

## ACLOUD Flight #18 – Polar 6 – 170616

Mission PI P6: Emma Järvinen

**Objectives:** Co-located flight with P5: two satellite overpasses with vertical cloud profiles over sea ice.

**Crew:**

Polar 6	
PI	Emma Järvinen
Basis Data Acq.	Cristina Sans i Coll
PMS	Guillaume Mioche
Alabama	Franziska Köllner
CVI	Stephan Mertes
A + TG	Oliver Eppers

**Flight times:**

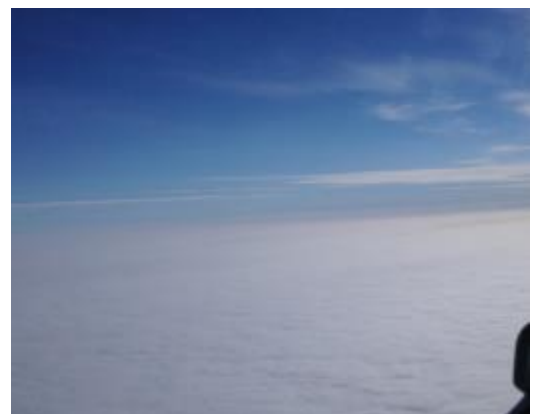
Polar 6	
Take off	6:40
Touch down	12:31

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

The flow direction on the flight day was from the north bringing colder air north and west of Svalbard. For the flight day a high cloudiness was predicted. In the area west and north west of Svalbard the GFS model predicted low level clouds and the ECMWF model both low and medium level clouds. During the flight a solid cloud deck was observed that continued unbroken from Longyearbyen to Polarstern (PS). The cloud top after Longyearbyen was found at 7000 ft and at PS around 3000 ft. Unlike predicted, the clouds were more uniform and mainly in one layer. Some brokenness was observed in the lower parts of the cloud layer. Below 2000 ft only thin and broken clouds were seen. The solid cloud deck began to dissipate in the west coast of Svalbard but over Ny Ålesund still a thinner cloud layer from 4500 ft to 5000 ft existed.

**Overview:**

On the way to the first satellite overpass P6 measured aerosols at 7000 ft, 12000 ft, 9000 ft and 6000 ft. In the first attempt to decent below the cloud base, pilots observed vibrations in the pito-tube due to icing and had to interrupt the descent and ascent above the cloud layer. The inversion layer above the cloud deck was around zero degrees and so the deicing of the aircraft structures was slow. In the second attempt the same problem occurred again, so it was decided to perform the planned double triangle patterns at C1 above the cloud and only in the top cloud layers. The first legs were made at 8000 ft, 6000 ft



The cloud deck before the first double triangle pattern.



**The cloud deck before the second double triangle profile.**



**Cloud base after the second double triangle profile. Some thin clouds below the cloud deck.**

and 5000 ft before P6 descended in the uppermost cloud layer (between 2800 ft and 3000 ft) for the satellite overpass. During the legs in cloud the instruments gathered ice and the transitions between the straight legs were spend above the clouds to de-ice. The next level was at 2600 ft and since the pito-tube was not causing problems, the last leg was made at the level 2300 ft. After this, P6 headed to the second satellite overpass position at C2.

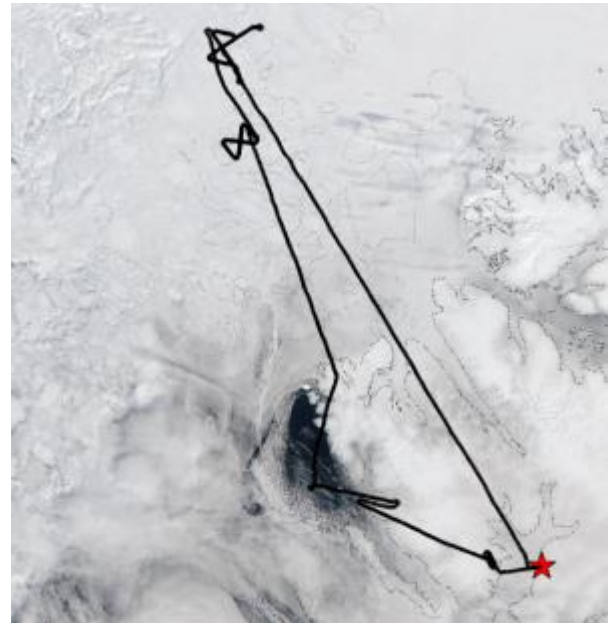
P6 was well ahead the schedule and at arrival to C2 the satellite overpass was 40 minutes away. It was decided to start the double triangles again above the cloud at levels 6000 ft, 5000 ft and 4000 ft before descending to the cloud top for a leg at 3100 ft. Between the first legs in the cloud top, P6 ascended above the clouds to de-ice. The next levels were made inside the cloud at 2600 ft and at 2300 ft. After the leg at 2300 ft, the icing problem seemed to have settled and the time between the legs were spend in cloud. Since P6 was ahead of the schedule an extra double triangle pattern were made at levels 2000 ft (in the cloud base) and at 1200 ft (below the cloud).



