

ACLOUD Flight #20 – Polar 5 – 170620

Mission PI P5: Christof Lüpkes

Objectives:

The main goal of the flight was a study of the boundary layer structure and energy fluxes over Fram Strait. The focus was on the profiles of vertical fluxes of heat, humidity, momentum and on radiation fluxes.

Crew:

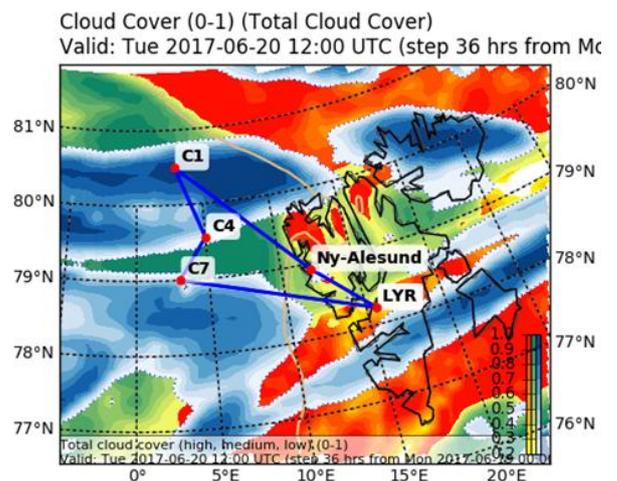
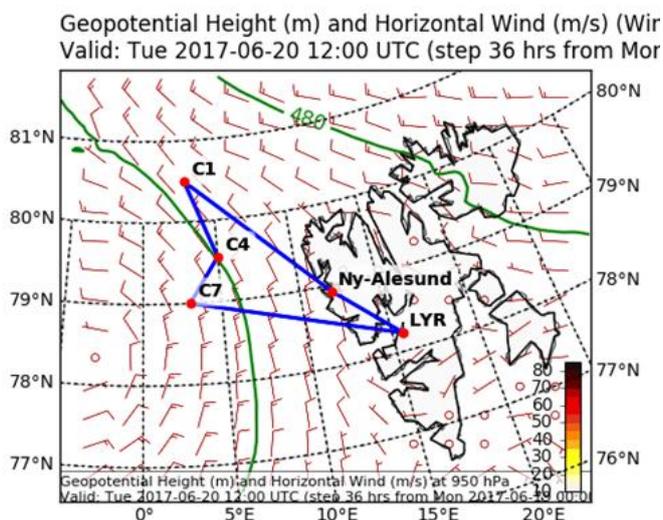
Polar 5	
PI	Christof Lüpkes
Basis Data Acq.	Lukas Kandora
SMART	Johannes Stapf
Eagle/Hawk	Tobias Donth
MiRAC	Tobias Doktorowski
AMALi	Erlend Knudsen

Flight times:

Polar 5	
Take off	07:30 GMT
Touch down	13:55 GMT

Predicted Weather Situation:

GFS and ECMWF predicted northerly winds in the measurement region over Fram Strait west of Svalbard. This flow was caused by a weak high pressure system that had been developing over the sea ice covered region between Svalbard and Greenland with a center at 78.5°N and 3° W. Clouds were predicted by ECMWF as a low-level layer reaching to about 300 ft above the surface and as a layer of high clouds. The Figure below shows the 36 hrs forecast of ECMWF (note that the measurements were carried out in a North-South section along 3° E; the Figure shows only three of 18 waypoints over sea ice.)



Actually, we observed a westerly flow as would have been expected from the forecast only further to the west. The observed cloud fields agreed roughly with the prediction (see also below in the description of clouds).

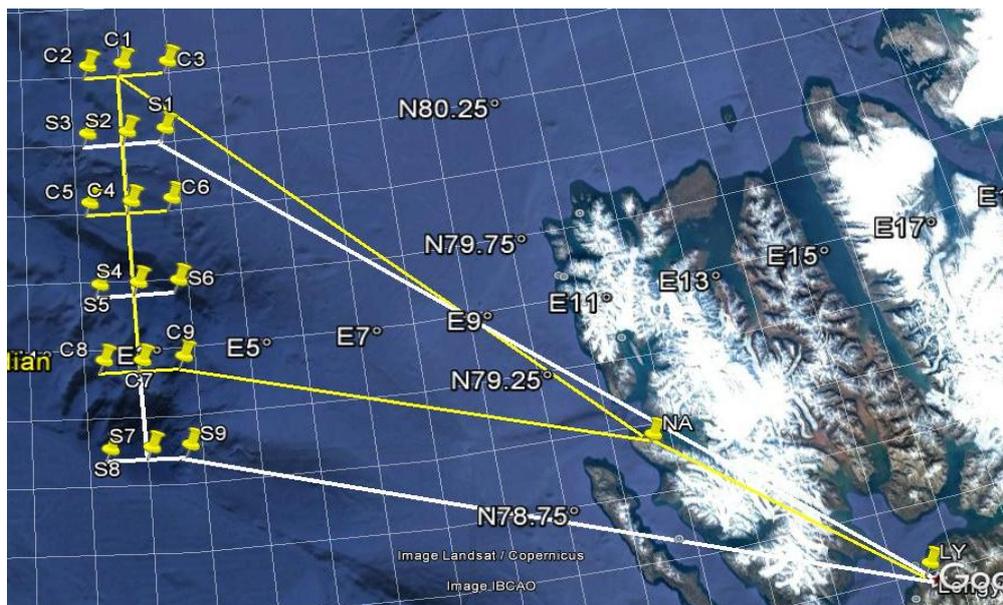
Overview:

