

## ACLOUD Flight #08 – Polar 5 – 170529

Mission PI P5: Christof Lüpkes

Objectives:

The main goal of the flight was a study of the cloud development during a cold air outbreak over the Northern Fram Strait. Secondary goal: Nose boom calibration.

Crew:

Polar 5	
PI	Christof Lüpkes
Basis Data Acq.	Christoph Petersen
SMART	Johannes Stapf
Eagle/Hawk	Evelyn Jäkel
MiRAC	Tatiana Nomokonova
AMALi	Tobias Doktorowski

Flight times:

Polar 5	
Take off	04:54 GMT
Touch down	08:50 GMT

Predicted Weather Situation:

Still, cold air was flowing off the sea ice in southerly direction (see Figure below) with wind from northeast as seen in the figure below showing the 3 hour GFS forecast for 9 Z (wind and low clouds). The flight was carried out early due to an approaching front from east across the entire Svalbard region.

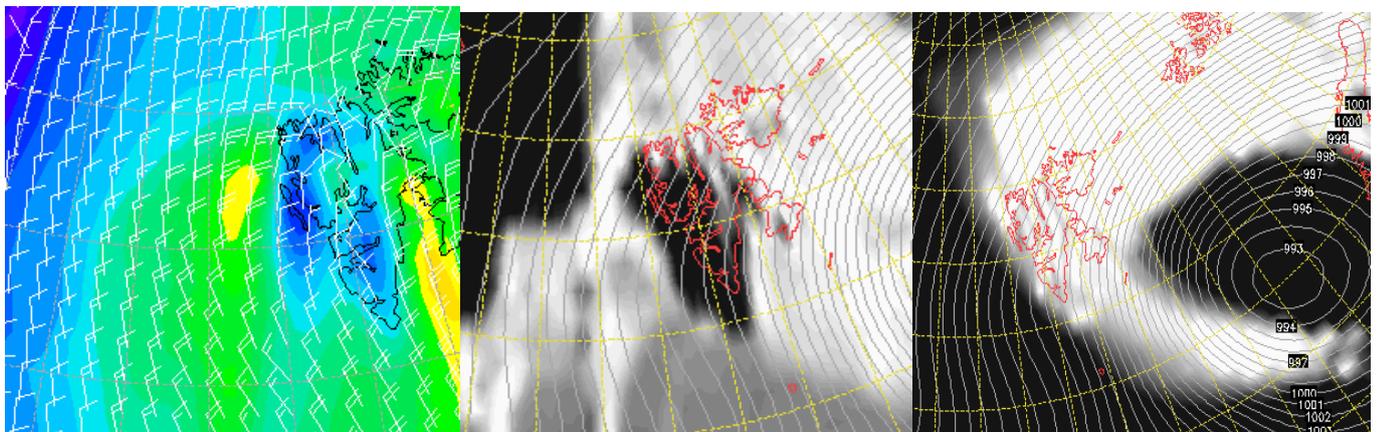


Figure: 10 m wind, low clouds (middle) and high clouds (right) from 9 Z GFS 3 hr prediction.

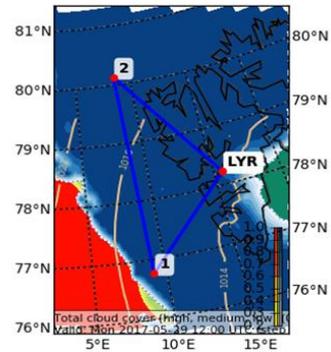
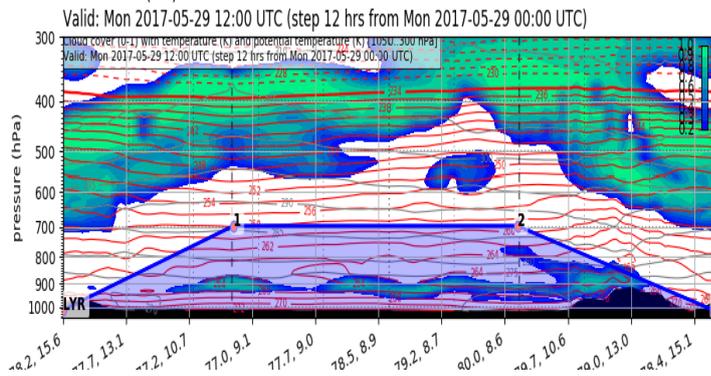