**Cloud base at Ny Ålesund.**

After the double triangles, it was decided to head to Ny Ålesund for a cloud profile. On the way to Ny Ålesund, aerosol profiles were measured at 200 ft, 5000 ft, 8000 ft and 12000 ft. Ny Ålesund was approached from the sea and P6 turned under the cloud base in the fjord to align with the Ny Ålesund runway. Above the runway P6 ascended one through the cloud. The cloud base was at 4500 ft and top at 5000 ft. After the last profile P6 headed back to Longyearbyen.

### Flight track and pattern:



### Detailed Flight Logs:

All times are in local time.

6:40	Take off
6:42	Ascent through cloud <ul style="list-style-type: none"> <li>• Multi-layer cloud</li> </ul>
6:50	7000 ft just above the clouds
7:08	12 000 ft <ul style="list-style-type: none"> <li>• No cirrus above</li> <li>• Cloud deck solid but more uneven than in first half of the campaign</li> </ul>
7:16	Start descent to 9000 ft
7:29	Start descent to 6000 ft
7:34	6000 ft
7:40	Start descent to 3000 ft <ul style="list-style-type: none"> <li>• Cloud deck at 4000 ft</li> </ul>
7:45	Vibrations in the pito-tube -> back above the cloud
7:59	New try to descent into the cloud -> again vibrations
	Double-triangle C1
8:13	Reached 8000 ft <ul style="list-style-type: none"> <li>• Some cirrus above</li> </ul>

8:16 – 8:20	1 <sup>st</sup> leg at 8000 ft (above cloud)
8:25 – 8:29	2 <sup>nd</sup> leg at 6000 ft (above cloud)
8:34 – 8:38	3 <sup>rd</sup> leg at 5000 ft (above cloud)
8:43 – 8:48	4 <sup>th</sup> leg at cloud top at 2800-3000 ft
8:46	Satellite overpass
8:52 – 8:57	5 <sup>th</sup> leg at 2600 ft (inside cloud) <ul style="list-style-type: none"> <li>• Few ice particles in CIP, nothing in PHIPS</li> <li>• Droplets around 18 <math>\mu\text{m}</math></li> </ul>
9:09 – 9:16	6 <sup>th</sup> leg at 2300 ft (inside cloud) <ul style="list-style-type: none"> <li>• CVI iced</li> <li>• Droplets around 16 <math>\mu\text{m}</math></li> <li>• Some ice (rimed aggregates in PHIPS)</li> </ul>
Double-triangle C2	
9:33 – 9:37	1 <sup>st</sup> leg at 6000 ft (above the cloud)
9:41 – 9:46	2 <sup>nd</sup> leg at 5000 ft (above the cloud)
9:50 – 9:55	3 <sup>rd</sup> leg at 4000 ft (above the cloud)
10:00 - 10:05	4 <sup>th</sup> leg at cloud top at 3100 ft <ul style="list-style-type: none"> <li>• Droplets around 22-26 <math>\mu\text{m}</math>, sometimes 2 modes</li> <li>• At one point CIP recorded ice particles, whereas no ice in the PHIPS</li> <li>• -5°C</li> </ul>
10:11 – 10:16	5 <sup>th</sup> leg at 2600 ft (inside the cloud) <ul style="list-style-type: none"> <li>• -3°C</li> <li>• Droplets around 18 <math>\mu\text{m}</math> and LWC 0.2 g/m<sup>3</sup></li> <li>• Few ice particles in CIP, nothing in the PHIPS</li> </ul>
10:18 – 10:24	6 <sup>th</sup> leg at 2300 ft (inside the cloud) <ul style="list-style-type: none"> <li>• -3°C</li> <li>• sometimes ground can be seen through</li> <li>• droplets around 16-18 <math>\mu\text{m}</math> and sizes varying a lot</li> <li>• LWC 0.15 g/m<sup>3</sup></li> <li>• Ice in both CIP and PHIPS -&gt; graupel, riming and needles</li> </ul>
10:28 – 10:32	7 <sup>th</sup> leg at 2000 ft (the lowest level of the cloud) <ul style="list-style-type: none"> <li>• Cloud sometimes patchy, maybe in between cloud layers but no clear separation</li> <li>• Droplets around 12 <math>\mu\text{m}</math></li> <li>• Some ice particles</li> <li>• Patchy and small low level clouds below</li> </ul>
10:37 – 10:42	8 <sup>th</sup> leg at 1200 ft (under the cloud) <ul style="list-style-type: none"> <li>• Mostly no precipitation but sometimes smaller burst of ice appears</li> <li>• At times inside patchy low level clouds</li> </ul>
Cloud penetration and Aerosol Profile	
10:44 – 10:53	At level 200 ft <ul style="list-style-type: none"> <li>• No precipitation</li> </ul>
10:53	Climb to 4000 ft
10:56	Cloud base at 2500 ft <ul style="list-style-type: none"> <li>• Some small cloud below</li> <li>• Droplets 13-14 <math>\mu\text{m}</math></li> <li>• Some ice</li> </ul>
10:58	Cloud top at 4000 ft
10:59 - 11:06	5000 ft
11:10 – 11:16	8000 ft
11:22 – 11:28	12 000 ft

