ACLOUD Flight #04 – Polar 5 – 170523

Mission PI P5: Christof Lüpkes

Objectives:

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

Crew:

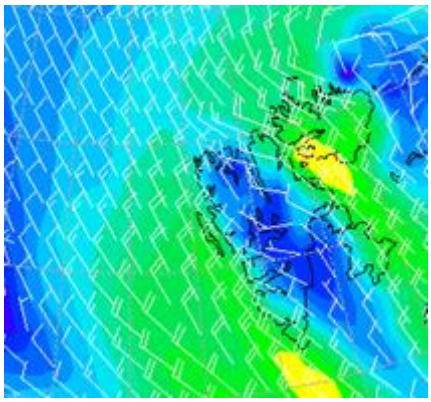
Polar 5	
PI	**Christof Lüpkes**
Basis Data Acq.	**Christoph Petersen**
SMART	**Johannes Stapf**
Eagle/Hawk	**Elena Ruiz**
MiRAC	**Tobias Doktorowski**
AMALi	**Friedhelm Jansen**

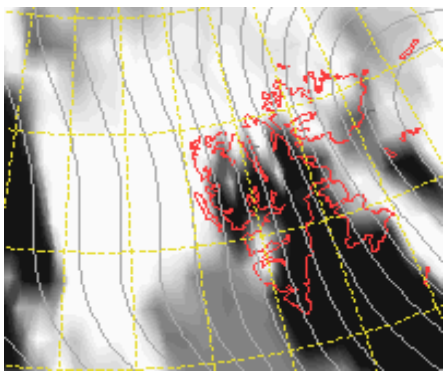
Flight times:

Polar 5	
Take off	**09:08 GMT**
Touch down	**14:20 GMT**

Weather situation as observed during the flight:

The weather was characterized by a weak coldair outbreak with wind from northeast as seen in the figure below showing the 3 hour GFS forecast for 9 Z (wind and low clouds).



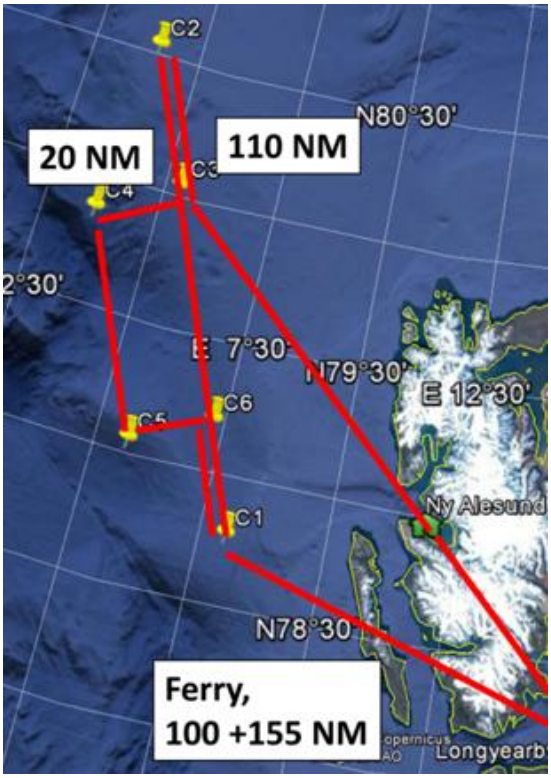


The predicted wind direction agreed well with the (visual) observation (based on wave orientation in leads) during the flight. Over sea ice the observed cloud cover was smaller than predicted (see below).

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 temeperature over sea ice at the northernmost position, and near-surface turbulent fluxes along several flight legs over the sea ice covered part and over open water.

Flight track and pattern:



The figure shows the planned flight pattern.

Flights should be performed in 10.000 ft from C1 to C2.

At 200 ft: C2→ C3 →C4 → C5→C6

Then in 10.000 ft:

C1 → C6→ C5→C4 → C3 → Ny Alesund

Due to icing conditions (precipitating clouds), the low level flight sections had to be aborted close to C5. Some problems occurred with the Eagle Hawk and Smart Albedometer. They were working only during parts of the flight. The shortening of the low-level flight section (no low-level leg C5→ C6) allowed later a high altitude calibration pattern for the noseboom.

Detailed Flight Logs:

Clouds

Although convection rolls could be seen in the satellite image, during the whole flight section from C1 to C2 clouds appeared to be homogenous (complete cloud cover; stratus and stratocumulus). Only over the sea ice part close to half the way between C3 and C2 convection rolls were visible.

