

ACLOUD Flight #23 – Polar 5 – 170625

Mission PI P5: Christof Lüpkes

Objectives:

The main goal of the flight was a study of the boundary layer structure and energy fluxes north from Svalbard during warm air advection. The focus was on the profiles of vertical fluxes of heat, humidity, momentum and on radiation fluxes.

Crew:

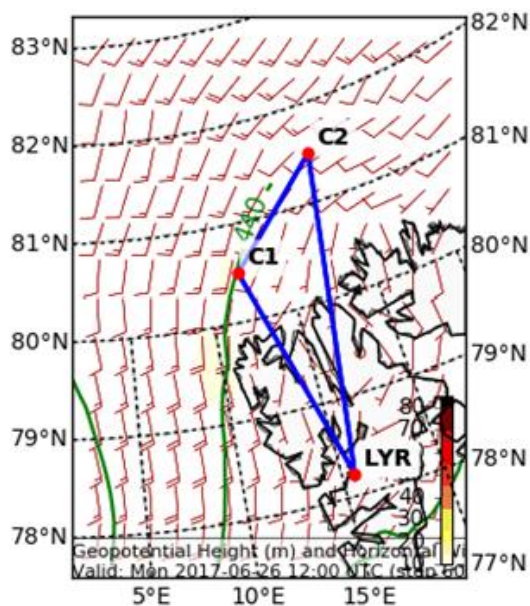
Polar 5	
PI	Christof Lüpkes
Basis Data Acq.	Martin Gehrman
SMART	Johannes Stapf
Eagle/Hawk	Tobias Donth
MiRAC	Tobias Doktorowski
AMALi	Pavel Krobot

Flight times:

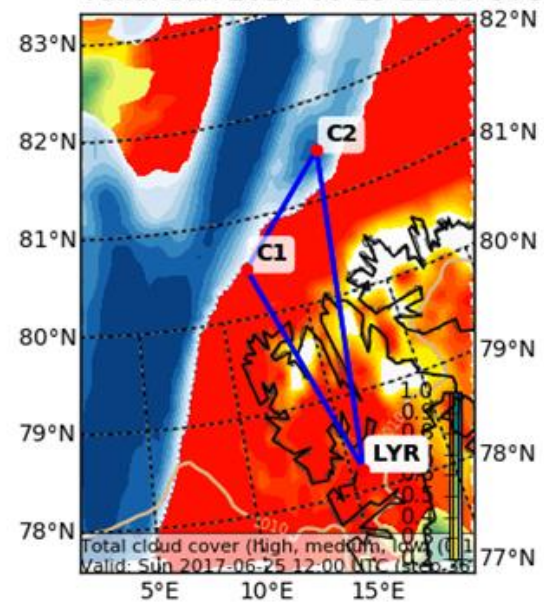
Polar 5	
Take off	13:09 GMT
Touch down	19:30 GMT

Predicted Weather Situation:

GFS and ECMWF predicted winds from southeast in the measurement region north of Svalbard while the cloud prediction differed. GFS predicted no clouds, ECMWF predicted high low cloud cover.



Cloud Cover (0-1) (Total Cloud Co
Valid: Sun 2017-06-25 12:00 UTC



This time, GFS was closer to reality since an ideal clear sky situation was found in the measurement region.

Overview:

The flight strategy was the same as on 14 and 23 June during missions also focusing on the ABL. Along the main flight direction series of 3-5 cross-legs were flown for the flux determination.

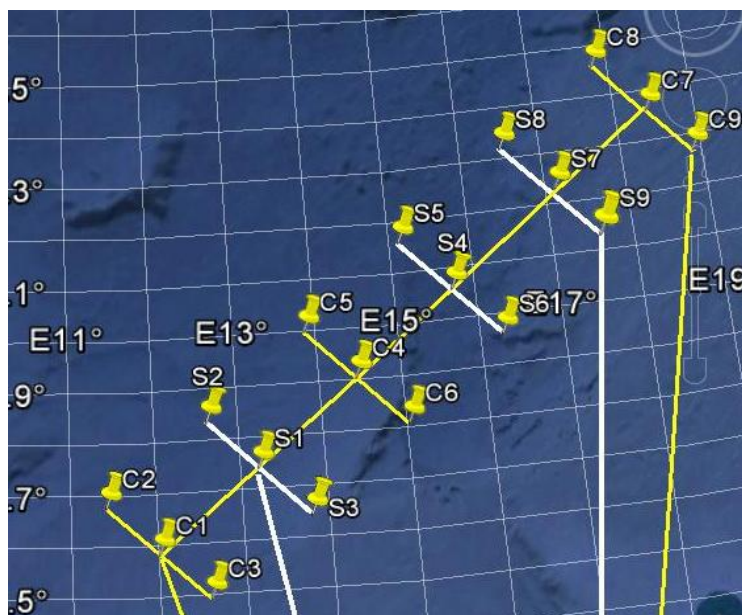
This case was characterized by a very stable stratification in the atmospheric boundary layer due to advection of an air mass with a temperature of +5-7° C in about 400 m height. Thus there was a surface based inversion at the position of the westernmost legs. Along the mean flow the inversion was found to be elevated and was at 120 m at the northernmost position.

