MOSAiC-ACA Flight Report #06–04 September 2020

Mission PI: Christof Lüpkes

Objectives:

Study the atmospheric structure along the transition from a cloud-free region to a cloudy region during warm air intrusion.

Crew: Crew

Polar 5	
Pilot	William Houghton (Kenn Borek Air)
Co-Pilot	Michelle Lacey (Kenn Borek Air)
Mission-PI	Christof Lüpkes
Basis Data Acq.	Martin Germann und Hannes Probst
SMART/Eagle Hawk	Marcus Klingebiel
Cloud Probes	Valerien Hahn
MiRAC	Friedel Jansen

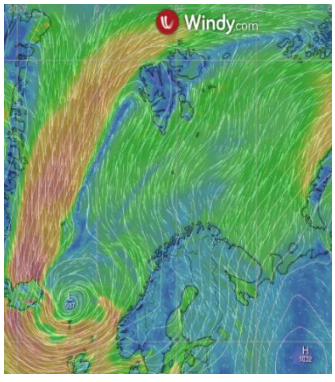
Flight times:

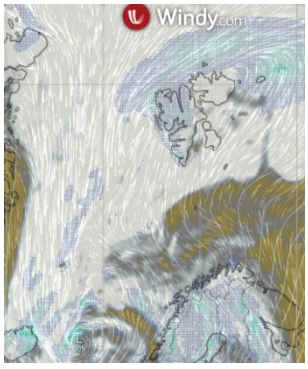
Polar 5	
Take-off	**12:12 GMT (?)**
Touch-down	**17:30 GMT (?)**

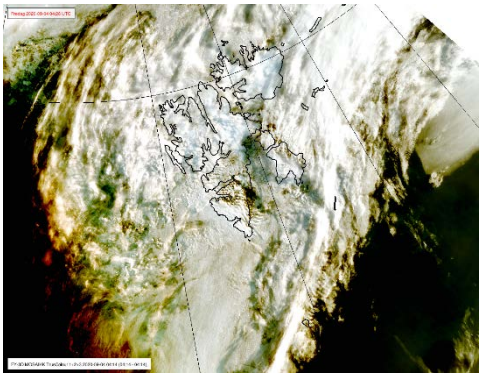
Overview:
During southerly flow two staircase patterns were flown south of Svalbard over the open sea. Two (sometimes three) cloud layers occurred in the northern part of the flight and cloud free conditions in the southern part. The flight to the southernmost positions was at 10.000 ft while staircase patterns have been flown on the way towards north.

Weather:
The warm air intrusion developed due to the formation of a low pressure ridge between a strong low pressure system near Iceland and a small low on the western side of Svalbard as shown in the figure below.

Predicted (24 hour forecast) near-surface wind (left), clouds and precipitation middle) (ECMWF, Windy) and satellite image of 4 September (right)

