, it is quite turbulent, many droplets
13:30 Cloud patches
13:32 Less clouds, still scattered, kind of messy
13:40 Cloud encounters
13:45 Nice low-level clouds, just little clouds above
13:50 Little cirrus above, nice clouds below

13:55 We reach C1

C1 – > S1 **40 Nm, 160 kn** **15 min**

13:56 Descend with 500 ft/min

14:00 9000 ft

14:02 8000 ft, almost mid-level cloud top, we start penetrating through a mid-level cloud

14:04 We reach mid-level cloud base at roughly 6000 ft

14:12 We reach the top of lower cloud (1200 ft)

14:13 We reach S1

at S1 5 staggered legs 8 min length 120 kn 60min

14:18-14:25 Leg below cloud, 200-300 ft, below cloud base, partly in clouds, partly out of clouds, 15 cm^{-3} particle number concentration

14:27-14:37 Leg through the middle of the cloud, 600 ft

14:40-14:48 Leg through cloud top, 900 ft, partly out of cloud, some icing, traces of ice at the wings, -0 °C

14:50-14:58 Leg above cloud, 1500 ft, mostly out of cloud, icing not gone, is an issue

S1 – S2 saw tooth 24 Nm, 120 kn 12 min

15:00 Go through cloud from above

15:03 Below cloud, we go at 200 ft below the cloud to the south into the direction of S2, we get rid of the ice.

at S2 5 staggered legs 8 min length 120 kn 60min

15:09-15:17 Leg at 200 ft, mostly below the cloud, icing is gone, melted away, sometimes in cloud, +0 °C

15:19-15:27 Leg at 600 ft, within cloud all the time during this leg, again icing, accumulating, at the end of the leg heating of CVI does not work anymore, Because of the CVI heater problem, the inverter was affected as well and it might be that the heating of the noseboom was off. After flight preliminary data analysis showed that the noseboom was not affected, data seemed okay.

15:28-15:42 We go to 4000 ft to get rid of the iced CVI inlet

S2 –> S3 **40 Nm, 120 kn** **20 min**

15:43-15:46 We go below cloud again

at S3 3-5 staggered legs **8 min length** **120 kn** **36- 60 min**

15:54-16:02 Leg at 200 ft, repeated in backward direction

16:06-16:14 We stay at 200 ft

S3 --> LY **10.000 ft** **160 kn** **60 min**

16:15 Start climbing to 4500 ft, inverter switched on again.

16:35 Reaching 4500 ft, we stay 6 mins at this altitude, then go to 10,000 ft, then to 8000 ft

16:42 We encounter a heavy pollution plume, which we sample.