Figure: ECMWF 12 hr forecast of cloud situation

Low clouds were predicted for the ice free part of the Fram Strait and the marginal sea ice zone (see Figure above). The observed situation agreed well with the prediction clouds were sometimes surface based at the position of the northernmost box.

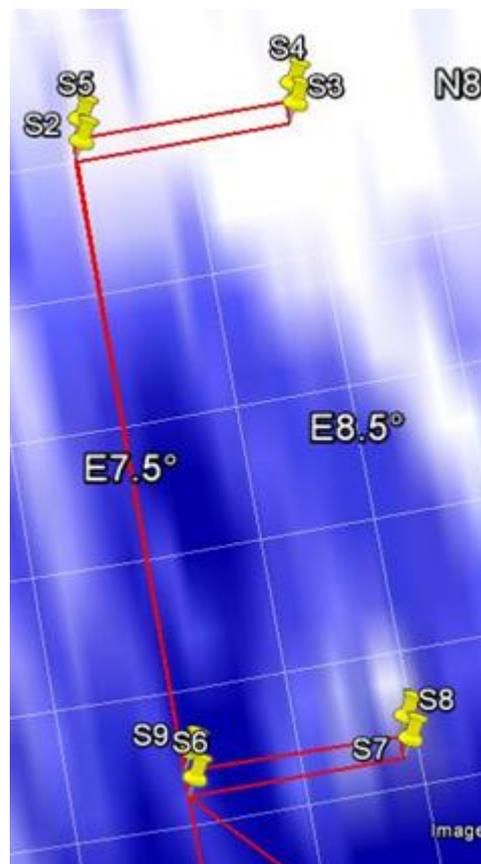
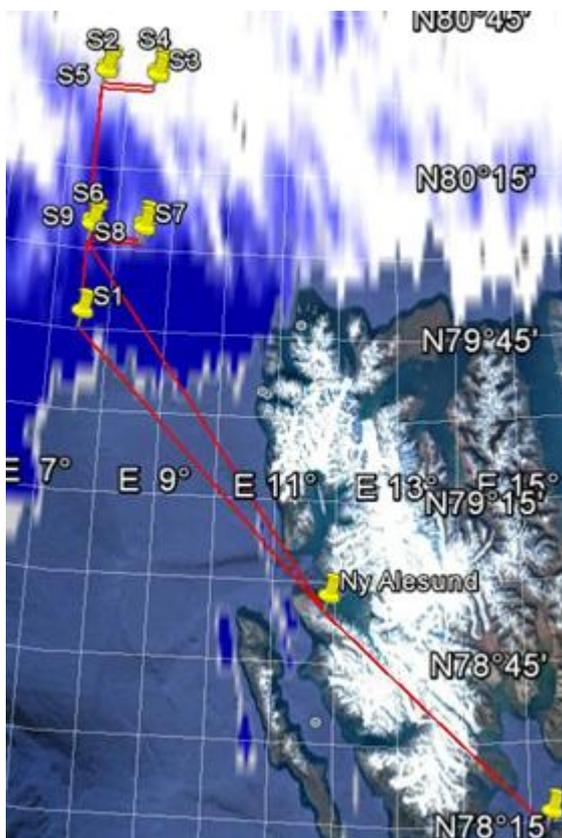
### Overview:

The flight strategy was to measure the cloud structure by the remote sensing instrumentation (Lidar, Eagle Hawk, Mirac), the inflow profile of wind and temperature over sea ice at the northernmost position, and near-surface turbulent fluxes along two boxes over sea ice with P5. Another box should follow with P6 flown between the northern and southern box of P5.