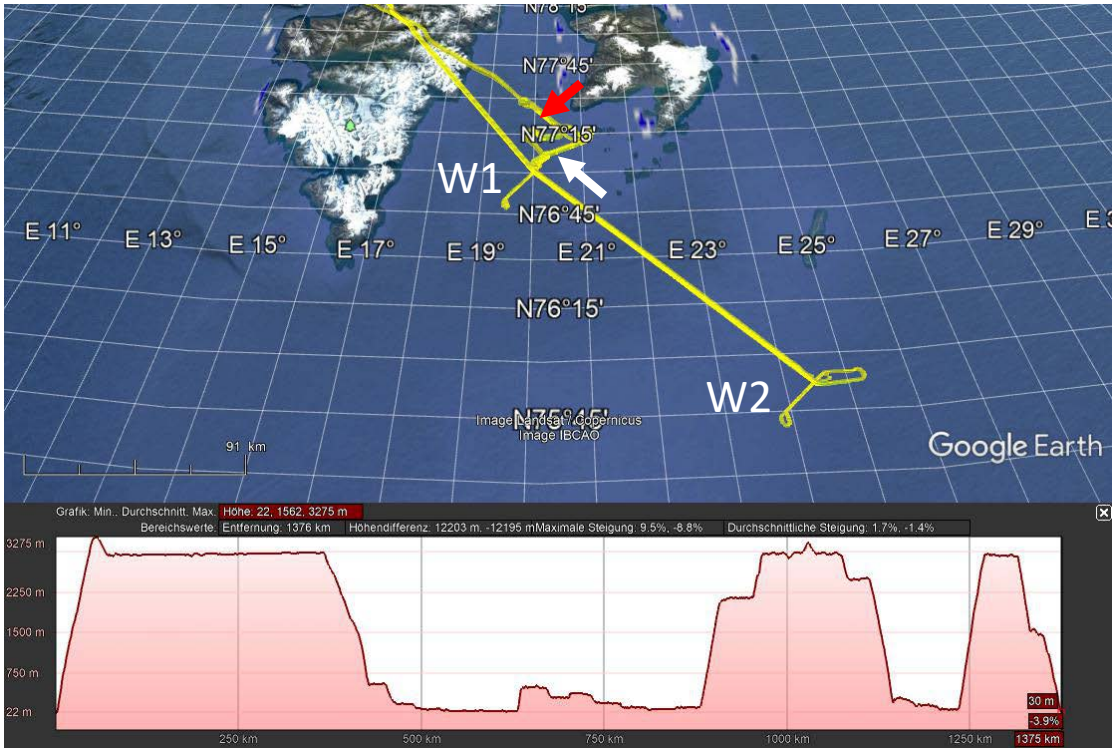






The surface analysis map (not shown here) showed two fronts, one on the western side of Svalbard (Southwest-Northeast orientation) and an occlusion southeast of Svalbard. The latter had to be passed during our track towards South.

Flight track, pattern and clouds



The track from LYR to W1 was flown in 10.000 ft. On the way to W1 three cloud layers were visible, low clouds, mid-level clouds (tops below us) and some cirrus clouds. Between W1 and W2 we crossed the clouds belonging to the occlusion because the tops of the mid-level clouds were higher than 10.000 ft for a distance of about 10 Nm. To avoid icing we changed altitude to reach a lower level (3000 ft) between the mid-level and low clouds while approaching W2. We crossed the cloud edges and reached then W2 in a cloud free region as predicted. After a staircase pattern was flown at W2, our plan was to go to W1 in 200 ft. However, this could not be carried out because of thick surface based clouds (fog) before we reached W1. Thus we changed to a level slightly above cloud top. At W1 another staircase patter was flown with the highest level at 600 ft. The lowest one had to be flown at 300 ft because visibility was too bad for a lower altitude. Instead of this level the 400 ft leg was repeated.

After the low-level staircase pattern at W1 we ascended to about 6000 ft and flew one leg slightly above the base of a mid-level cloud (white arrow in the above figure). Another one 300 ft higher had to be interrupted due to icing. Thus another leg followed at 10.000 feet above this cloud.

After some manoeuvring (waiting for a drop sonde and navigation issues) we flew another low-level staircase at the position of the red arrow.

Turbulence: No turbulence was felt during the staircase at W1 and only weak turbulence at W2. However, much turbulence occurred while the mid-level cloud was probed (white arrow). Also, turbulence occurred during the lowest leg at the position of the red arrow (third staircase).

Sea ice and Cloud Conditions

No sea ice was observed.

Mid-level cloud layer between LYR and W1.

Position between W1 and W2 on the way towards W2 showing the mid-level and low clouds as well as the cloud-free region in a distance of about 20 Nm.

