

ACLOUD Flight #17 – Polar 5 – 170614

Mission PI P5: Christof Lüpkes

Objectives:

The main goal of the flight was a study of the boundary layer structure and energy fluxes in the environment of RV Polarstern. The focus was on the profiles of vertical fluxes of heat, humidity, and momentum as well as radiation.

Crew:

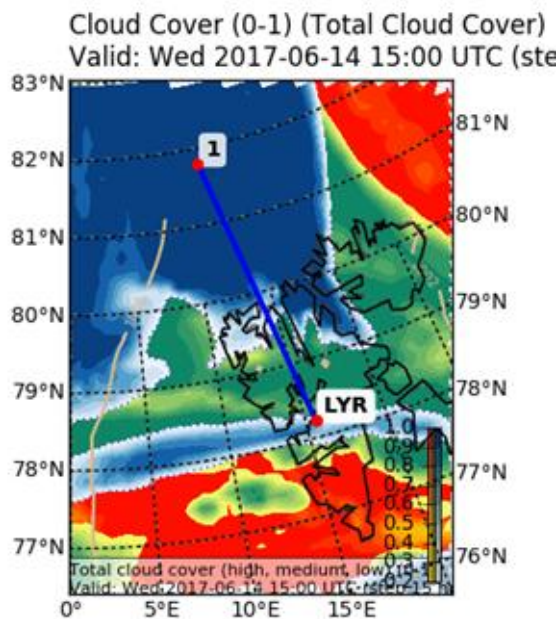
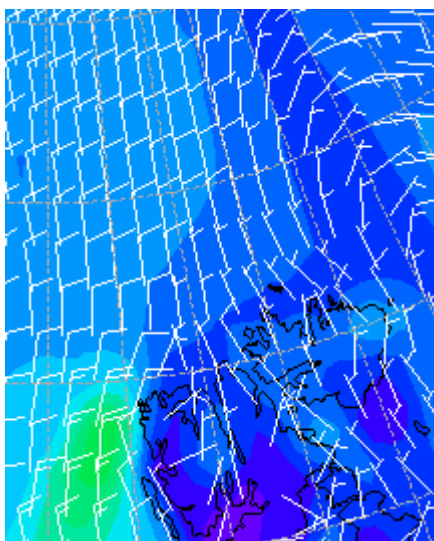
Polar 5	
PI	Christof Lüpkes
Basis Data Acq.	Lukas Kandora
SMART	Johannes Stapf
Eagle/Hawk	Tobias Donth
MiRAC	Tobias Doktorowski
AMALi	Ana Radovan

Flight times:

Polar 5	
Take off	12:48 GMT
Touch down	08:50 GMT

Predicted Weather Situation:

Measurements were carried out north of Svalbard during predicted northerly flow of roughly 10 Kn (below: 12 UTC prediction of GFS). In the measurement region an elevated layer of low clouds was predicted as well as high clouds. Mid-level clouds had been expected for the region between Longyear and the northern coast of Svalbard.



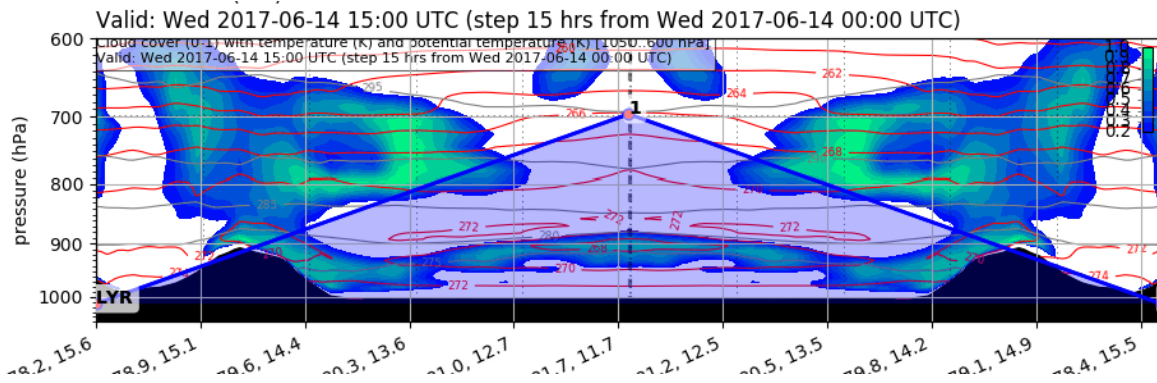


Figure: ECMWF 15 hr forecast of cloud situation along the flight track. Polarstern position is at point 1.