Horizontal legs should be flown in the boundary layer in different heights.

Albedo measurements were planned over the glacier between Longyear and Ny Alesund at 1000 ft and in the region of the boxes.

### Flight track and pattern:



F

Figure: flight pattern.

## Detailed Flight Logs:

### Clouds

As predicted, there were only cirrus clouds over Svalbard increasing in thickness towards East (see photo below taken over the glacier).



*Foto (taken at 7:06 Z)*

### **Cloud situation over Fram Strait**

Cloud cover increased considerably over Fram Strait with typical coldair stratocumulus rolls.



Foto taken over Fram Starit at 07:40 Z.

Over the northern box, low cloud was still high (7/8 - 8/8). Some clouds were surface based causing bad visibility at 200 ft.

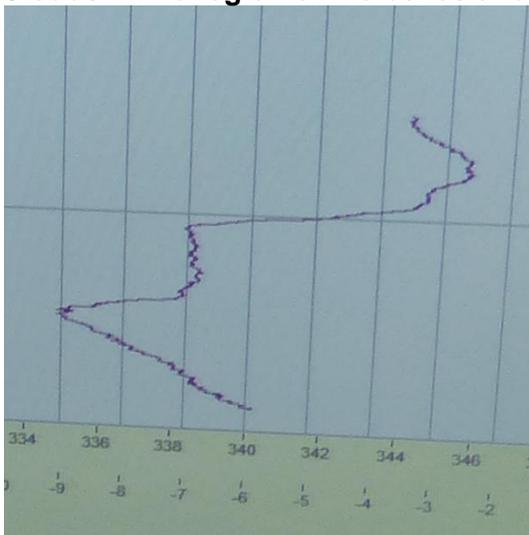


**Foto:**

During first 200/400 ft leg at northern box



**Clouds in the region of the boxes and boundary layer**



**Quicklook of temperature profile (noseboom)**

Lowermost inversion base is at 1500 ft. The secondary inversion base at 3000 ft (height marked by horizontal grey line).

About 90 % cloud cover (low clouds) has been observed at the position of the northern box. Some clouds were surface based, visibility was very low (about 1 km and less ). Cloud tops were at 1500 ft (north) and 1300 ft at the southern box. Cloud base increased significantly on

the way towards south to about 800 ft at the southern box. As shown in the Figure above, there were multiple inversions, the lowermost in 500 ft, but clouds extended up to 1300-1400 ft.

### **Maneuvers**

The northern boxes consisted of four flight sections in different heights. The first one was started at 200 ft, however, the leg had to be interrupted due to decreasing visibility along the flight leg. The remaining leg was flown in 400 ft. The other legs followed in 700, 1000 and 1300 ft. The latter was 100, 200 ft below cloud top.

A low-level leg at 200 ft followed on the way towards south (S2 → S6). There, the visibility increased significantly and clouds were not any more surface based.

The southern box at S6 was flown in 4 levels 200 ft, 400 ft, 800 ft, and 1200 ft. The last base had to be interrupted due to strong icing and vibrations during the flight.

### **Sea ice conditions**



During 200 ft leg between S2 and S6.

There was large sea ice cover, but several ice free small polynyas and leads occurred along the tracks.



Between S6 and S7

At the southern box (between (S6 and S7) also drifting floes were observed during the first third of the leg.