The ideal clear-sky conditions allowed some patterns for the determination of the sea ice surface albedo.

Two drop sondes have been released, both over sea ice between the northern coast of Svalbard and the main flight track during the flux pattern (see below).

Flight track and pattern:

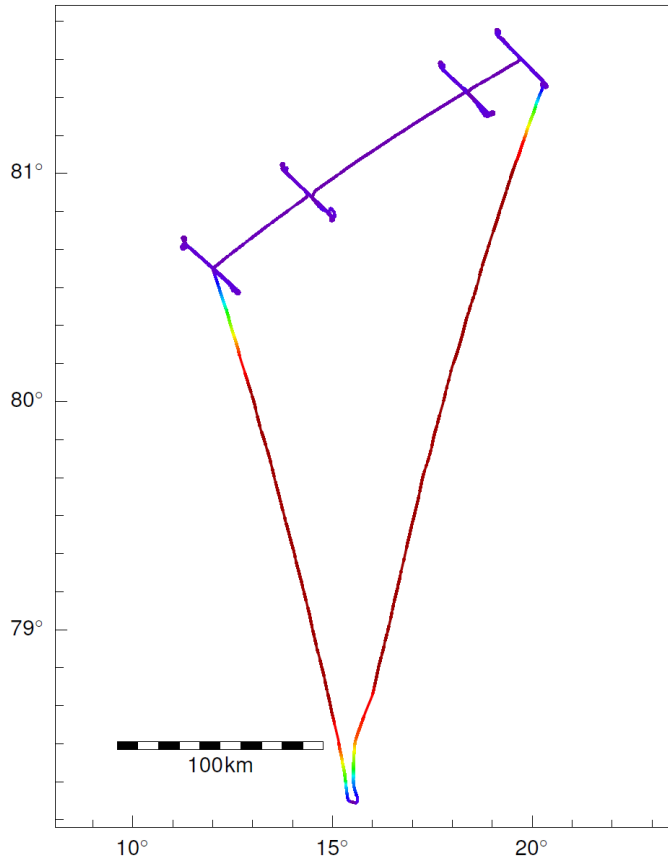
For Polar5, it was planned to fly 5 cross-wind legs for the flux determination at 3 positions as in the previous flights with similar mission plans (Figure below).



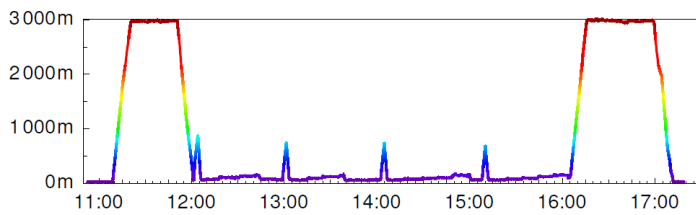
Planned flight track with Polar 5 (yellow) and Polar 6 (white).

However, due to the extremely shallow ABL only three cross-wind legs were flown at the first two positions so that there was time left for another (4th) position with cross-wind legs (see Figure below).

GPS, 20170625_23_P5



Flight path of Polar 5.



Detailed Flight Logs:

Clouds



Over the southern part of Svalbard, there was a closed layer with low clouds as shown on the left. However, these clouds disappeared more and more in the northern part and in the measurement region ideal clear-sky conditions were found

almost during the whole flight pattern. The foto below (view towards Southwest during the first cross-wind leg) shows only some very thin cirrus clouds. This situation did not change

