

ACLOUD Flight #11 – Polar 6 – 170602

Mission PI P6: Emma Järvinen

Objectives: Relate remote sensing observations of cloud microphysics (P5) to in-situ observations (P6) of cloud horizontal and vertical variability. Vertical cloud profile over Polarstern.

Crew:

Polar 6	
PI	Emma Järvinen
Basis Data Acq.	Daniel Damaske
PMS	Delphine Leroy
Alabama	Hans Clemen
CVI	Stephan Mertes
A + TG	Heiko Bozem
Nevzorov	Dmitry Chechin

Flight times:

Polar 6	
Take off	10:27
Touch down	16:09

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

The last days the low-pressure system over northern Russia combined with a high-pressure system north of Svalbard had brought northeasterly wind flow. For the flight day, the winds had predicted to change to southwesterly flow bringing cloudiness to the area. The IFS predicted low level clouds from Ny Ålesund to Polarstern, whereas the GFS predicted only high-level clouds. Luckily for the mission, the IFS forecast seemed to be more accurate and a fairly uniform low-level cloud deck was observed starting from Ny Ålesund. The cloud top near Ny Ålesund was at 2800 ft, whereas near Polarstern clouds were lower, at 1300 ft. The cloud base was found at 1600 ft in Ny Ålesund and at 300 ft near Polarstern.

Overview:

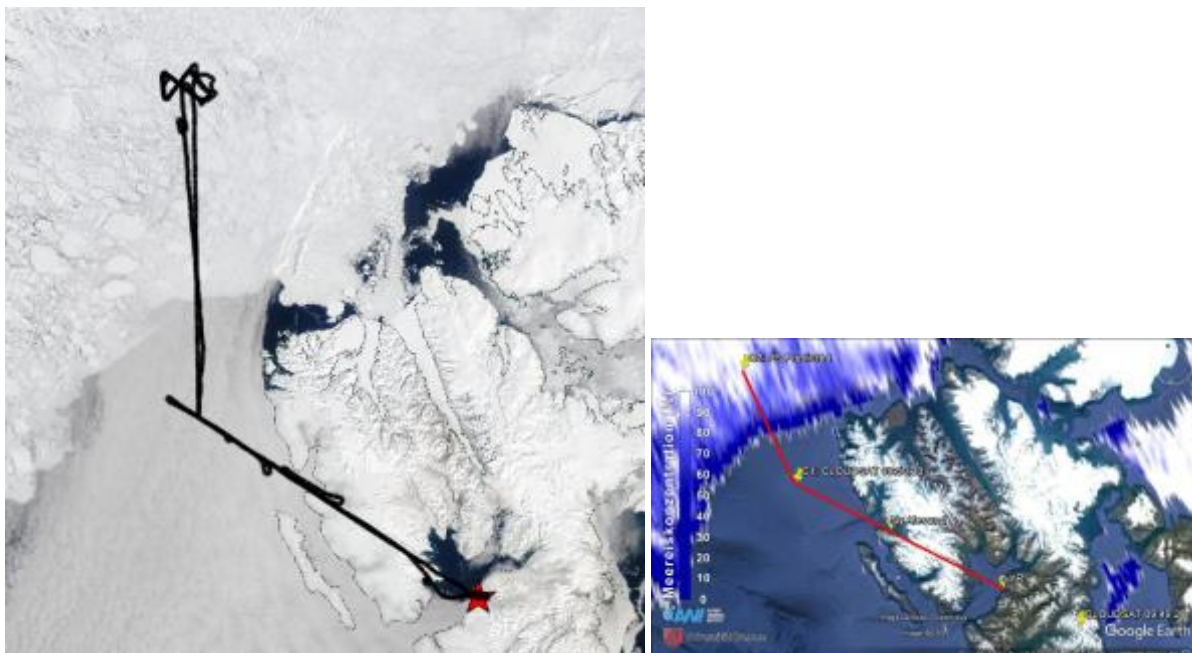
Polar 6 (P6) flew the first leg to Ny Ålesund at an altitude of 4000 ft before starting the descent. Since clouds were present above the Ny Ålesund airport the approach had to be made from the sea towards the fjord. P6 descended below the cloud deck (1600 ft), turned in the fjord and aligned with the Ny Ålesund airport runway. Above the runway, we ascended back in the cloud and did first straight leg at 2200 ft. The second leg at 2700 ft had to be interrupted because of icing problems. Looking back, it would be recommended to perform a faster and continues ascent though the clouds to get a more localized vertical profile.