The observed cloud features agreed roughly with the prediction. The main difference: many clouds appeared to be surface based in reality. This differed from the prediction of an elevated cloud layer.

Overview:

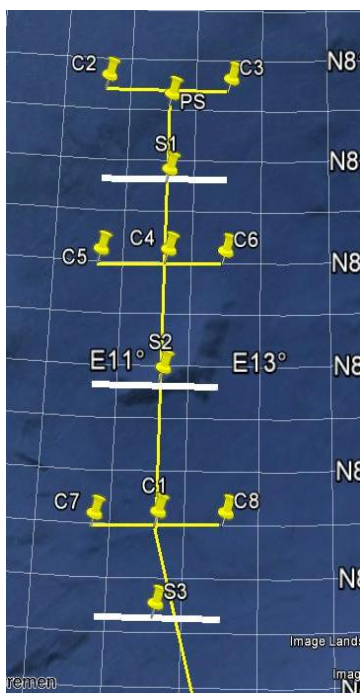
The flight strategy was to measure first the cloud structure by the remote sensing instrumentation (Lidar, Eagle Hawk, Mirac) flying at 10.000 ft in northerly direction from C1 to Polarstern. Then the inflow profiles of wind and temperature were obtained during a fast descend reaching Polarstern in 200 ft. Fluxes were measured then along flights in five different heights between 200 ft and cloud top at three positions.

The flight was performed in close collocation with Polar 6 measuring e.g. fluxes at further positions along the Polar 5 track.

At the end of the flight the last horizontal flight leg had to be finished a little earlier than planned due to sudden icing.

Also several drop sondes had been launched (see below).

Flight track and pattern:



The planned flight track is shown in the Figure on the left. Waypoints C1-C8 refer to the Polar 5 flight, while S1, S2, S3 and white lines refer to the Polar 6. C1---C4 was flown in 10.000 feet, while the 'flux tracks' were flown orthogonal to this direction. Each of them lasted 8 minutes corresponding to 16 Nm. Between PS and C4 as well as between C4 and C1 Polar 5 performed measurements in 200 ft.

Drop sondes were released at C1, C4 (outbound) and south of S3 (inbound flight).

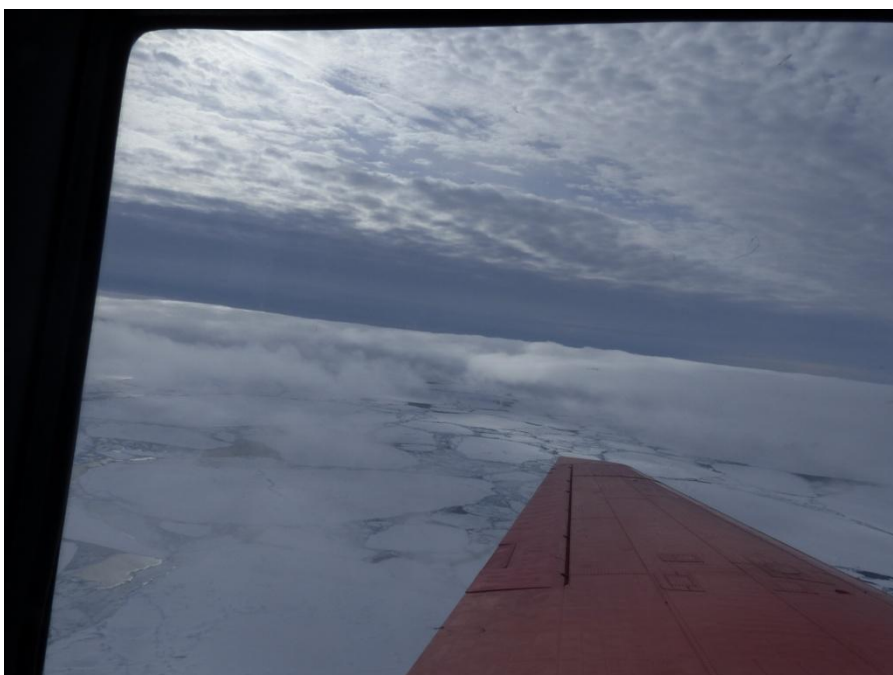
Detailed Flight Logs:

Clouds

As predicted, there were two cloud layers (high and low) as shown in the foto below taken at a position between S1 and C4.



Further north the fraction of the low clouds decreased as shown by the foto below that was taken not far from Polarstern.



During all legs the altitudes of cloud base and cloud top were rather nonhomogeneous. For example, on the leg C2 C3 close to Polarstern clouds were surface based while farer away on the same leg, they were elevated from the surface. The thinner clouds had tops in 1200-1300 ft while other cloud tops were at least 200-300 ft higher (estimated values since we did not fly at the level of the higher cloud tops). Towards south, the cloud tops were on average at higher altitudes (around 1400 ft) but also this value is an estimate due the strong inhomogeneity.

Some further fotos of the cloud situation are added in the following:



An example of large (low) cloud cover (adjusted colours)



Another example showing that some parts of the legs were almost free of low clouds.



An example with surface based clouds.

Sea ice conditions

There was a slight North South gradient in sea ice cover with higher sea ice concentration and larger floes in the North and lower sea ice cover and smaller floe diameters in the South. However, along the 16 Nm leg (C7 C8) the sea ice (cover, floes, ridges) looked over some miles very similar to the situation found in the North close to Polarstern.



The left Figure shows an example with small floes.



An example with large floes between C5 and C6.

There were indications for melting. We observed grey, dark snow patches, but only very few melt ponds were clearly identified. Most pond-like structures seemed to be flooded ice floes in the vicinity of ice ridges.

Detailed notes during the flight, heights of flight legs:

S3→C1: 8/8 low clouds, 6/8 cirrus clouds

C2→ C3: legs in 200 ft, 400 ft, 600 ft, 800 ft, 1200 ft (cloud top, and inversion base)
1200 ft leg, mostly at cloud top, but sometimes still within clouds

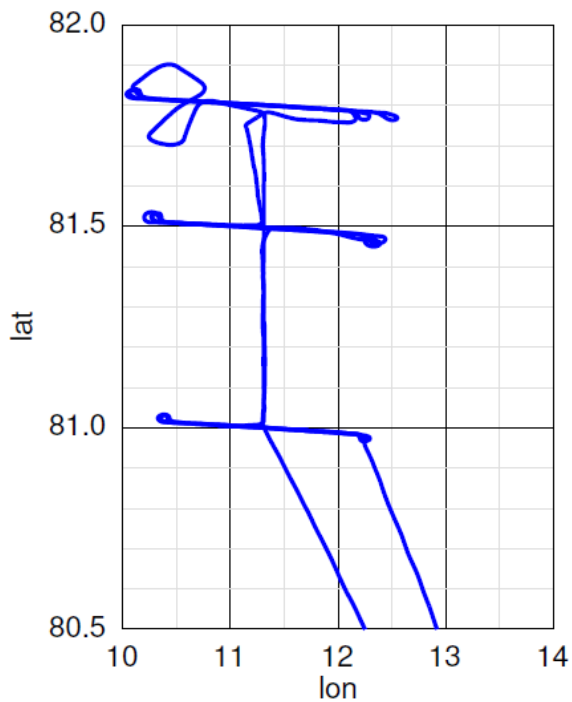
PS→ C4 mostly good visibility

C5→C6,: legs in 200 ft, 400 ft, 600 ft, 850 ft, 1200 ft. More indications for melting, in the eastern part of the leg initially less open water, at the end again more open water. Clouds elevated from the surface with a very variable base, the 400 ft leg sometimes at cloud base, sometimes below.