16:52 Partly in clouds

17:13 Enter mid-level cloud, we stay in this cloud almost until landing

17:19 Start descending

17:37 Touch down

17:41 Parking

Instrument Status

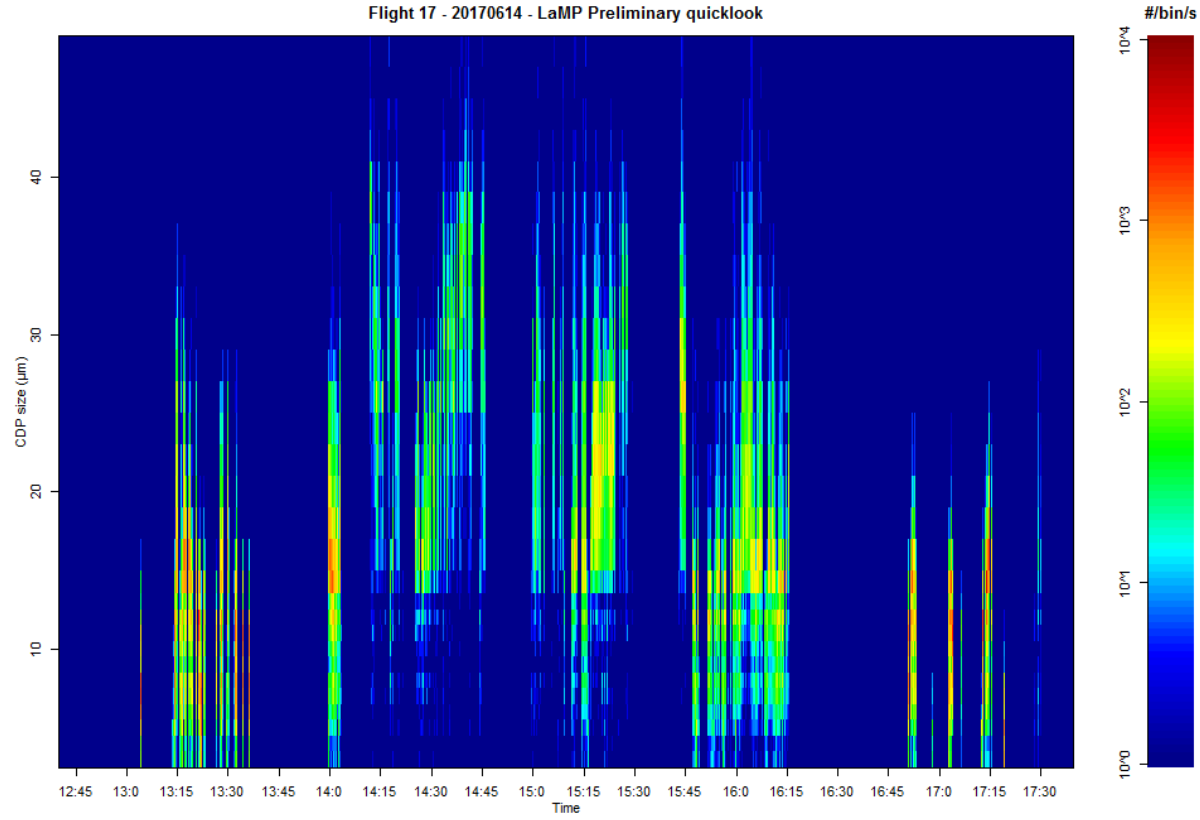
Polar 6	
Basis data acquisition	
Nose Boom	
PHIPS	
SID-3	
CIP	
PIP	
CDP	
ALABAMA	
CVI	
CVI UHSAS	
CVI	
AWI SP2	
AWI UHSAS	
CO/CO2/O3	

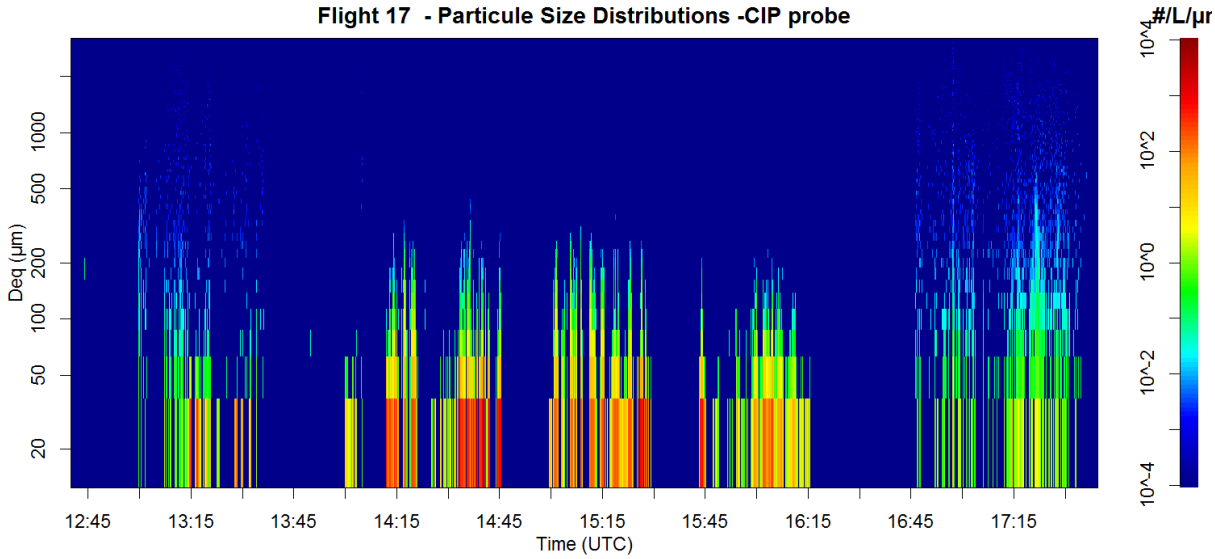
Comments

- Problems with the CVI heating, otherwise the flight was successful.
- Thanks to the crew!