After sampling clouds at 2200 ft, 2700 ft and 2800 ft a saw tooth pattern was started on the way to C1. One ascent and descent were made, in which time C1 was passed. Above the cloud top P6 turned around to be co-located with P5 and to meet the satellite at C1 at 11:50. This time the P5 had encountered some technical problems, so that the co-location was possible only after the satellite

had passed. From C1 to C2 P6 continued the saw tooth patterns inside the clouds as P5 measured above. Over Polarstern (PS) P6 and P5 performed four coordinated double-triangle patterns, P5 in one altitude and P6 changing altitudes after every co- and cross-wind leg. The patterns were performed at 300 ft (below the clouds), 800 ft, 1000 ft and at 1300 ft, which was right at the cloud top. One leg was 15 miles long and took approximately 7 minutes. To get a better vertical profile of the cloud, it would have been possible to change altitude after every leg.

After PS P6 did a horizontal profile that was supposed to be flown in one level to C1. We started at 1000 ft but as the cloud base rose towards the open ocean, we had to adjust the height to 1500 ft. Keeping one representative level in clouds over such a large distance was proven challenging and it is advised to perform saw tooth patterns for the horizontal variability instead of single straight leg. From C1 to LYR an aerosol profile with altitudes at 6000 ft and 12000 ft was flown before landing.

Flight track and pattern:



Detailed Flight Logs:

All times are local time.

10:27	Take off <ul style="list-style-type: none"> • 4000 ft towards Ny Ålesund • clouds over the glacier, solid cloud deck • almost no cirrus above
10:52	Start decent to Ny Ålesund, 500 ft/min
10:54	In cloud <ul style="list-style-type: none"> • cloud top was at 3000 ft • Temperature +1°C • Liquid cloud
10:56	Underneath the cloud at 1400 ft

	<ul style="list-style-type: none"> No precipitation
	Ny Ålesund Cloud Profile
11:07	Centered with the Ny Ålesund runway <ul style="list-style-type: none"> Cloud base at 1600 ft
11:07	2200 ft <ul style="list-style-type: none"> Temperature 0°C CIP: ice particles SID3: small droplets PHIPS: needles
11:15	2700 ft
11:17	Out of the cloud to 3100 ft due to icing problems
11:18	Climbing to 4000 ft to de-ice at +8°C
11:23	Cloud probes ice free, start descent into clouds
11:25	At 2800 ft in cloud top <ul style="list-style-type: none"> Ice particles observed
	Saw Tooth Cloud Horizontal Profile
11:27	Saw tooth ↓ 100 ft/min <ul style="list-style-type: none"> First profile over open ocean Icing on SID-3 Droplets get smaller as descending
11:34	Underneath the cloud at 1200 ft <ul style="list-style-type: none"> No precipitation
11:41	Saw tooth ↑ 200 ft/min <ul style="list-style-type: none"> Both ice particles and droplets (mixed-phase) Cloud profile past C1
11:47	Cloud top at 2500 ft
11:50	180° turn to head back to C1
11:52	Saw tooth ↓ 200 ft/min
11:59	Underneath the cloud at 1000 ft <ul style="list-style-type: none"> Delphine: problems with the PIP probe
12:06	Saw tooth ↑ 200 ft/min
12:10	Cloud top at 2000 ft
12:12	Saw tooth ↓ 200 ft/min <ul style="list-style-type: none"> Both ice particles and droplets (mixed-phase)
12:20	Underneath the cloud at 300 ft <ul style="list-style-type: none"> Sea ice visible Cloud base lower, almost reaching the surface
12:21	Change altitude to 200 ft
12:24	Saw tooth ↑ 200 ft/min
12:26	Change to 500 ft/min
12:27	Cloud top at 1700 ft
12:33	360° turn
12:35	Saw tooth ↓ 200 ft/min <ul style="list-style-type: none"> Cloud top at 1300 ft PHIPS: ice needles, more ice observed as in the first profiles
12:36	Underneath the cloud <ul style="list-style-type: none"> precipitation
	Double Triangle (Vertical Profile) over Polarstern
12:50-13:08	Level 300 ft (below cloud) <ul style="list-style-type: none"> precipitation (ice needles with sizes >700 μm)