C4 → C1 in 200 ft, initially in clouds, later elevated clouds.

C7→C8: legs in 200 ft, 400 ft, 600 ft, 800 ft, 1300 ft. The last leg had to be aborted due to strong icing.

Maneuvers



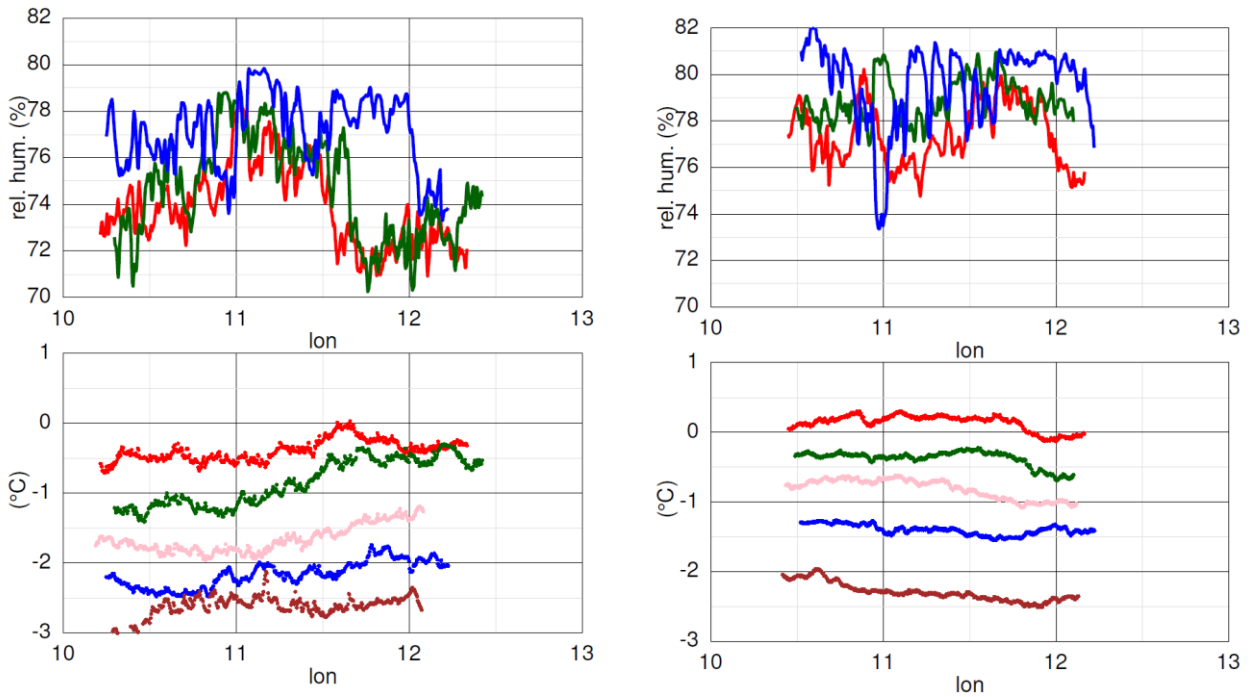
The position of Polarstern was a few Nm west of the expected one, so that the position of the northernmost leg (C2-C3) was slightly shifted. (The goal of this maneuver was to have Polarstern in the center of the leg).

A drop sonde that was planned for C1 had to be launched later (between S1 and Svalbard) due to GPS alignment problems.