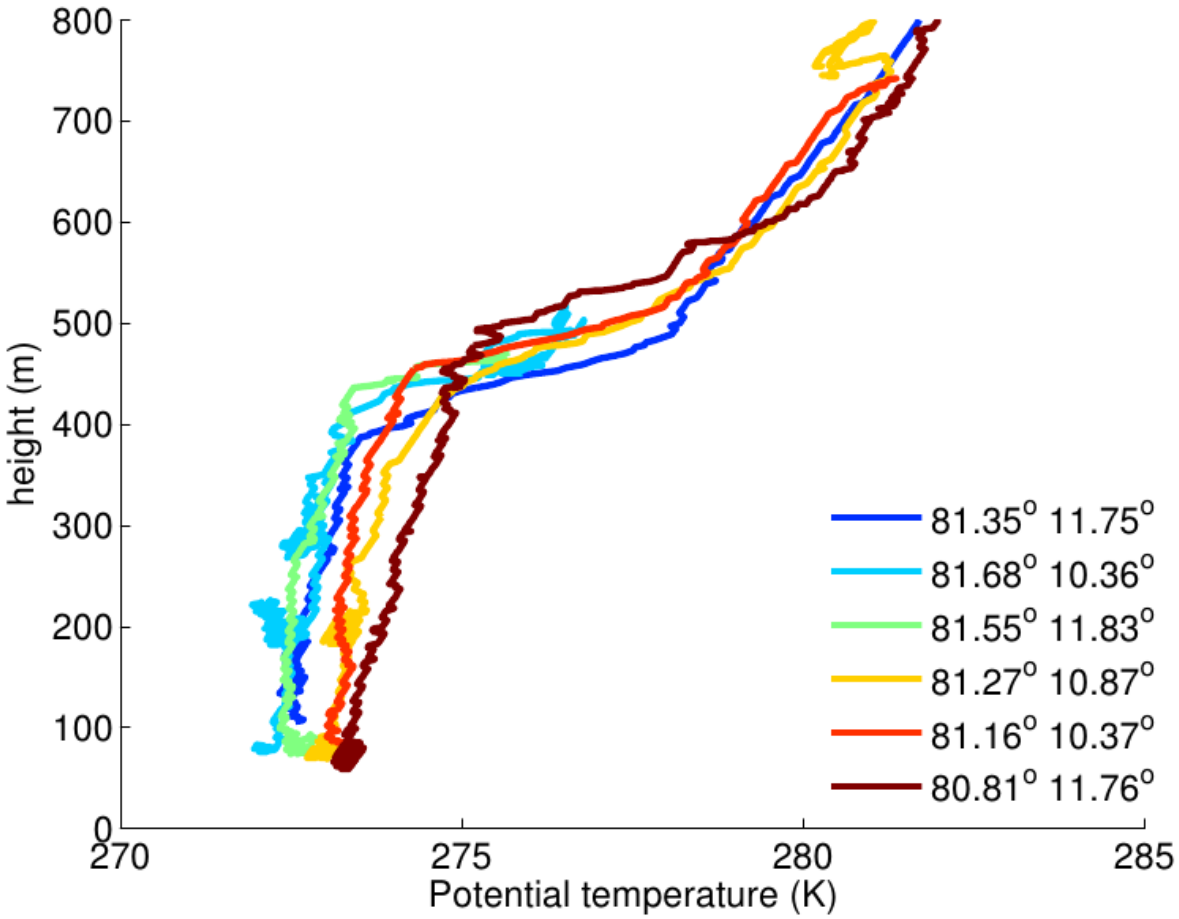
Quicklooks

PMS

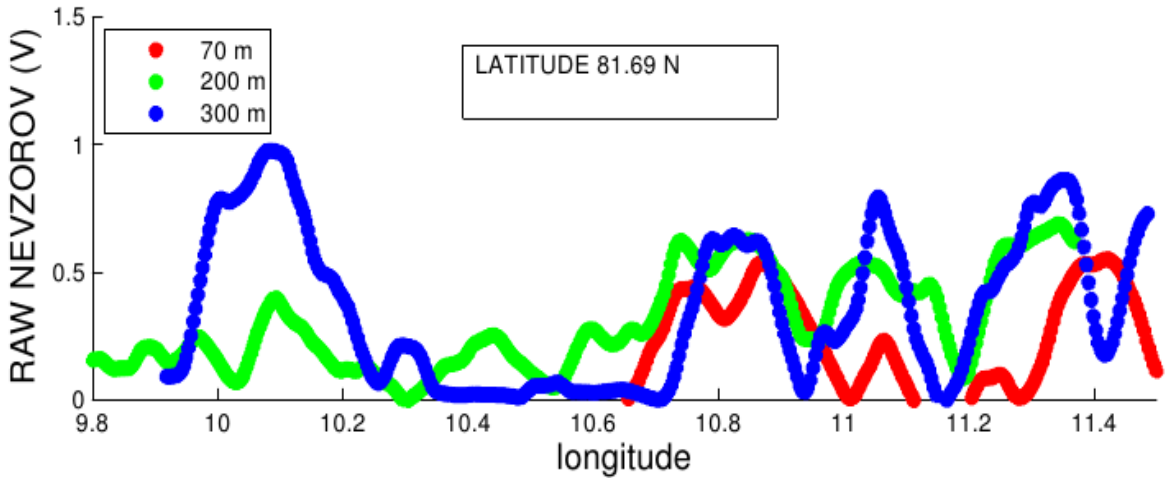


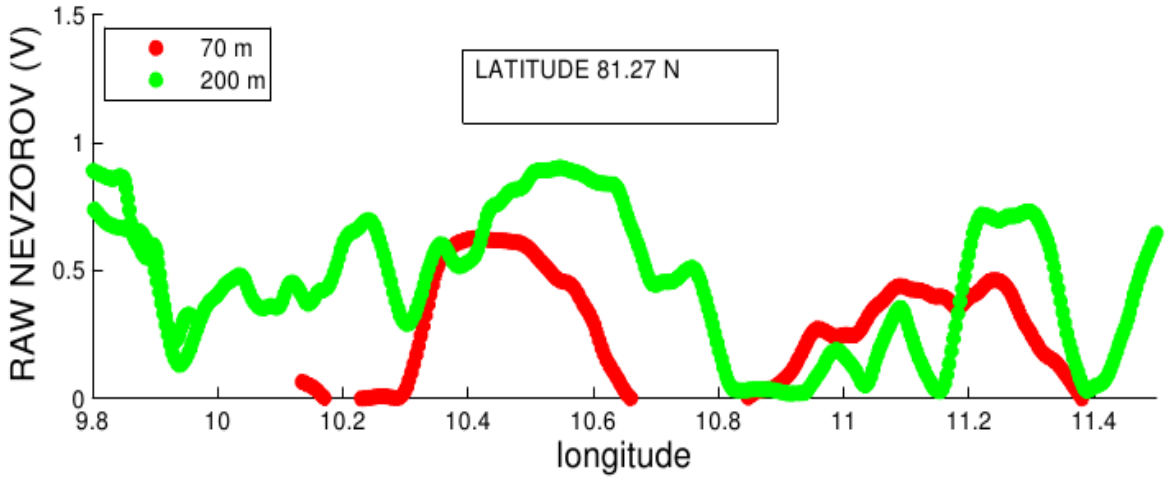


Temps


800
700
600
500
400
300
200
100
0
height (m)
270
275
280
285
Potential temperature (K)
81.35° 11.75°
81.68° 10.36°
81.55° 11.83°
81.27° 10.87°
81.16° 10.37°
80.81° 11.76°