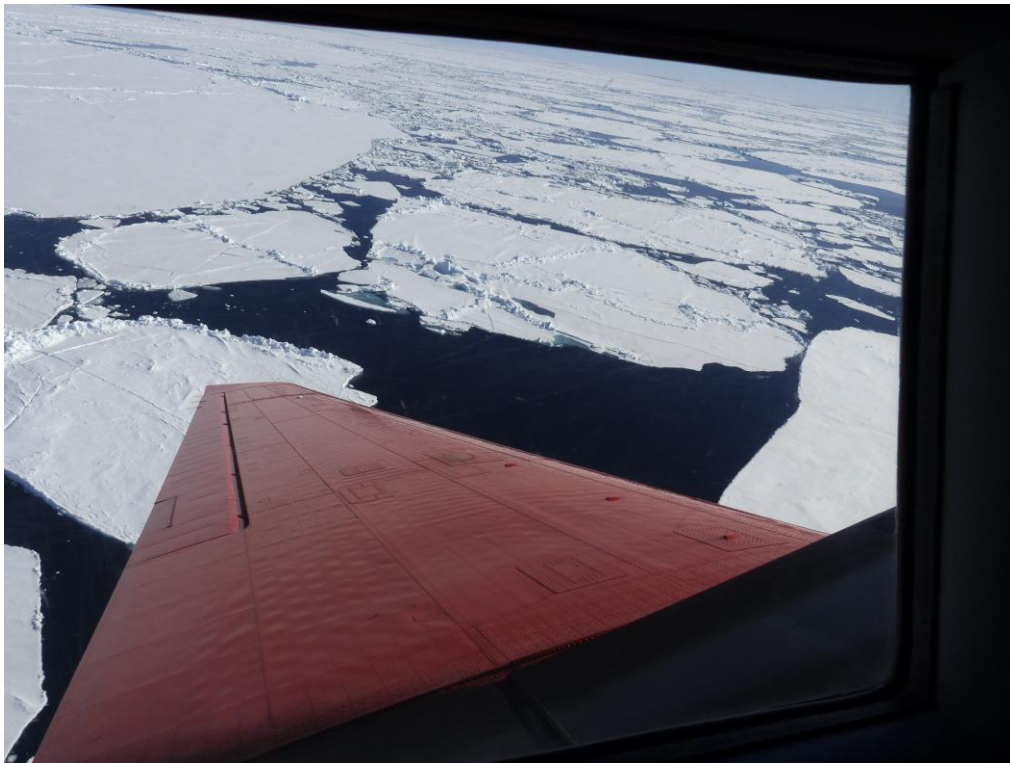


until the third position with cross-legs was reached. About 20 -30 Nm north of the track a layer with low clouds was present as shown below. This layer became clearly visible on the foto only after adjustment of the colours and during the flight it was difficult to identify these clouds.



Sea ice conditions

The sea ice cover was about 90 -95 % with open water patches whose diameters varied strongly. Also the diameter of floes was variable with floes ranging from 30 m to 1 km diameter.



At some locations individual floes could not be identified any more (see below).



The largest open water patches had already lead character as shown below.



Detailed notes during the flight, heights of flight legs:

NY →C1: During descend to C1 the temperature maximum amounted to +7°C at 500 m height. The stable ABL was found to be surface based. For this reason we decided to fly only 3 legs C2-C3 at heights of 200, 300 and 400 ft.

The situation did not change at C4, thus also were only three legs followed, this time at 200, 250 and 300 ft. During these legs only little turbulence was felt in the aircraft, but turbulence increased on the 200 ft leg towards C7. There, the ABL height increased to about 100-120 m and we decided for leg height between C8 and C9 of 200, 250, 300, 350 and 500 ft. At the last position of cross-legs levels were flown at 200, 250, 300, 400, and 500 ft. This last leg became possible by the reduced number of legs at C1 and C4, but also by increasing the speed between positions C3 and C1 after leg 3 and between C6 and C4 on the way to the next 200 ft leg towards north-east.

Maneuvers

Several circles have been flown for the albedo detection. The last one with most ideal conditions with respect to sea ice (large floe) was done after the last cross-leg was flown at the northernmost position.

