ACLOUD Flight #12 – Polar 6 – 170604

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. Satellite overpass and vertical cloud profile over Polarstern.

Crew:

Polar 6	
PI	**Emma Järvinen**
Basis Data Acq.	**Daniel Damaske**
PMS	**Christophe Gourbeyre**
PMS	**Martin Schnaiter**
Alabama	**Hans Clemen**
CVI	**Stephan Mertes**
A + TG	**Heiko Bozem**

Flight times:

Polar 6	
Take off	**10:06**
Touch down	**15:39**

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

The high-pressure system on that day located west of Svalbard bringing northerly flows over the open water. Low-level clouds were predicted north of Longyearbyen stretching all the way to Polarstern. As predicted a relative uniform cloud layer was observed from Longyearbyen to Polarstern. Near Svalbard the cloud top was found at 1600 ft and at Polartern at 1300 ft.

Prediction of cloud cover for flight path.

Overview:

Due to problems with the P5, P6 headed alone to the planned satellite overpass towards C1. On the way to C1 an aerosol profile was performed with legs at two heights: 10 000 ft and 5 000 ft. At this part of the flight it was discovered that the INS did not align before take-off and, therefore, was not working during the flight. C1 was reached ahead of the schedule so a loop was performed to leave

C1 planned at 10:38 LT. The part of the satellite overpass over continent was flown above the clouds at 5000 ft and the saw tooth pattern in the clouds was started over the open ocean. The first descent was performed over open ocean. The cloud consisted of only liquid droplets with sizes below 100 µm. Below the cloud sea ice started to appear and the next ascent was performed over broken sea ice. Now, some ice was detected in the clouds with increasing ice particle concentration towards the cloud top. The dominant ice particle shape was needles. In the second descent the satellite was met at a height of 600 ft – in the mid of the mixed-phase cloud. The saw tooth profile was continued to C2 and from there to Polarstern. In all of the profiles both ice and liquid droplets were measured.

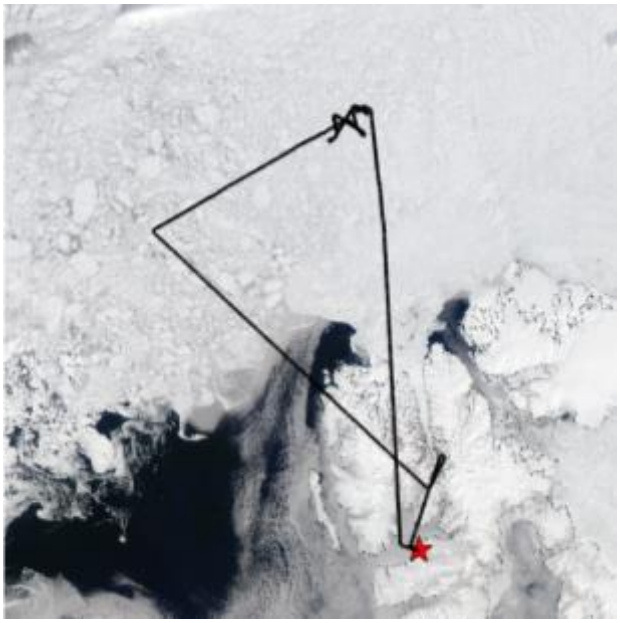
Cloud top at 11:00 LT and cloud base at 11:38 LT.

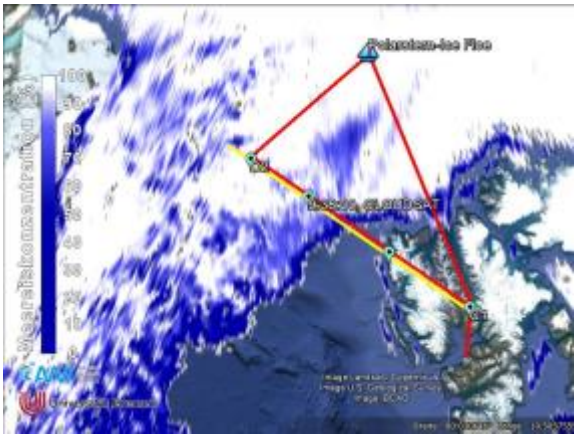
Near Polarstern three double-triangle patterns were performed starting below the cloud at 100 ft. The cloud base was found at 300 ft. After each co- and cross-leg the altitude was changed. The legs inside the cloud were performed at 400 ft, 600 ft, 800 ft, 1000 ft and at 1200 ft. The cloud top was found at 1300 ft. After the leg at 800 ft P6 faced some icing problems, so it was decided to spend the transitions between the legs above the clouds to de-ice. The cloud was found to be mixed in all layers with relative high concentrations of ice of several counts per liter.