Cloud situation between C1 and C3 (left).

Cloud cover decreased considerably a few miles south of C2. The reduction was stronger than expected based on the GFS and ECMWF model forecast.

During the low-level flight from C2 to C3 low cloud cover increased from about 30 % at C2 to 100 % at C3. Cloud tops at C2 were in about 1200 ft, cloud base in 600 ft. Towards C3 cloud base decreased more and more and some clouds over leads were surface based. Between C3 and C4 low cloud cover was 100 % , we crossed one shower (snow). Close to C5 a shower was that strong that the pilots had first to interrupt the straight line of the track (turning more to the west) and afterwards they decided to go up above the cloud top. An attempt was made to fly 200 ft below cloud top (roughly 4500 ft) between C5 and C6. However, also this had to be aborted due to icing.

Maneuvers

Two noseboom calibration patterns were flown. The first one (between C2 and C3) consisted of acceleration and deceleration legs staying at the same height (200ft). The second one (at C3) consisted of 3 squares with 3 Nm edge length flown with different speed (100, 120, 145 kn) in 10.000 ft .

Sea ice conditions

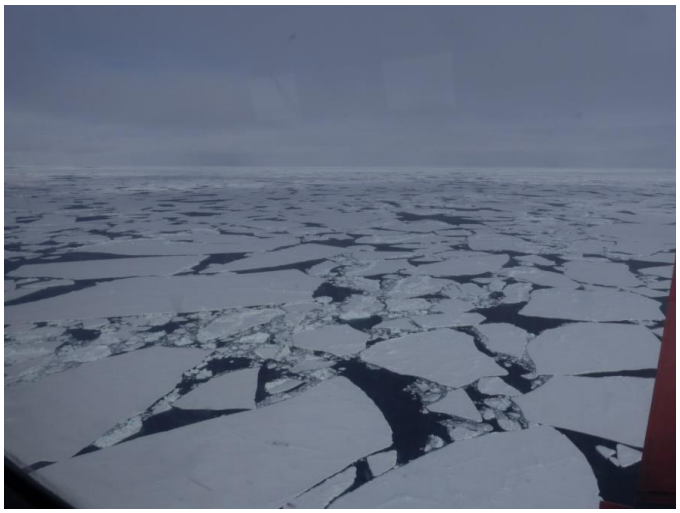
Sea ice was visible only during the low level sections C2→C3→C4→C5.
At C2 there was 95% sea ice cover with open small leads (no nilas visible) and polynyas (estimated width 100 – 200 m).

At C2.

Further south, the number and width of leads increased (see below).

Between C2 and C3

Between C4 and C5 sea iced opened more and more and the typical ice floe structure of a marginal sea ice zone developed.



Half the way between C4 and C5

The ice edge was reached at about 79 N 5 E (see foto below, left).

But close to C5 there were still some drifting ice fields (right foto, above). The foto has been taken shortly before the low-level section had to be terminated .

Instrument Status:

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

Instrumental problems

Eagle/Hawk: Some problems occurred due to a broken cable.

SMART: Connection sometimes interrupted for unknown reason.

Drop Sondes: System was not working , reason unknown.

Quicklooks:

SMART

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 K hr^{-1} and cloud base heating of 5 K hr-1 (Johannes Stapf).