Drop sondes

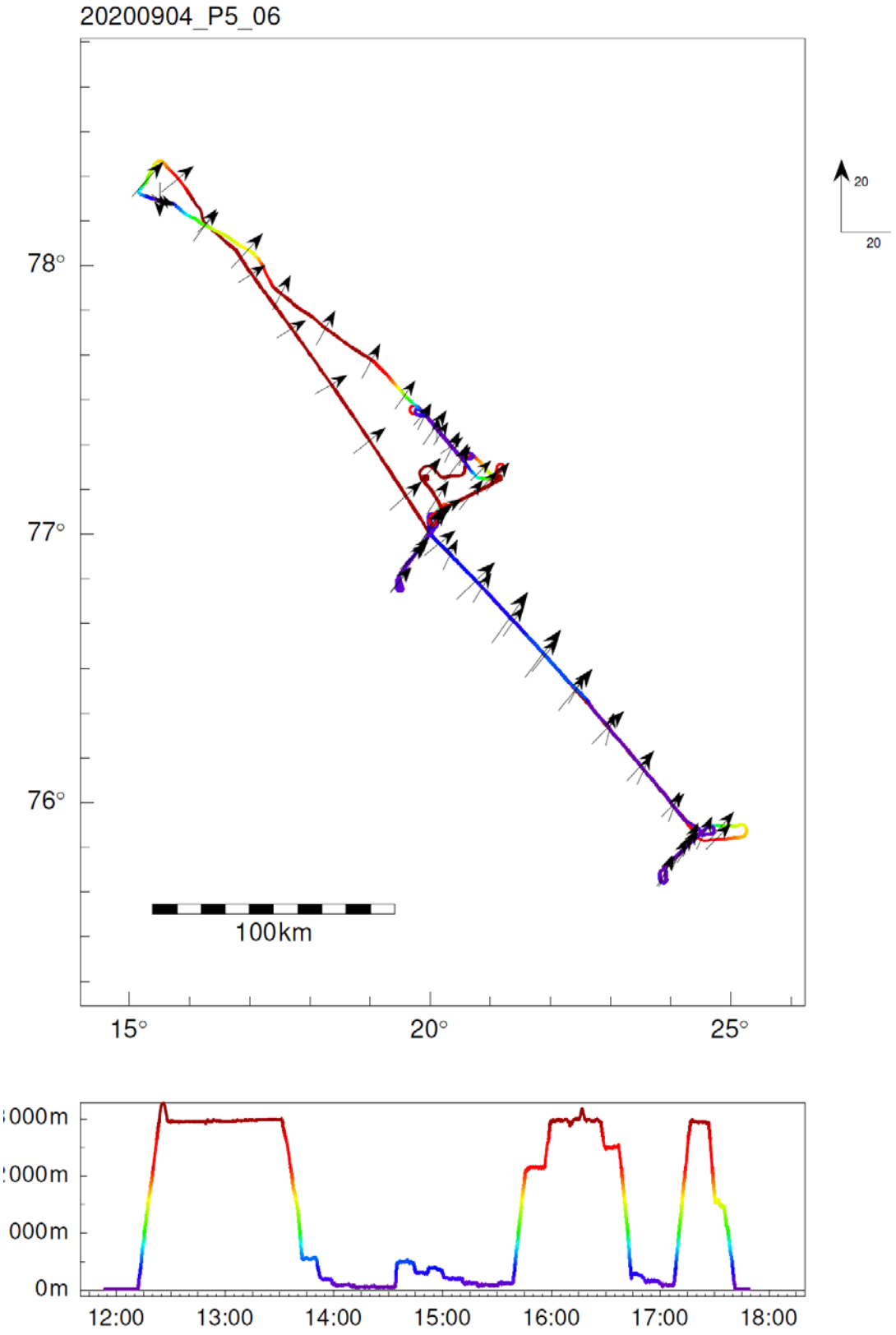
Four drop sondes have been thrown between W1 and W2 and another one at W1 and one near the position of the red arrow. At least, two further ones were released but they did not work properly.