After the double-triangle patterns an aerosol race-track was performed near the double-triangle. A continuous climb with 800 ft/min with 1 minute legs was done until 12000 ft was reached. During the climb a pollution layer was observed at 11000 ft. P6 descended to the pollution layer and followed it towards Longyearbyen for about 20 minutes before free speed and height was given to the pilots for the rest of the flight.

Polarstern

Flight track and pattern:





Detailed Flight Logs:

All times are local time.

10:06	Take off
10:12	At 6000 ft
	Aerosol Profile C1
10:24	At 10 000 ft
10:27	Check aerosol inlet heating by turning on and off
10:30	INS Problem noticed: INS did not align at the airport. Decision to continue to flight without INS.
10:37	C1
10:46	Start descenting
10:56	At 5000 ft (+5°C)
	Saw Tooth Cloud Horizontal Profile C1-PS
11:07	Saw tooth ↓ 100 ft/min
11:12	Cloud top at 1600 ft • +1°C • SID3: stable counts (3000 1/s), Dp<100 µm, all liquid cloud • Some patches in cloud
11:23	At 200 ft -> cloud reaches the ground • Ice sheets appearing below
11:26	Saw tooth ↑ 200 ft/min • Few ice particles
11:29	Cloud top at 1200 ft • More ice on cloud top (PHIPS: needles)
11:31	Saw tooth ↓ 200 ft/min
11:33	Cloud top at 1300 ft • Large droplets and big ice crystals at the cloud top
11:38	Satellite overpass, P6 at 600 ft

11:39	Martin: only ice (needles), temperatures around 0°C
11:40	Cloud base at 200 ft • Steady ice counts
11:45	Saw tooth ↑ 200 ft/min
11:47	Droplets and ice, about 50/50
11:49	Low number and size of ice, PHIPS sees no ice
11:50	Cloud top at 1600 ft
11:54	Saw tooth ↓ 200 ft/min • Cloud top at 1700 ft • Ice in all sizes and in all levels in the cloud
11:59	Turn to C2 (almost below the cloud)
12:01	Mostly ice observed (needles and aggregates of needles)
12:02	At 200 ft -> cloud down to ice
12:07	Saw tooth ↑ 200 ft/min
12:11	Cloud top at 1600 ft
12:15	Saw tooth ↓ 200 ft/min
12:16	Cloud top at 1600 ft • Ice in the cloud top
12:24	Cloud base at 400 ft
12:26	At 200 ft • precipitation
12:31	Saw tooth ↑ 200 ft/min
12:35	Cloud top at 1300 ft
12:40	Saw tooth ↓ 200 ft/min • cloud top at 1300 ft
12:46	At 300 ft
	Double Triangle (Vertical Profile) over Polarstern
12:53-13:00	Cross-wind at level 100 ft (below the cloud)
13:04	Level 400 ft
13:06-13:10	Co-wind at level 400 ft (inside the cloud) • mainly droplets but also some ice particles
13:11	Sampled PS blume
13:11	Balloon launch from PS
13:12	Level 600 ft
13:15-13:21	Cross-wind at level 600 ft (inside the cloud) • droplets somewhat larger and have a steady concentration • ice with same concentration as in level 400 ft
13:25	Level 800 ft
13:26-13:31	Co-wind at level 800 ft (inside the cloud) • bigger droplets and stable Ntot • ice particles -> rimed needles
13:32	Out of the cloud due to icing
13:38	Descent into the cloud • cloud top at 1300 ft
13:41-13:48	Cross-wind at level 1000 ft (inside the cloud) • Ntot the same but some tendency towards bi-modal size distribution • Low concentration of ice
13:50	Procedure turn to de-ice above the cloud
13:54	Descent into the cloud
13:58-14:05	Co-wind at level 1200 ft