	<ul style="list-style-type: none"> • 13:07 encountered PS or P6 plume
13:18-13:35	Level 800 ft (inside cloud) <ul style="list-style-type: none"> • SID-3: small droplets • PIP: large ice needles
13:44-14:01	Level 1000 ft (inside cloud) <ul style="list-style-type: none"> • 0°C • some icing on SID-3 • ice and small droplets
14:09-14:28	Level 1300 ft (right at the cloud top) <ul style="list-style-type: none"> • mostly liquid cloud top and some ice particles • 14:10 out of cloud due to icing • 14:18 descent back to cloud
14:28	End of double triangle and out of cloud to de-ice <ul style="list-style-type: none"> • de-icing at +8°C
Horizontal Straight Leg towards C1	
14:32	In cloud 1000 ft <ul style="list-style-type: none"> • small cloud particles
14:58	Out of the cloud for de-icing <ul style="list-style-type: none"> • cloud top at 1800 ft
14:57	Back in cloud
14:59	Cloud base at 1200 ft <ul style="list-style-type: none"> • Still sea ice below
15:00	Level 1500 ft <ul style="list-style-type: none"> • Small particles, SID-3 records one mode • PHIPS: big droplets
15:11	Ice free water below
15:12	Ascent to 1700 ft
15:19	C1 <ul style="list-style-type: none"> • Climb to 6000 ft • Cloud top at 2800 ft
15:26	6000 ft
15:29	Climb to 12000 ft
15:37	12000 ft
15:40	Leave 12000 ft
16:09	TOUCH DOWN

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	

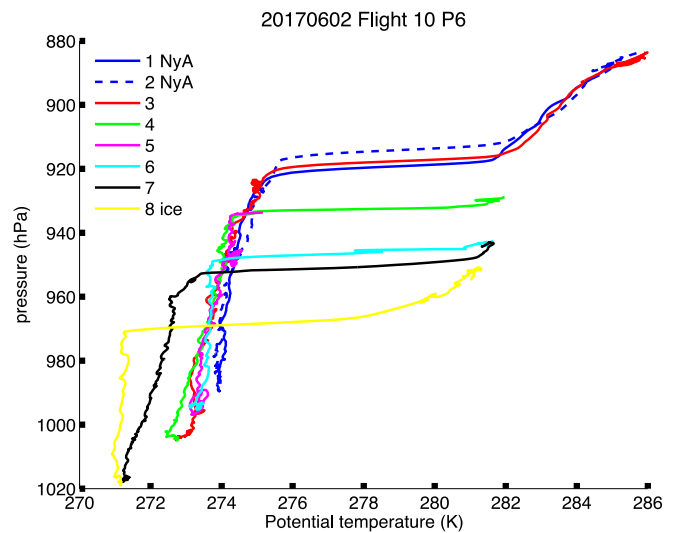
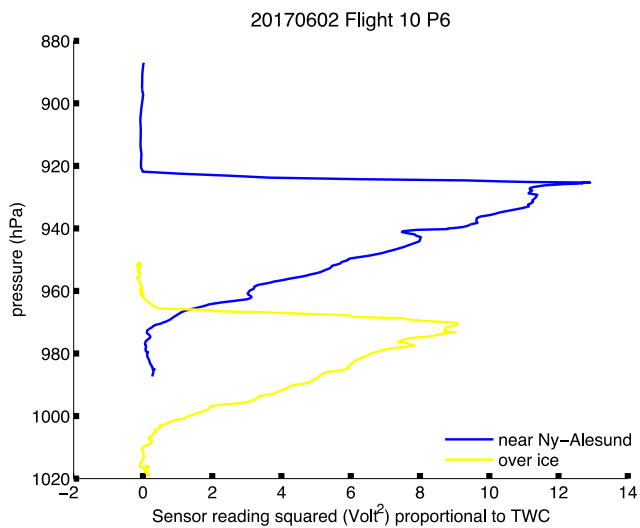
Comments:

PIP lost connection during saw tooth profiles but worked again later in flight.