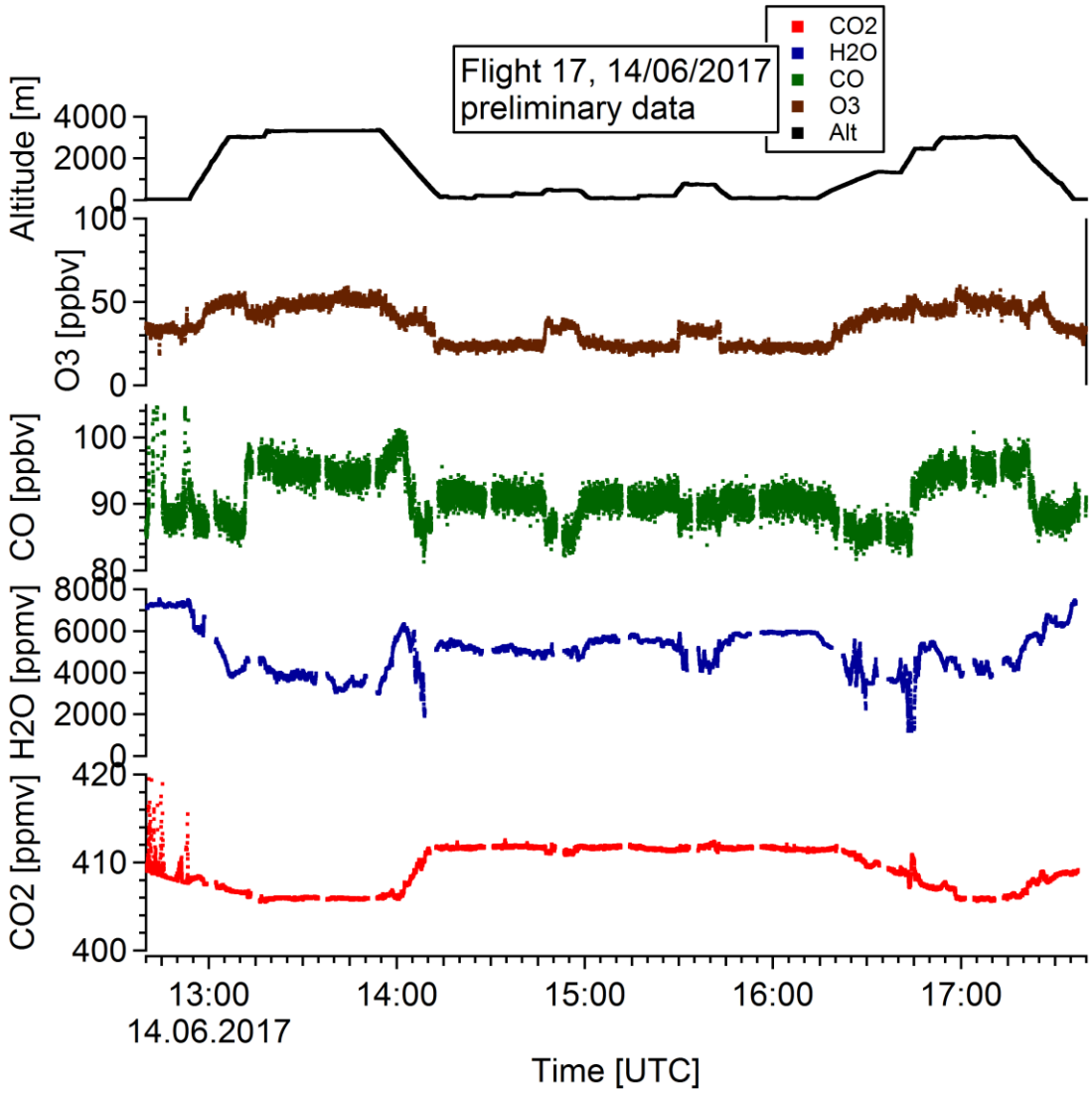
Nevzorov


70 m
200 m
300 m
LATITUDE 81.69 N
RAW NEVZOROV (V)
1.5
1
0.5
0
9.8
10
10.2
10.4
10.6
10.8
11
11.2
11.4
longitude


70 m
200 m
LATITUDE 81.27 N
RAW NEVZOROV (V)
1.5
1
0.5
0
9.8
10
10.2
10.4
10.6
10.8
11
11.2
11.4
longitude