	• Bi-modal droplet spectrum • Some small ice particles
	Aerosol race track
14:06	Start climbing with 800 ft/min and free speed
14:07	Right turn at 2300 ft
14:09	Right turn at 4300 ft
14:14	Right turn at 8000 ft
14:17	Right turn at 11 000 ft
14:19	At 12 000 ft • Pollution layer observed at 11 000 ft
14:24	Start descent
14:29	Pollution layer at 10 300 ft -> stay in this level
14:32	Ascent to 10 500 ft to follow the pollution layer
14:37	To 11 000 ft
14:48	Aerosol layer at 9000 ft
14:58	At 10 000 ft -> above the pollution layer
15:05	At 9000 ft
15:39	TOUCH DOWN

Instrument Status:

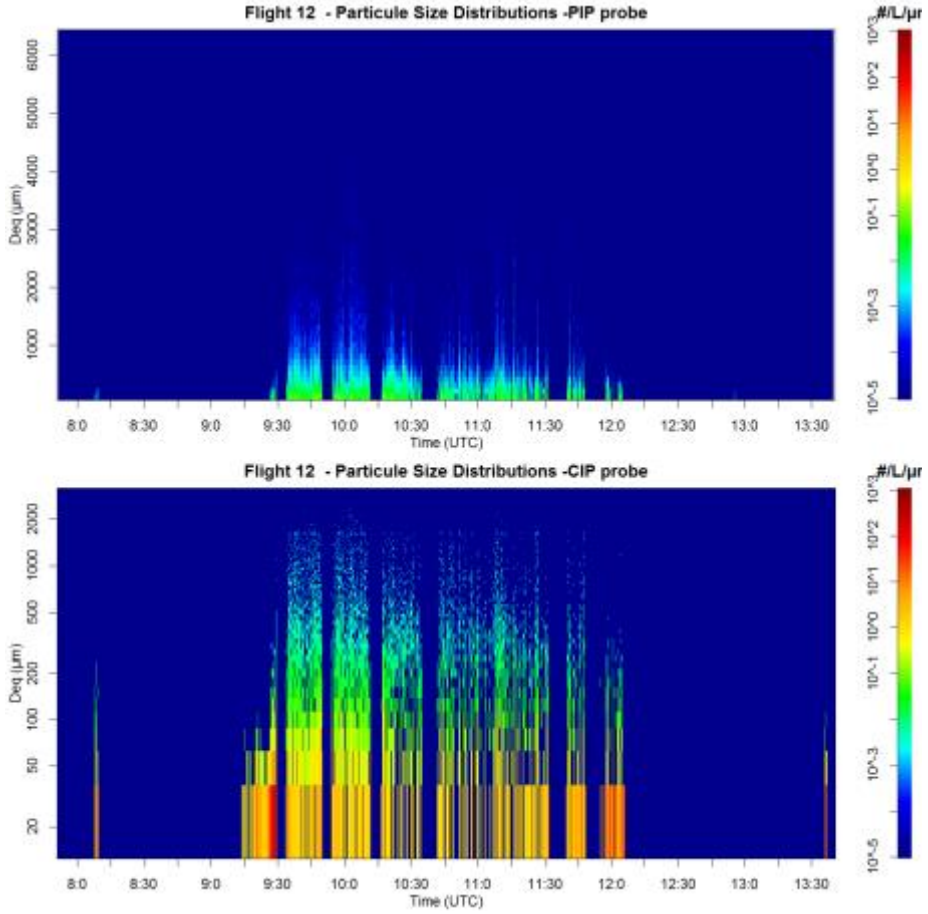
Polar 6	
Basis data acquisition	
Nose Boom	
PHIPS	
SID-3	
CIP	
PIP	
CDP	
ALABAMA	
CVI	
CVI UHSAS	
CVI ???	
AWI SP2	
AWI UHSAS	
CO/CO2/O3	

Comments:

INS did not work.

Quicklooks:

CIP and PIP: size distribution



SID-3: size distribution