The flight strategy was the same as on 14 June during a mission also focussing on the ABL. This means that along the main flight direction horizontal sections (series of 5 cross legs) were flown for the determination of fluxes and the detection of horizontal nonhomogeneity.

P5 did not fly with the planned measurement speed of 120 kn but with 130 kn (information of the pilot) so that the P5 pattern was finished earlier than expected. Thus there was enough time at the end to visit once more RV Polarstern. This time parts of the visit was flown very closely collocated with Polar 6. However, a planned overflow of Ny Alesund on the way back to Longyear was skipped. Over Longyear a calibration pattern followed for EAGLE/HAWK.

Two drop sondes have been released, one on the track from Ny Alesund to C1 (at 79.5°N, the other one on the way back from S9 to Longyear (at 79.25°N).

Flight track and pattern:



The planned flight track is shown in the Figure above. Waypoints C1-C9 refer to the Polar 5 flight, while S1-S9 and white lines refer to the Polar 6 flight. The distance LY to C1 was flown in 10.000 feet, while the lowest levels of the 'flux tracks' followed in 200 ft (with further legs in different heights). On the way back, only the first half of the track has been flown in 10.000 ft due to the meeting with Polarstern.

Detailed Flight Logs:

Clouds

As predicted, there was (see ECMWF forecast shown above) a sector with almost no high-level clouds in a section west of Ny Alesund. This is shown in the foto below.



Further north a closed layer (8/8) of high clouds was found which agreed also with the prediction. Furthermore, at around 79.5 N we reached at 2050 m the top of a mid-level cloud layer which was not seen in the ECMW prediction. Near cloud top there was a section with distinct turbulence. The base of these clouds was found in 1550 m.

In the region of the measurements clouds were very nonhomogeneous with respect to cloud depth, basis, top and visibility in the clouds. Sometimes, they were surface based but, for example, along the section C1-C4 they were clearly elevated from the surface. Some typical fotos are given below in the section with detailed notes.

Sea ice conditions

The sea ice cover was about 95 % showing the typical features of the marginal sea ice zone with drifting ice floes. The estimated diameters of the dominating floes were in the range of 100 – 200 m with very small floes between the large ones. The sea ice surface showed also clear signs of melting with increasing number of melt ponds. Nevertheless, only the initial stage of melting is reached.



Detailed notes during the flight, heights of flight legs:

NY →C1: At the latitude of S5, stronger turbulence occurred near the top of a midlevel cloud layer.

Leg heights at the northernmost position (C2-C3) were 200, 300,400,500,600 ft. The first one was mainly below the clouds the highest one was clearly above the cloud top (see foto below). Boundary layer height was at roughly 400 ft.



Cloud situation during the 200 ft leg C2-C3.



Above cloud top between C2 and C3

Leg C1—C4: At the beginning bad visibility, but after some miles increasing visibility (see foto below).



Leg C1 C4.

Diameter of open water patches increased further in the southern part of the leg.

C5-C6. Leg heights at these positions were 200, 300,400,550,700 ft. Leg 1 was flown clearly below clouds with good visibility. The 400 ft leg was at the beginning at cloud base, but he latter seemed to be variable. At C5 cloud base was clearly higher than 550 ft. The 700 ft leg seemed to be roughly in the center of the clouds. For this reason at the end (from C6 to C4) an additional (half) leg was flown in 900 ft.

C4 to C7: bad visibility within the first few miles but then visibility increased significantly. While approaching C7, it becomes more turbulent.

The top of the ABL was now lower (at 350 ft), so the leg heights were 200, 250, 300, 350, 500 ft. Conditions during the legs were very variable, parts were in light clouds, even light snowfall occurred. It was not possible to clearly identify the cloud base and top.



Between C4 and C7 polynya size increased.

Maneuvers

On the way back Polarstern was overflown together with P6 not far from Ny Alesund.