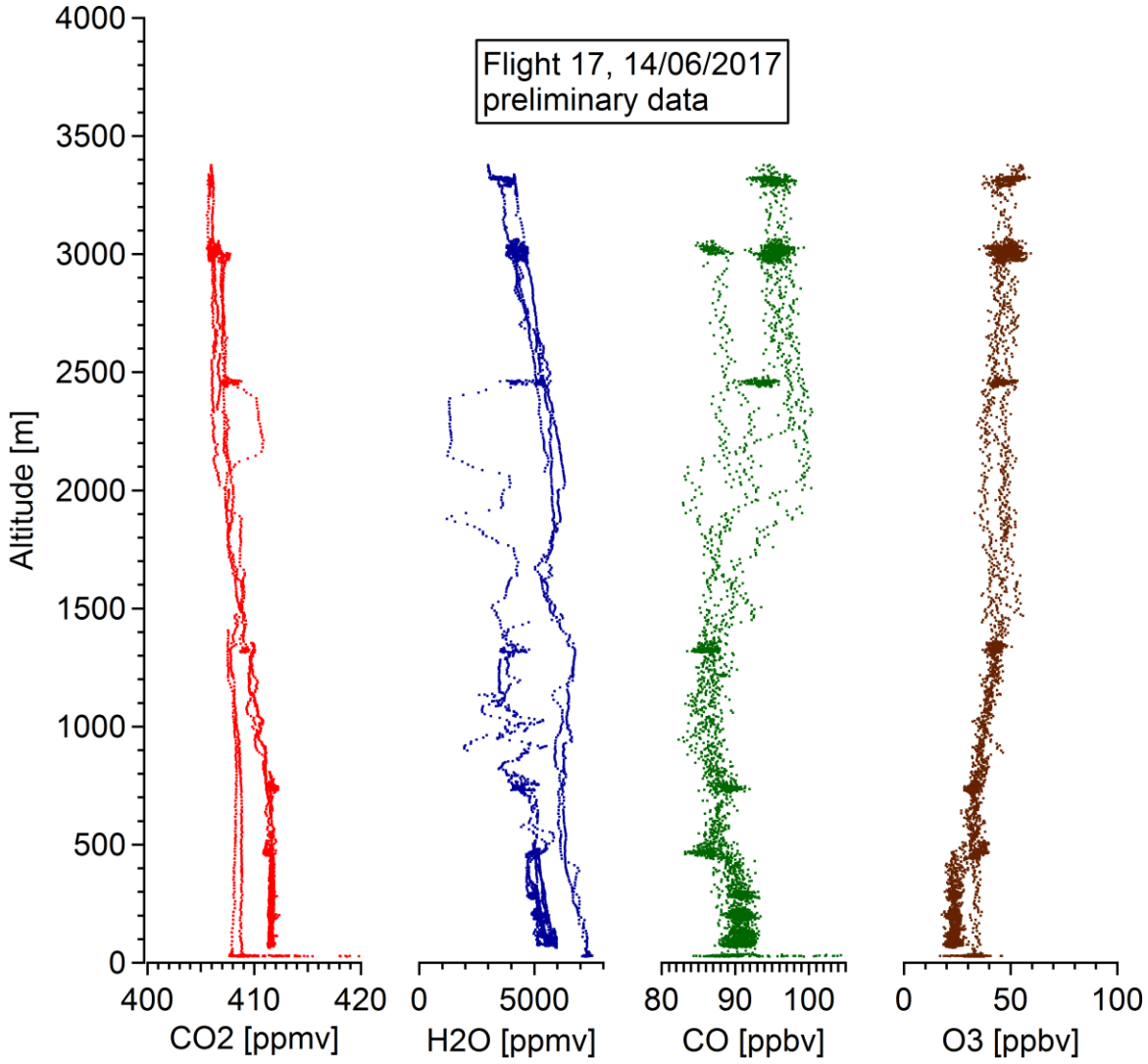
JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Trace Gases