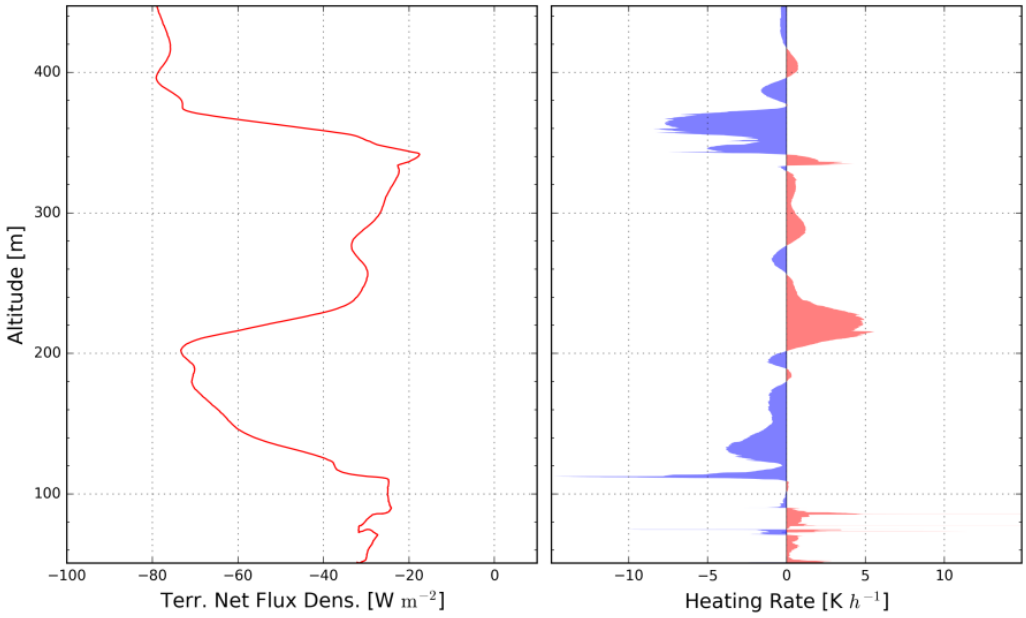


Fig. Q1:

Radiation data

NOSEBOOM

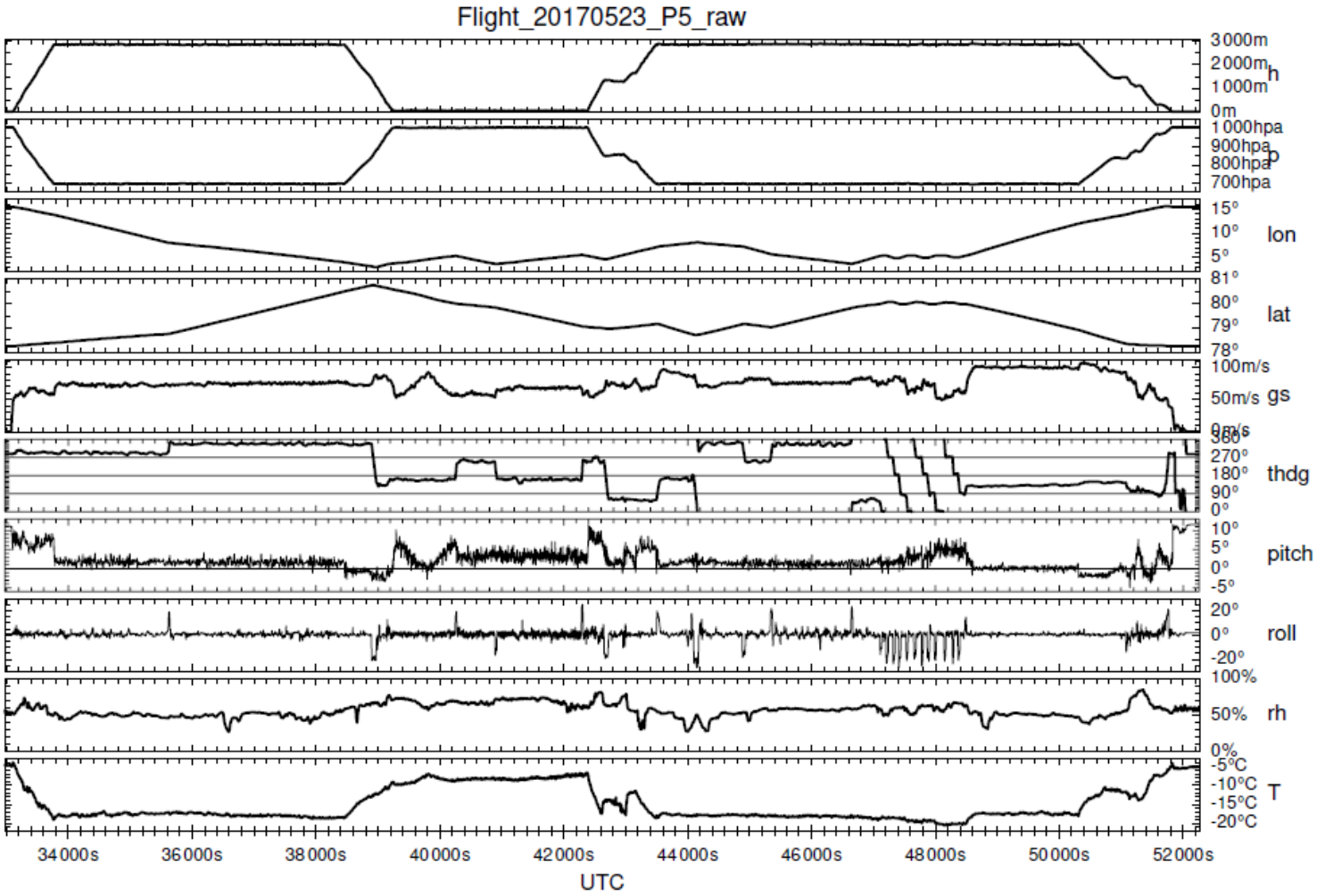


Figure Q2: Noseboom data for the whole flight (1 s averages of height, longitude, latitude, roll and pitch angle of the aircraft, ground speed, true heading, relative humidity and temperature (Jörg Hartmann).