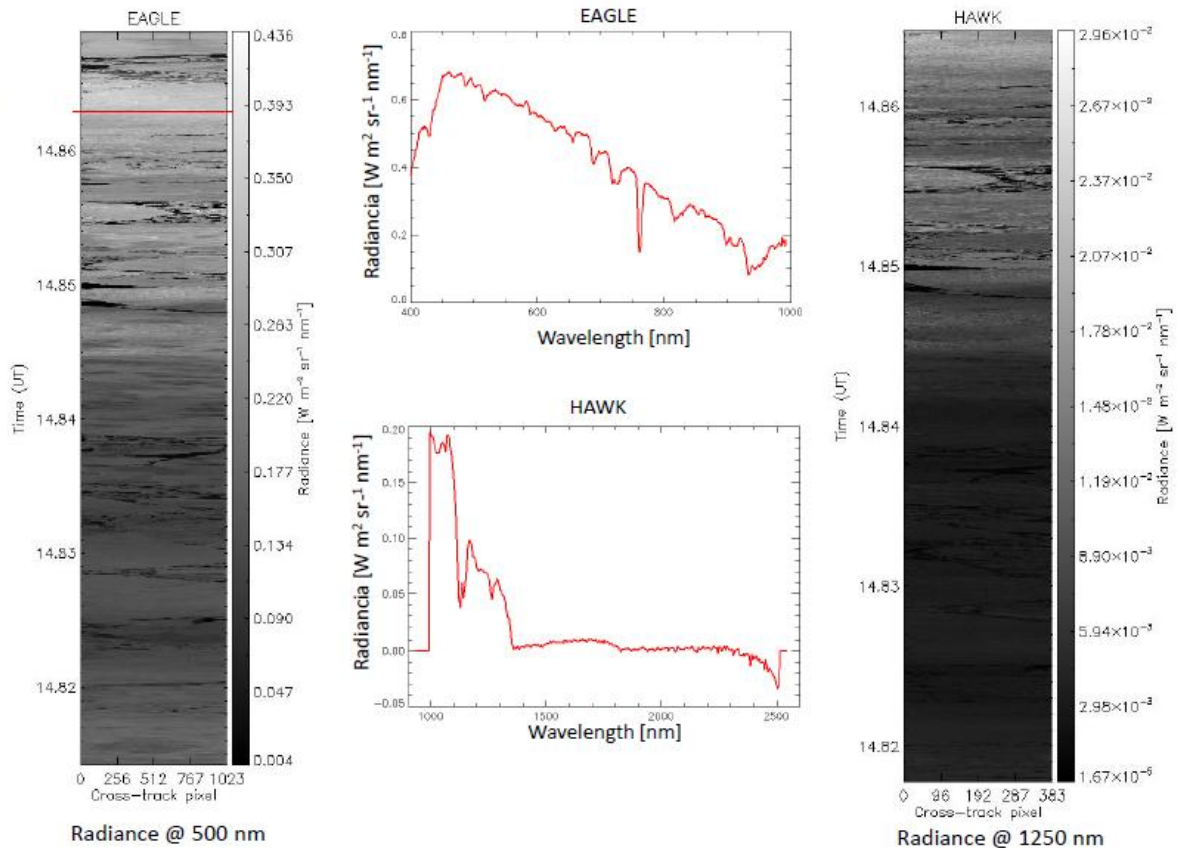
Instrument Status:

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

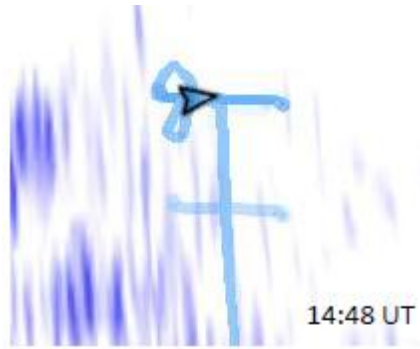
Quicklooks:



Raw data of the noseboom instruments show differences between the temperatures (brown: lowest level, red: highest level) measured in the north (left) and the south (right). Differences were found also for the humidity. At the southern position relative humidity and temperatures were obviously higher than in the north.



Systematic difference can be seen also in the radiances obtained by Eagle/Hawk at different positions of the northernmost legs (see Figure above and Figure below).



Different positions

Referring to the figures above and below.