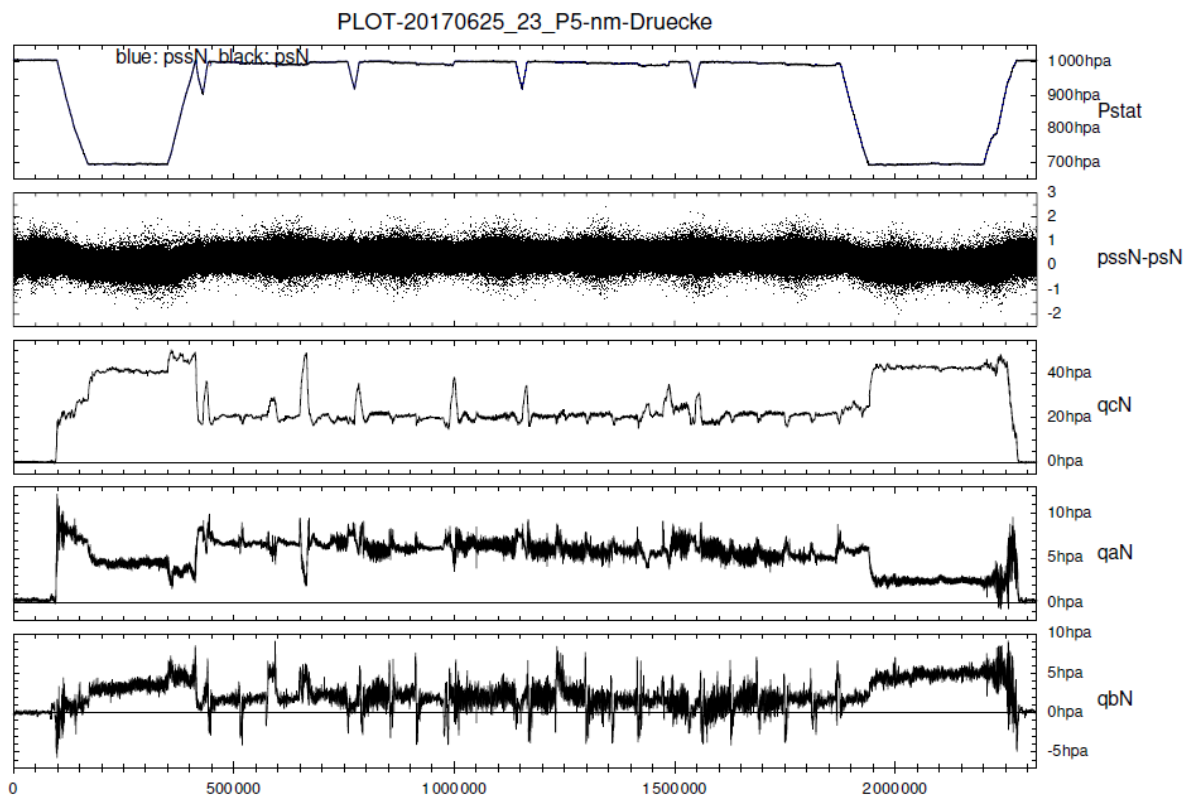
Drop sonde

Drop sondes were thrown over Whalers Bay polynya at 80° 3' N on the track to C1 and another one on the way back between at 81° 6' N and 19° 41' E.

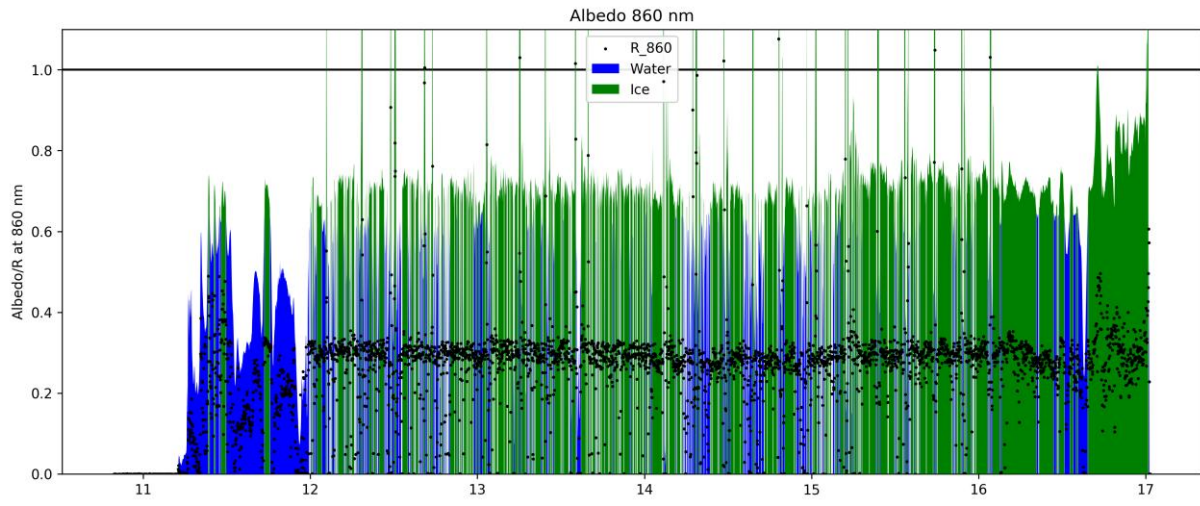
Instrument Status:

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

Quicklooks:



The above figure shows static and dynamic pressures registered by the noseboom. One can see (two lowermost graphs) that the variability is increasing from left to right indicating increasing turbulence towards North.



The figure above shows the albedo and reflectivity measured by SMART (860 nm).