MIRAC

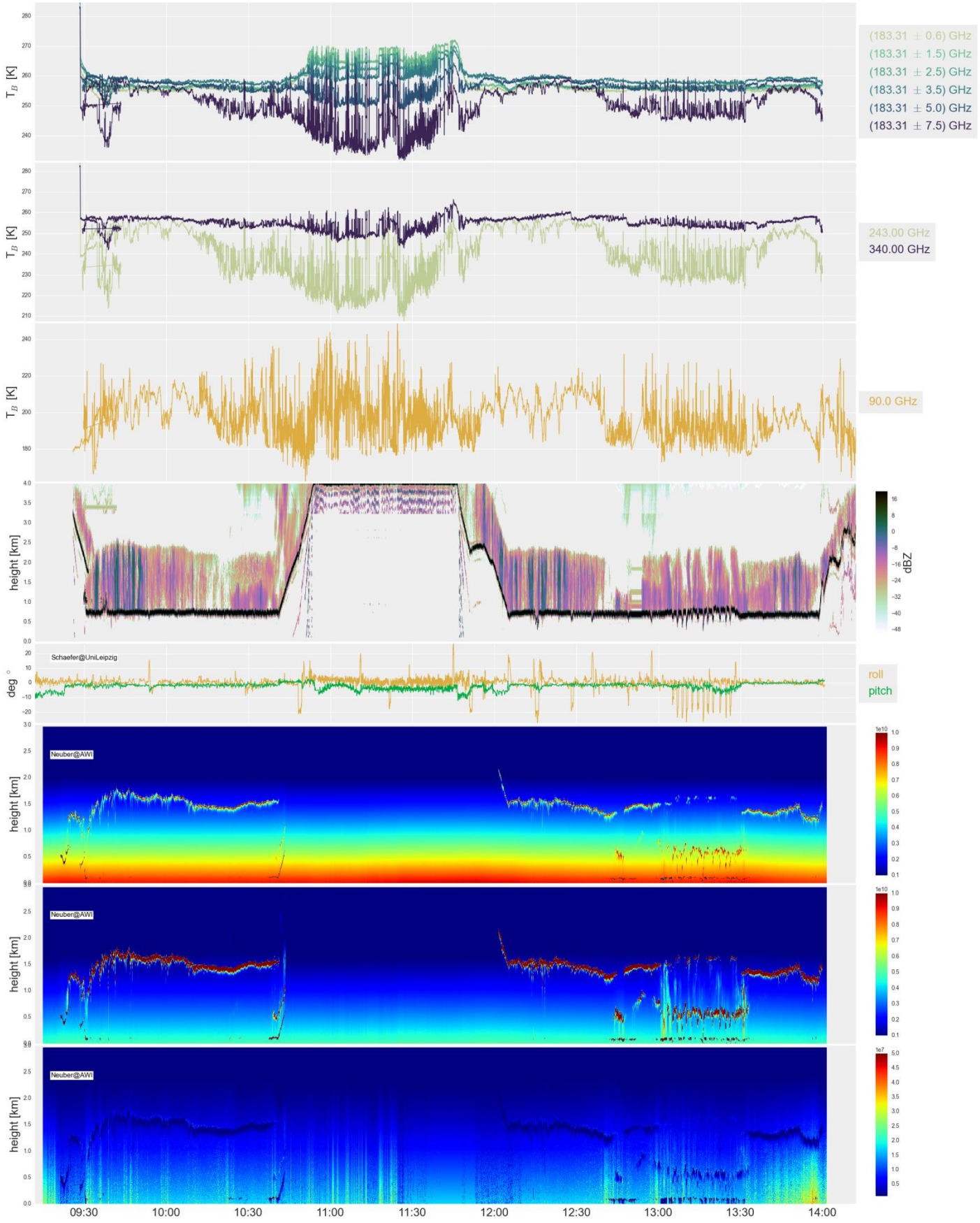


Figure Q3: Signals observed by the radar (Mario Mech).