11:28	Start descent
	Ny Ålesund Cloud Profile
11:39	Cloud base around 3500 ft but decreasing towards Ny Ålesund
11:44	Clouds down to 1000 ft
11:48	500 ft over Ny Ålesund
11:49	Start climbing
11:33	Cloud base at 4500 ft
11:54	Cloud top at 5000 ft <ul style="list-style-type: none"> <li>• Cloud all liquid</li> <li>• Below cloud base some ice</li> </ul>
11:55	7000 ft towards LYR
12:31	TOUCH DOWN

**Instrument Status:**

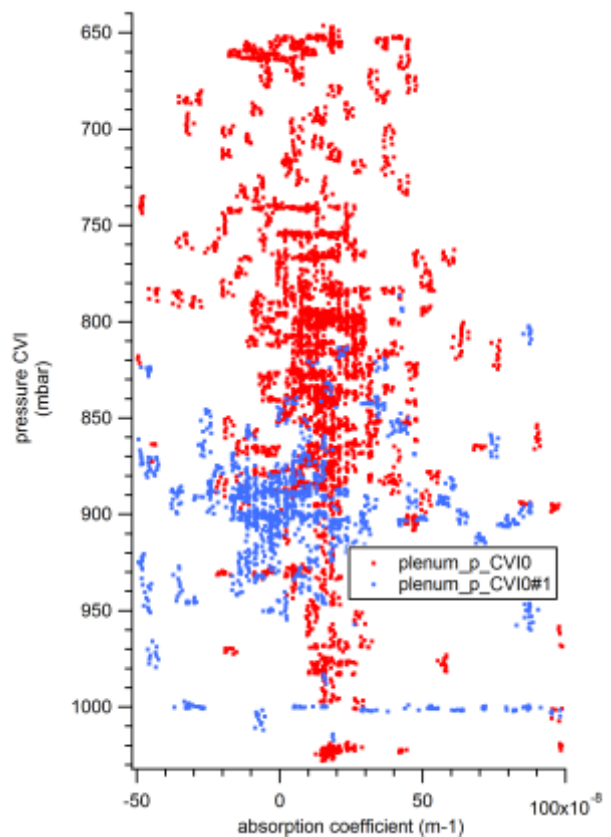
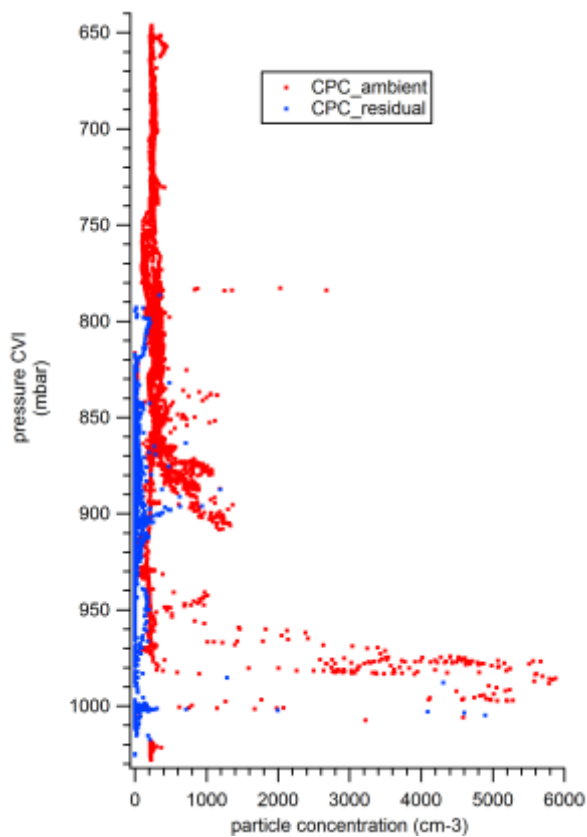
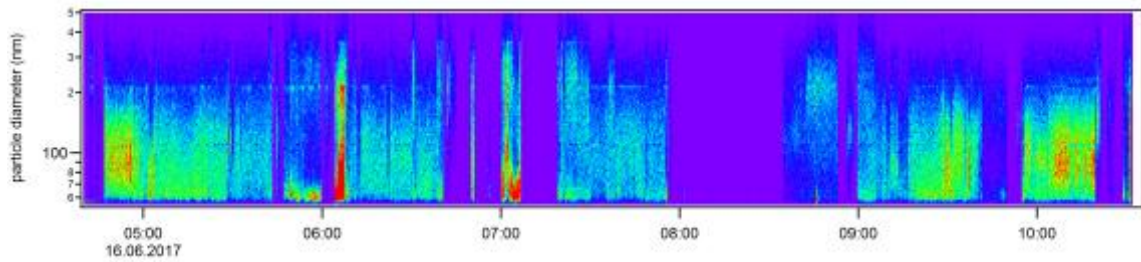
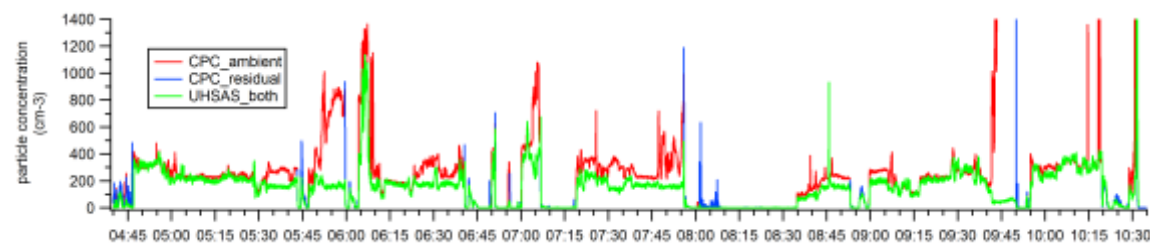
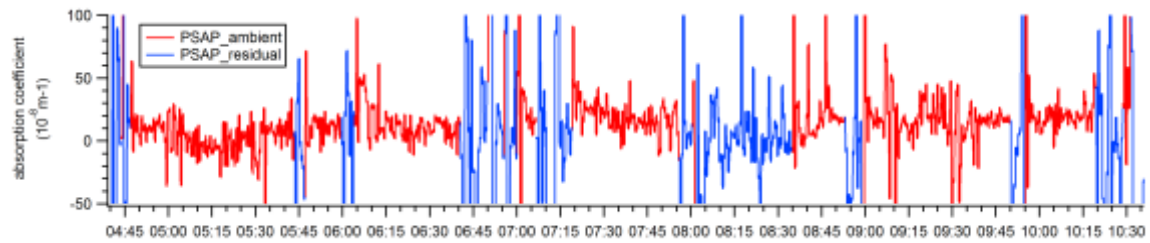
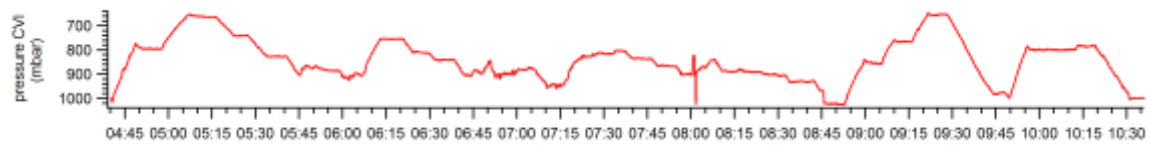
<b>Polar 6</b>	
Basis data acquisition	
Nose Boom	
PHIPS	
SID-3	
CIP	
PIP	
CDP	
ALABAMA	
CVI	
CVI UHSAS	
CVI ???	
AWI SP2	
AWI UHSAS	
CO/CO2/O3	