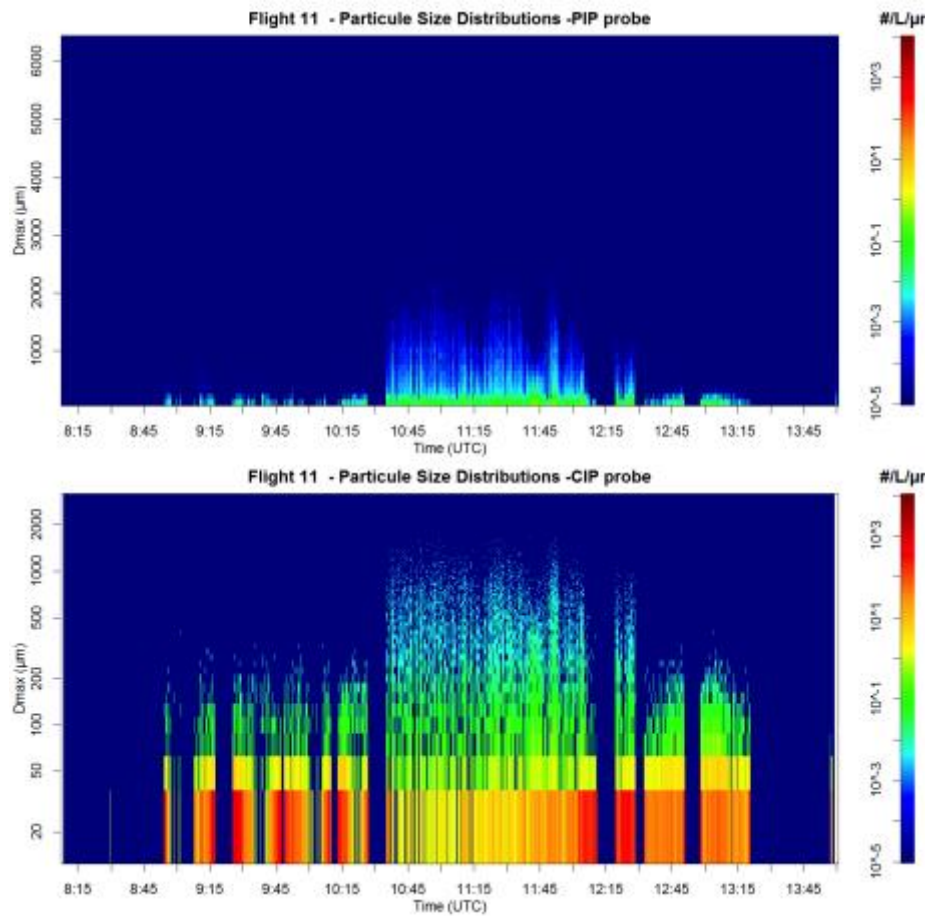
SP2 stopped working during the vertical profiles over Polarstern.

Quicklooks:

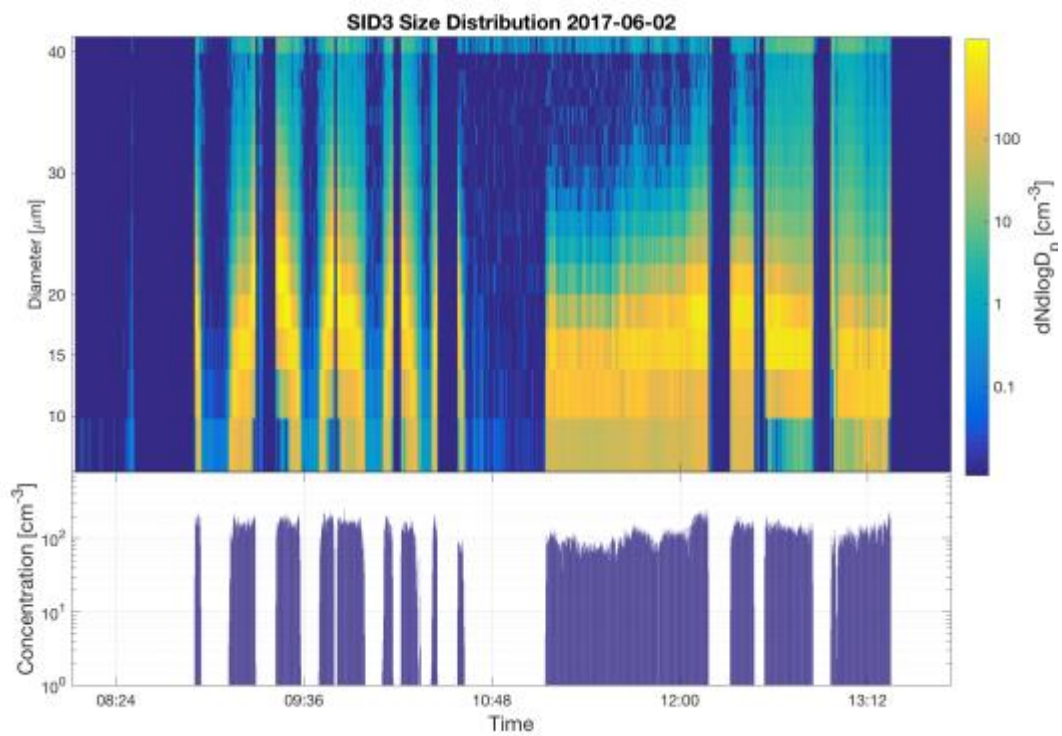
The Nevzorov liquid water content (LWC) and total water content (TWC) probe: Profiles of theta and squared voltages that are proportional to TWC (g/m^3)



CIP and PIP: size distribution



SID-3: size distribution



PHIPS: Precipitation ice images



CVI