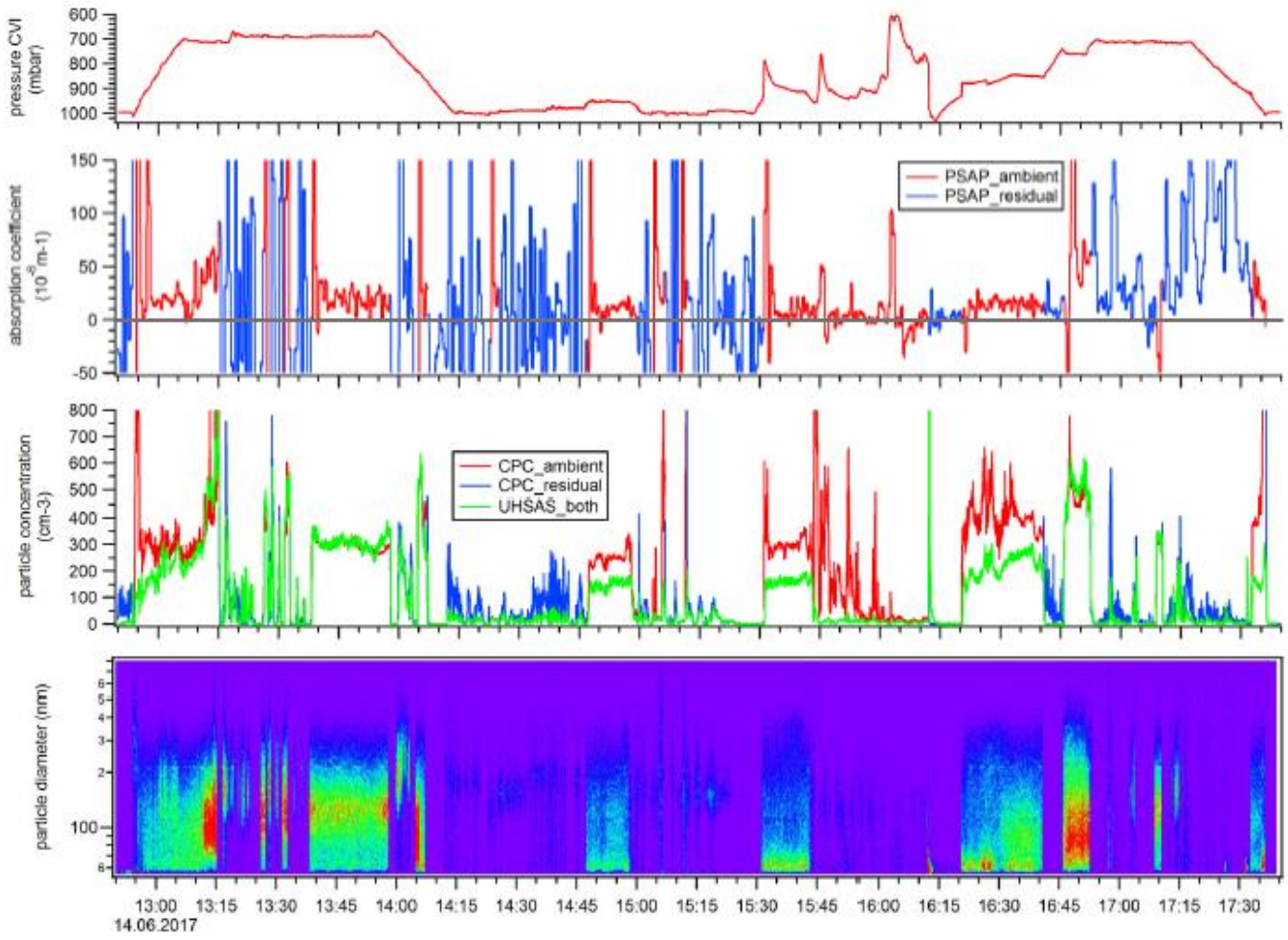


JOHANNES GUTENBERG UNIVERSITÄT MAINZ

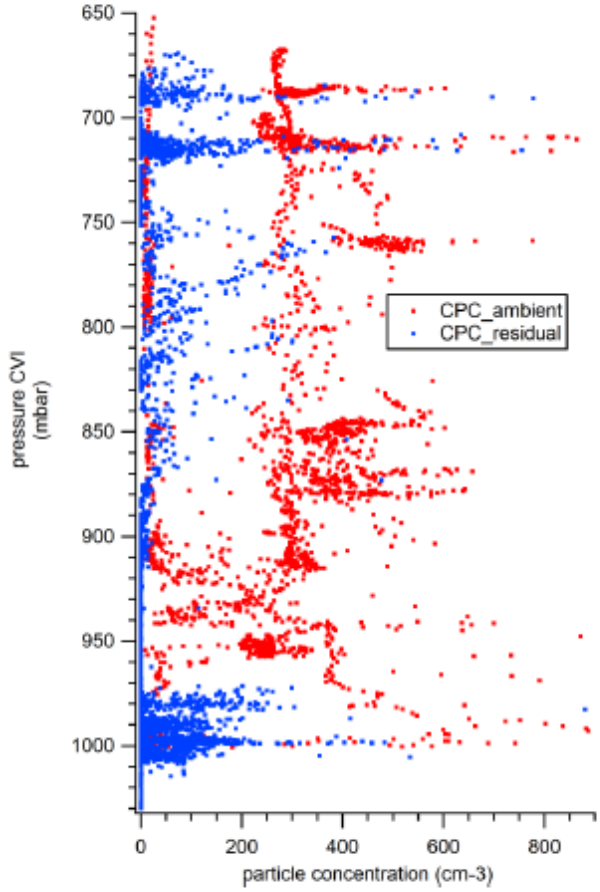
Trace Gases

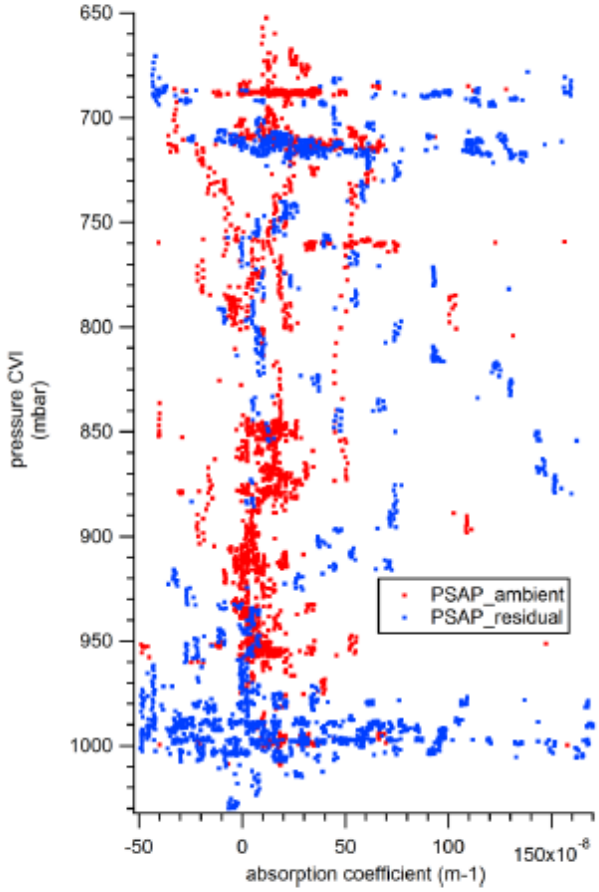


CVI

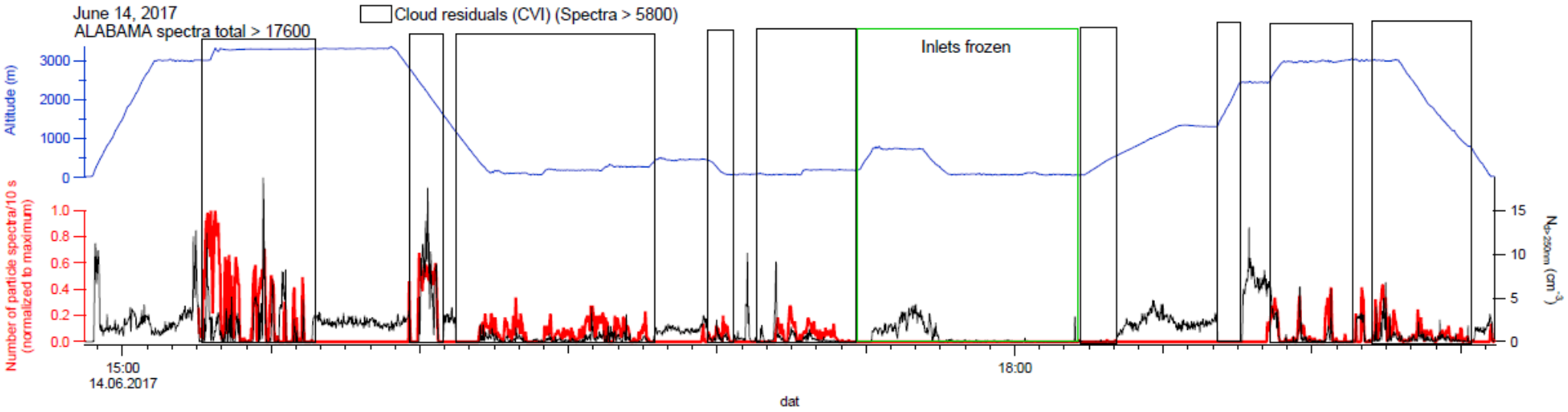

pressure CVI (mbar)
600
700
800
900
1000
absorption coefficient (10^-6 m-1)
150
100
50
0
-50
PSAP_ambient
PSAP_residual
particle concentration (cm-3)
800
700
600
500
400
300
200
100
0
CPC_ambient
CPC_residual
UHŠAŠ_both
particle diameter (nm)
6
5
4
3
2
100
6
13:00
13:15
13:30
13:45
14:00
14:15
14:30
14:45
15:00
15:15
15:30
15:45
16:00
16:15
16:30
16:45
17:00
17:15
17:30
14.06.2017

CVI


650
700
750
800
850
900
950
1000
pressure CVI (mbar)
CPC_ambient
CPC_residual
0
200
400
600
800
particle concentration (cm-3)


650
700
750
800
850
900
950
1000
pressure CVI (mbar)
PSAP_ambient
PSAP_residual
-50
0
50
100
150x10-8
absorption coefficient (m-1)

Alabama


June 14, 2017
ALABAMA spectra total > 17600
Cloud residuals (CVI) (Spectra > 5800)
Inlets frozen
Altitude (m)
3000
2000
1000
0
Number of particle spectra/10 s
(normalized to maximum)
1.0
0.8
0.6
0.4
0.2
0.0
15
10
5
0
$N_{dp\text{-}250nm}$ (cm^{-3})
15:00
14.06.2017
18:00
dat