Comments:

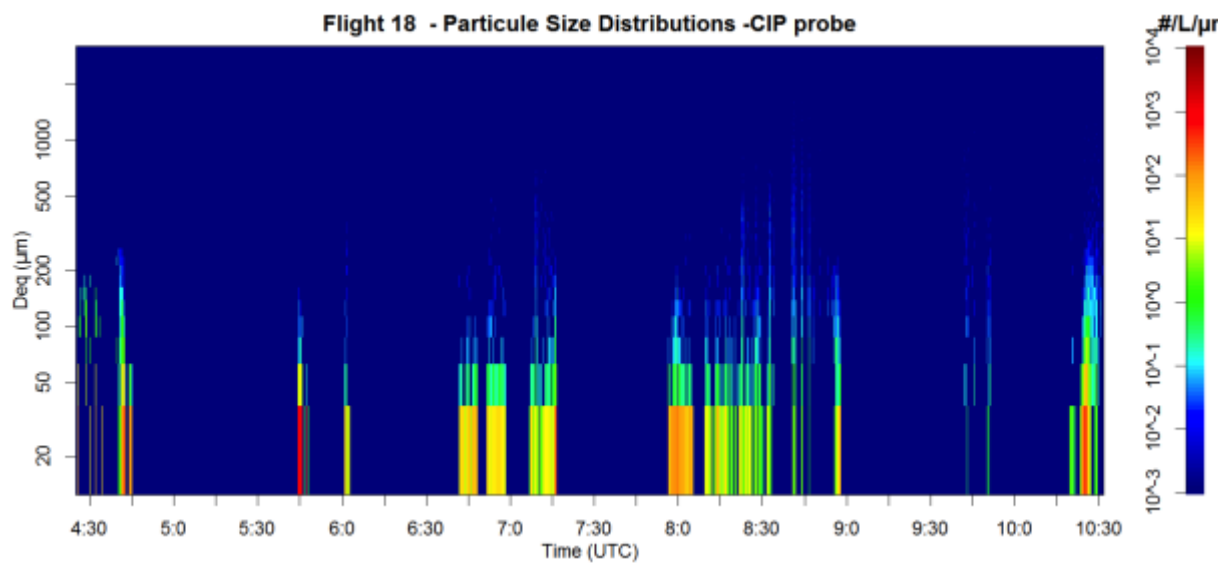
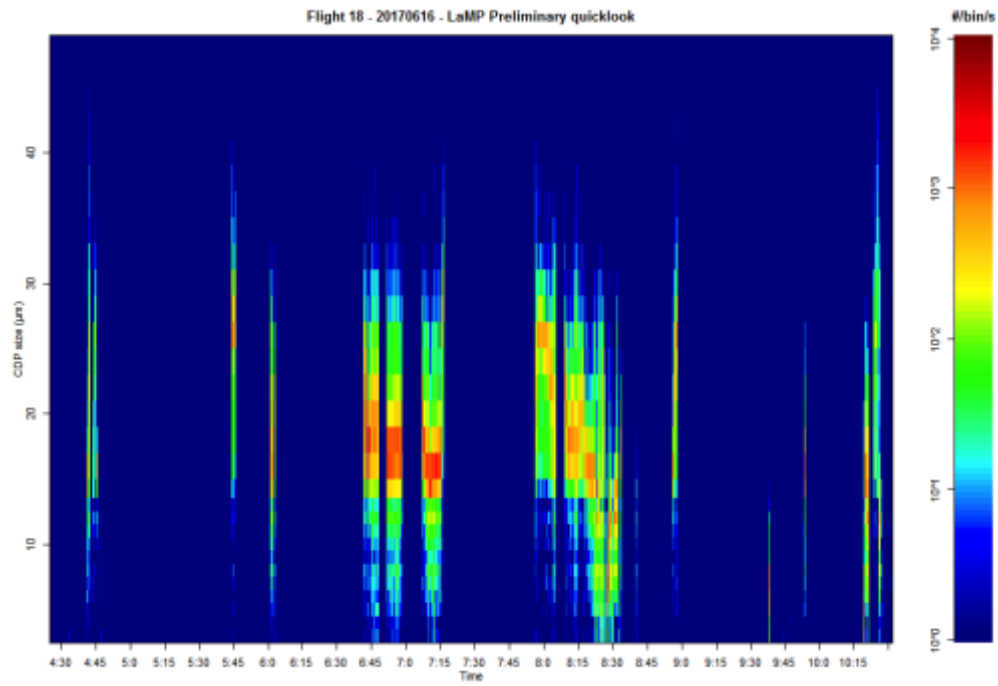
CVI heating did not work, which caused inlet freezing inside clouds.