Instrument Status:

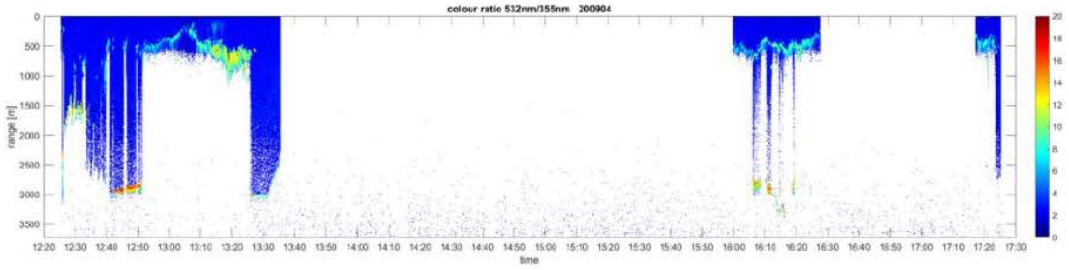
Polar 5	
Basis data acquisition	
Nose Boom	
MiRAC	
AMALi	
SMART	
Eagle/Hawk	
Cloud Particle Probes	

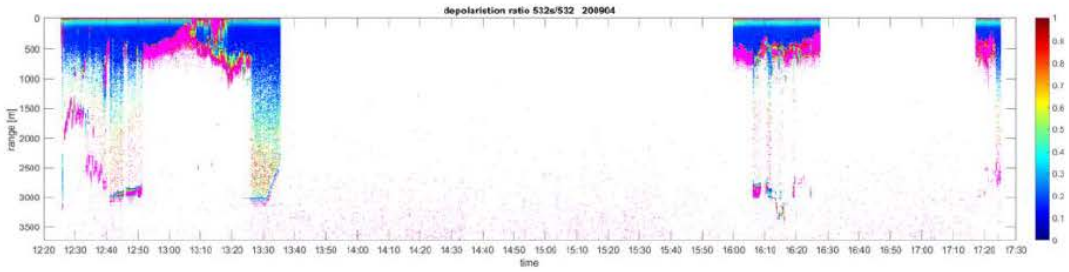
Quicklooks:

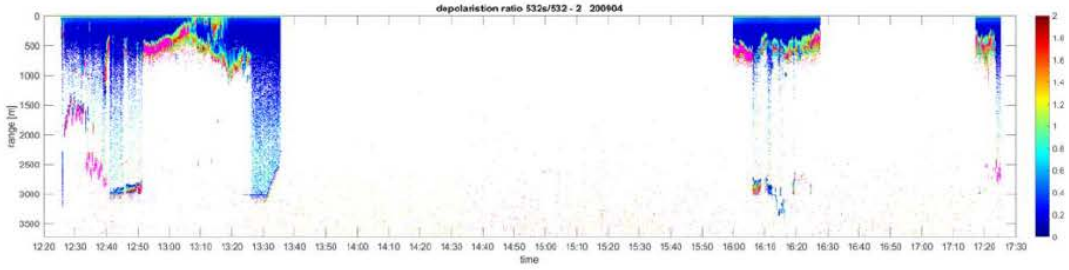
Noseboom data

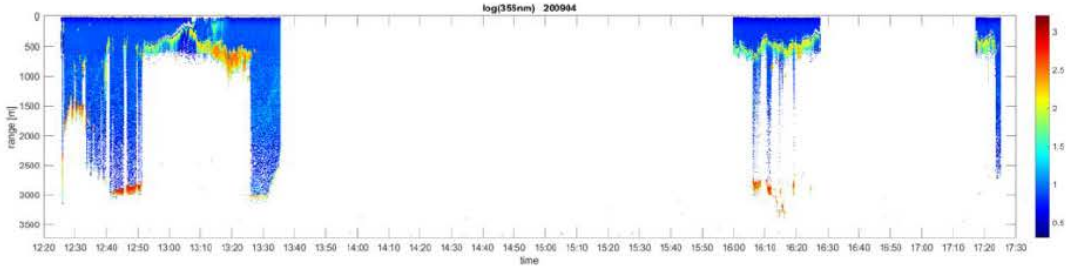


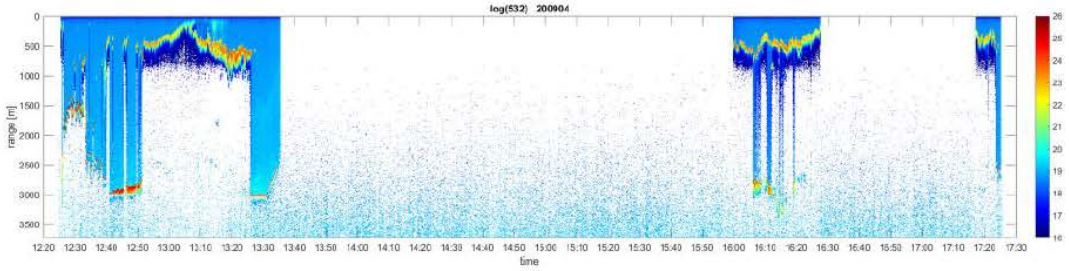
AMALI 20200904:

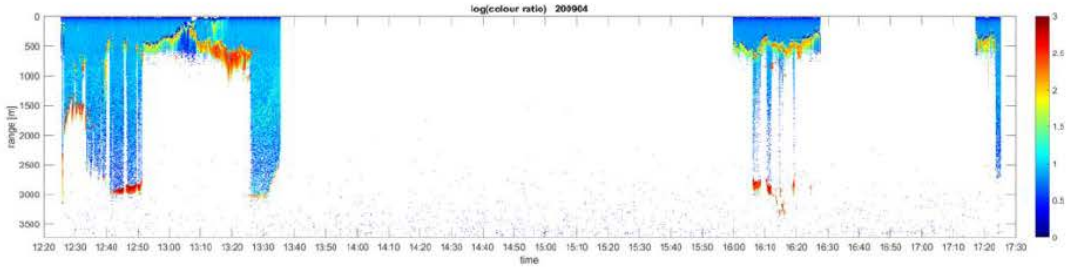






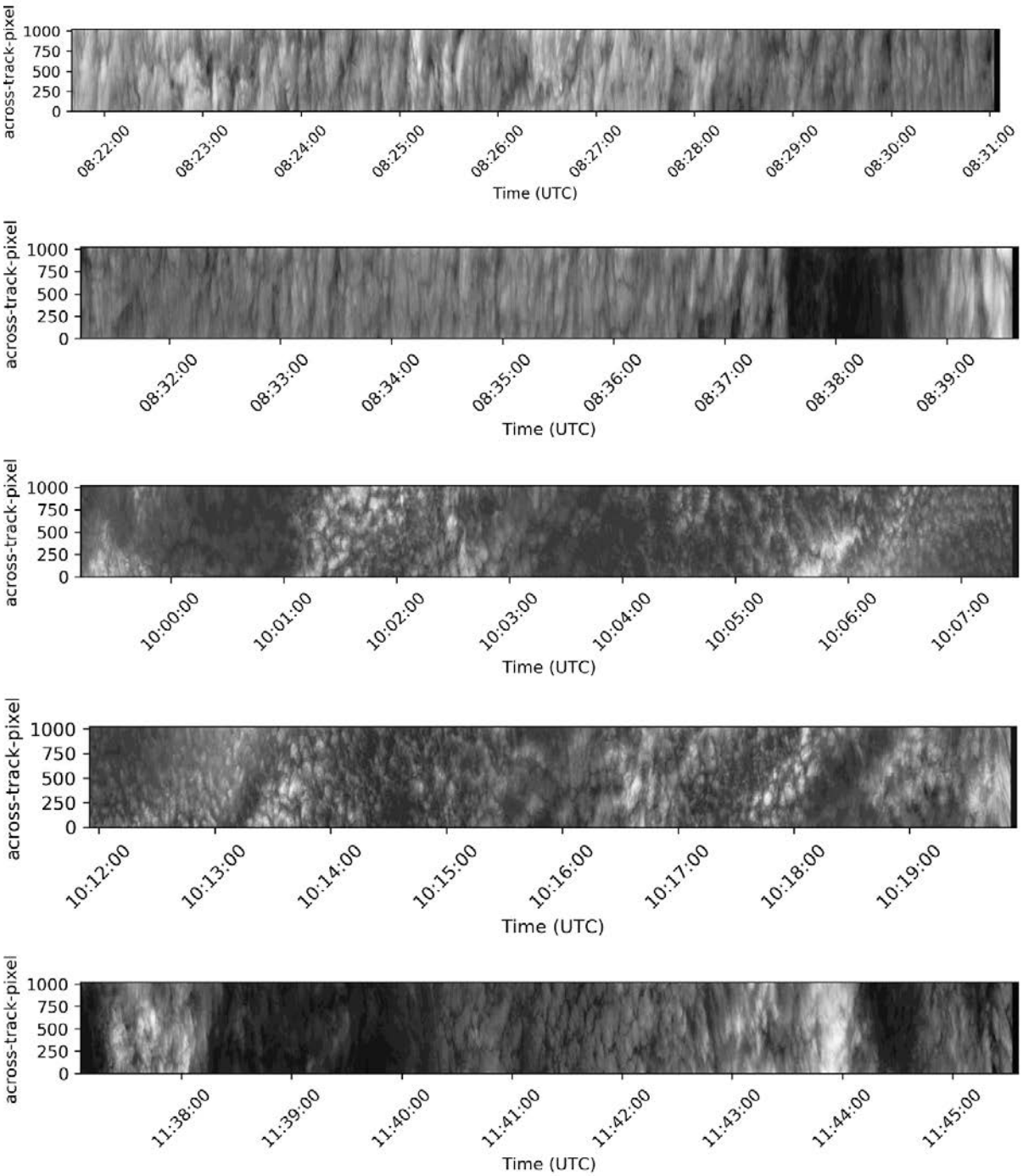


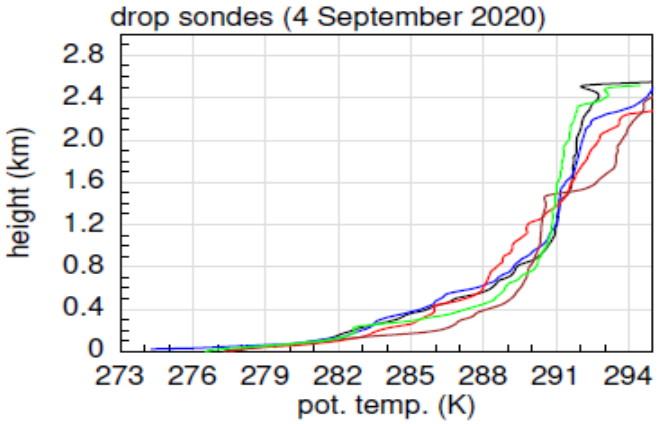


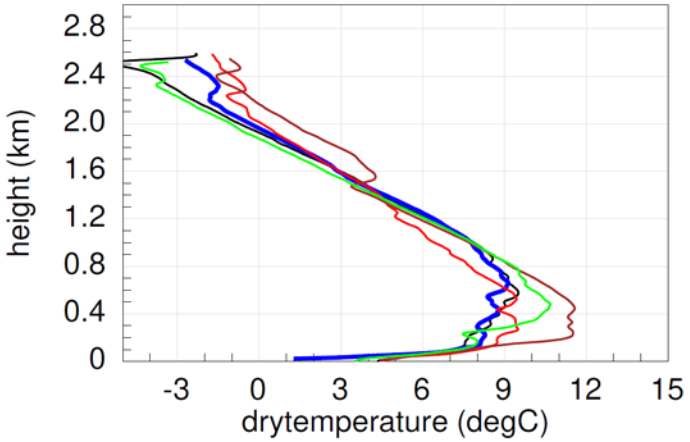


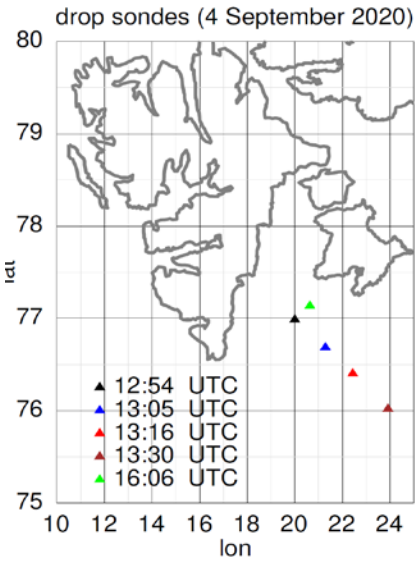
Quicklook Flight 05, 02.09.2020

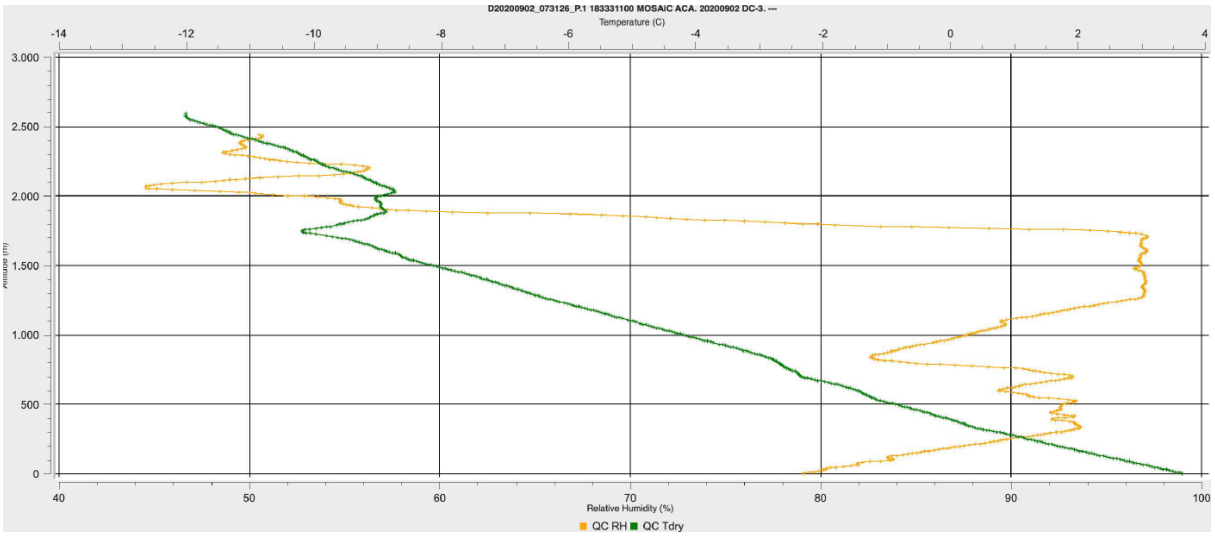
EAGLE (Spectral imager)




drop sondes (4 September 2020)
height (km)
2.8
2.4
2.0
1.6
1.2
0.8
0.4
0
273 276 279 282 285 288 291 294
pot. temp. (K)


height (km)
2.8
2.4
2.0
1.6
1.2
0.8
0.4
0
-3 0 3 6 9 12 15
drytemperature (degC)


drop sondes (4 September 2020)
lat
80
79
78
77
76
75
10 12 14 16 18 20 22 24
lon
12:54 UTC
13:05 UTC
13:16 UTC
13:30 UTC
16:06 UTC


D20200902_073126_P.1 183331100 MOSAIC ACA. 20200902 DC-3. ---
Temperature (C)
-14 -12 -10 -8 -6 -4 -2 0 2 4
3.000
2.500
2.000
1.500
1.000
500
0
40 50 60 70 80 90 100
Relative Humidity (%)
QC RH
QC Tdry