**Instrument Status:**

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

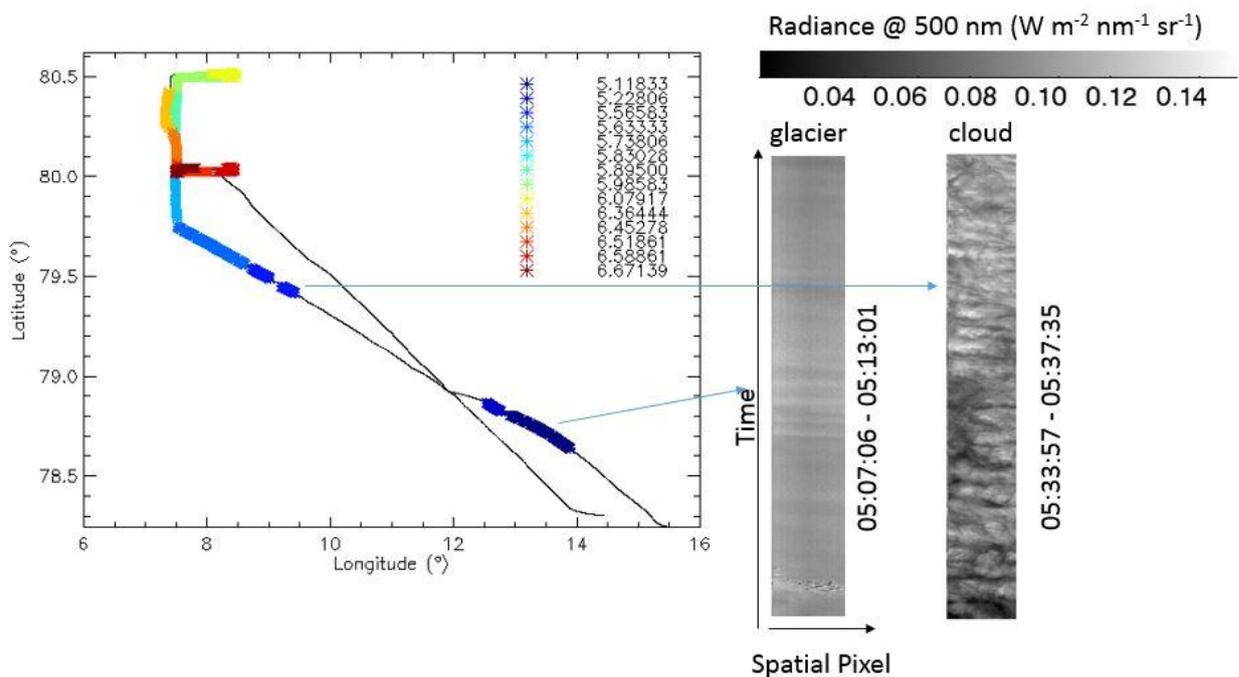
Instrumental problems

Noseboom was working only at the northern boxes due to strong icing (as seen after the flight).

**Quicklooks:**

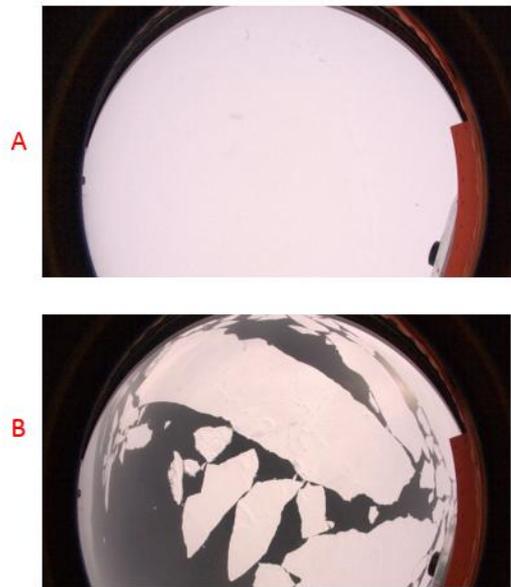
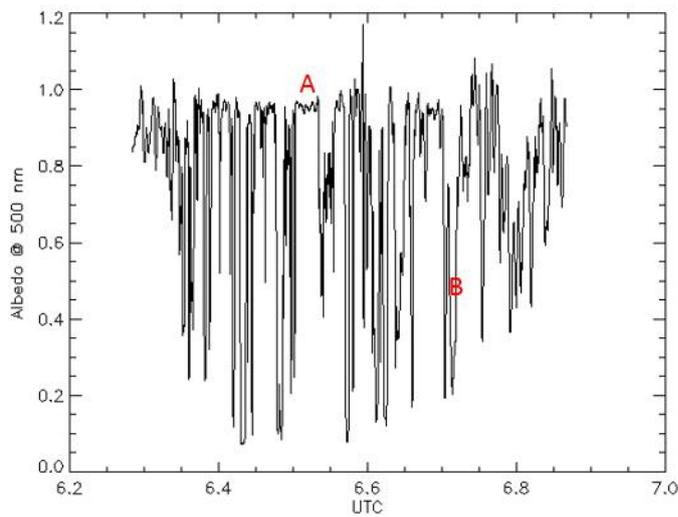
Figure Q1 shows the terrestrial net flux density profile measured during the first descend at 80.6545 N, 3.532 E down to 200 ft (Time: 10:52 UTC / SOD 39125 - 39290, Lon 3.532 E, Lat 80.6545 ). A double layer structure can be seen with derived cloud top cooling for the upper layer of up to  $-8 \text{ K hr}^{-1}$  and cloud base heating of  $5 \text{ K hr}^{-1}$ .