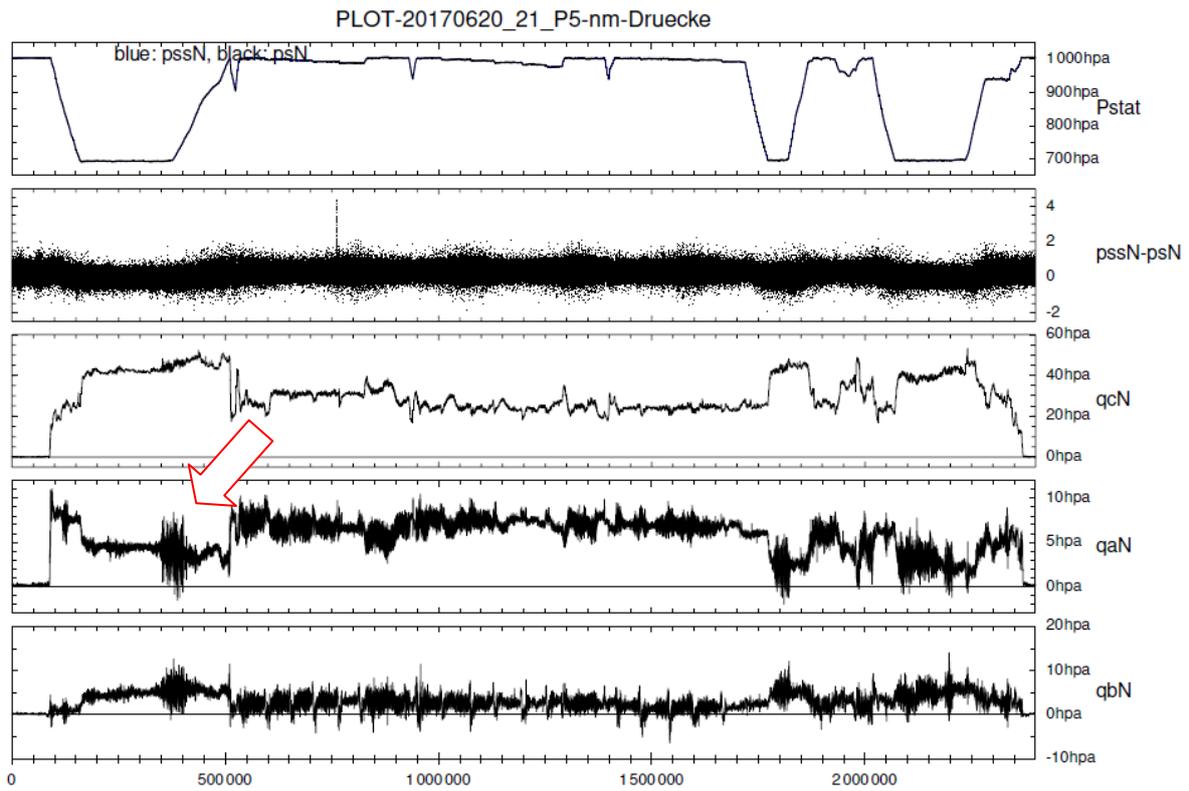


At the end, a calibration pattern followed for EAGLE/HAWK over Longyear airport.

Instrument Status:

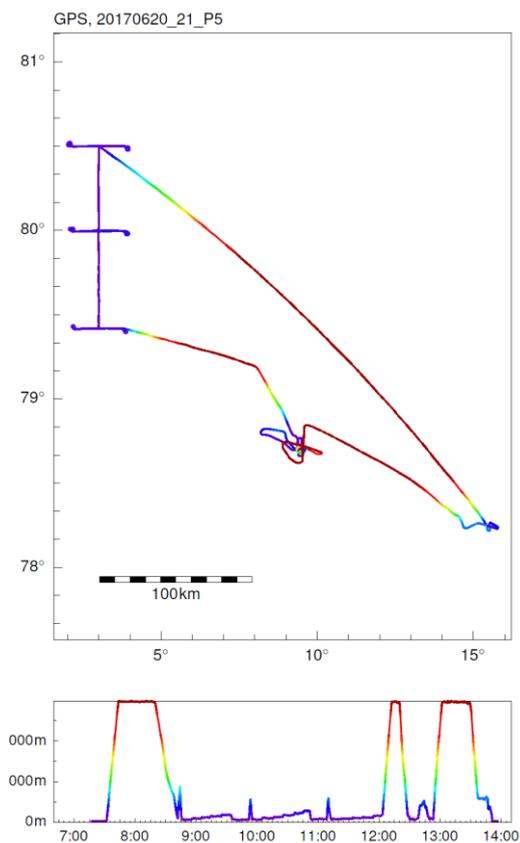
Polar 5	
Basis data acquisition	
Nose Boom	
MiRAC	
HATPRO	
AMALi	
SMART	
Eagle/Hawk	
Drop Sondes	

Quicklooks:



The above figure shows dynamic pressures registered by the noseboom. E.g. the red arrow marks the position with turbulence at cloud top during the flight leg NA-- C1.

The flight pattern is shown below (lowermost figure shows height versus time).



The measurements below from EAGLE/HAWK show the radiance reflected by the surface during one of the low level legs (C5-C6). The two spectra show the radiance spectra at nadir for two different ice floes and the blue plot shows the temporal evolution of the cross-track averaged radiance.