## Quicklooks:

### CVI

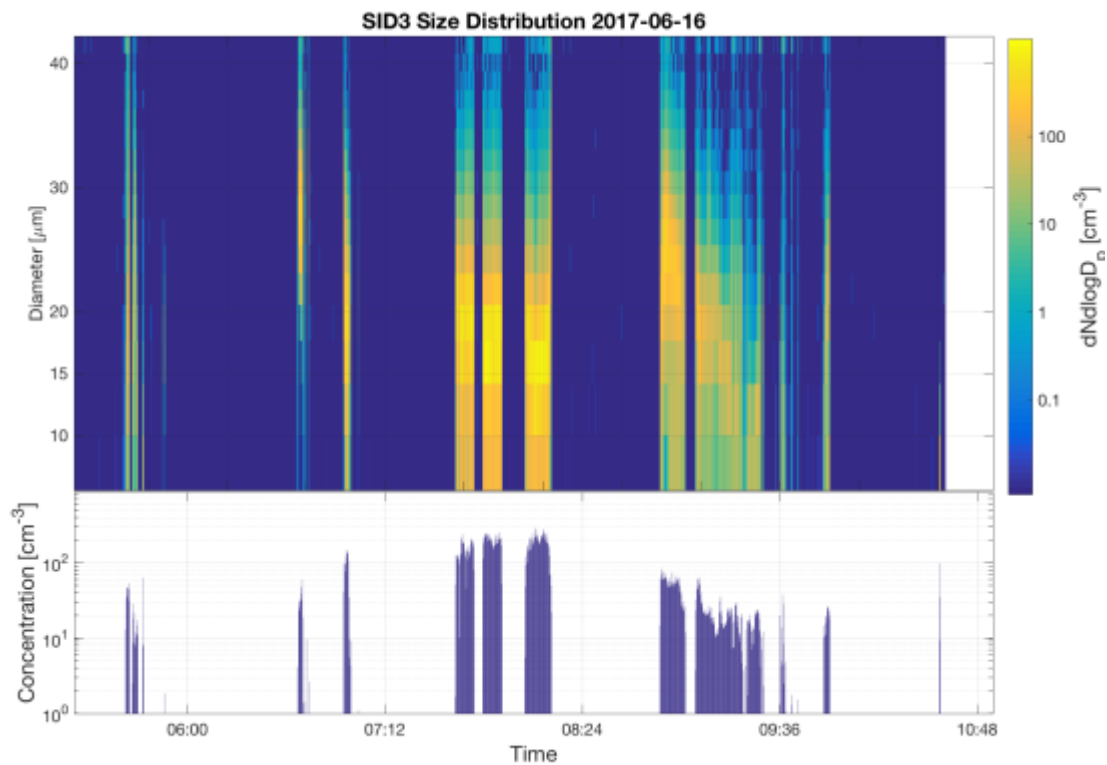


CDP and CIP: Size distribution.





**SID-3:** Size distribution. The droplet concentration in the first double triangle profile was higher ( $>100 \text{ cm}^{-3}$ ) than in the second double triangle ( $10\text{-}100 \text{ cm}^{-3}$ ), which led to icing problems.



**Trace gas:**

**Summarized by Olli:** The vertical profiles look quite good. As we saw it on the days before the 16<sup>th</sup>, CO shows a jump to higher concentrations in the highest altitudes. But this pollution layer seems to start higher than the days before (at about 2600 m instead of 2000 m on Wednesday).