Eagle Data:

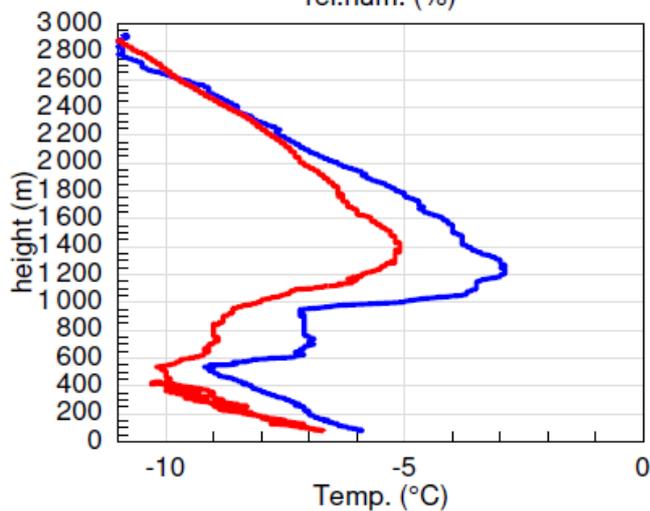
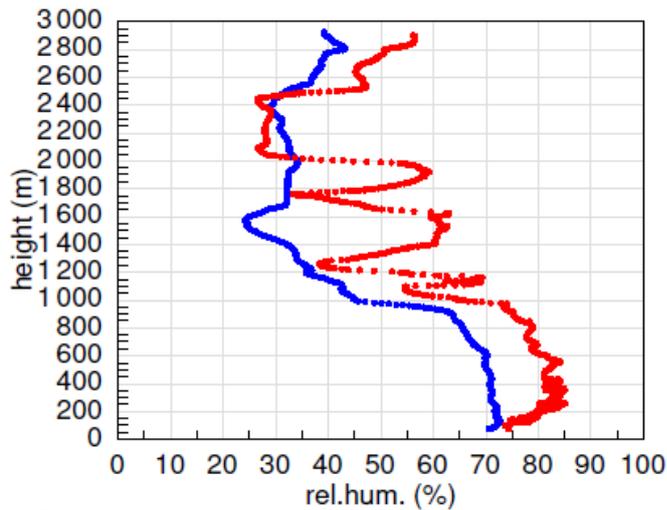


left: measurements of Eagle along track, right: two examples of spectral reflected radiance over glacier and cloud

SMART + Canon



Left: time series of surface albedo @ 500 nm, right: Canon images for period A and B.



Observed (noseboom) temperature and humidity profiles at the positions of the northern box (blue) and southern box (red). It is unusual that for northerly wind the temperature in the south is lower than in the north. This needs, however, further inspection since the shown curves do not yet contain the correction for dynamic pressure.