

AFLUX Flight #08–08 September 2020

Mission PI: Christof Lüpkes

Objectives:

Study differences in the atmospheric structure over sea ice and open ocean

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	08:10 GMT (?)
Touch-down	14:15 GMT (?)

Overview:

During near-surface easterly flow over Svalbard and northeasterly flow north of 80 N a transect was flown along 7°E between 79° and 82.5° N with two staircase patterns included, one over sea ice and one over the open ocean. Several cloud layers occurred at both staircase positions and again - as during flight number 6 (south of Svalbard) - the strongest turbulence occurred in the uppermost mid-level cloud. The flight to the northernmost positions was at 10.000 ft. Ny Alesund was on the flight track and was two times overflowed, first on the way towards North and second on the way back to Longyear.

Weather:

The synoptic situation was governed by a strong low-pressure system south of Svalbard, which moved only slowly during the day. The red colour in the figure below marks high clouds caused by the related frontal systems approaching from south. The low caused easterly, near-surface wind over Svalbard and over the eastern part of Fram Strait. However, at 850 hPa the opposite wind direction was predicted. The easterly wind caused a cloud free region along the western coast of Svalbard while almost complete StCu cover existed between waypoints 1 and 2 (see below).

The strong change of wind direction with height was confirmed by the wind measurements as can be seen below in the noseboom quicklooks. They show wind from northeast in the low-level legs and wind from south at 10.000 ft.

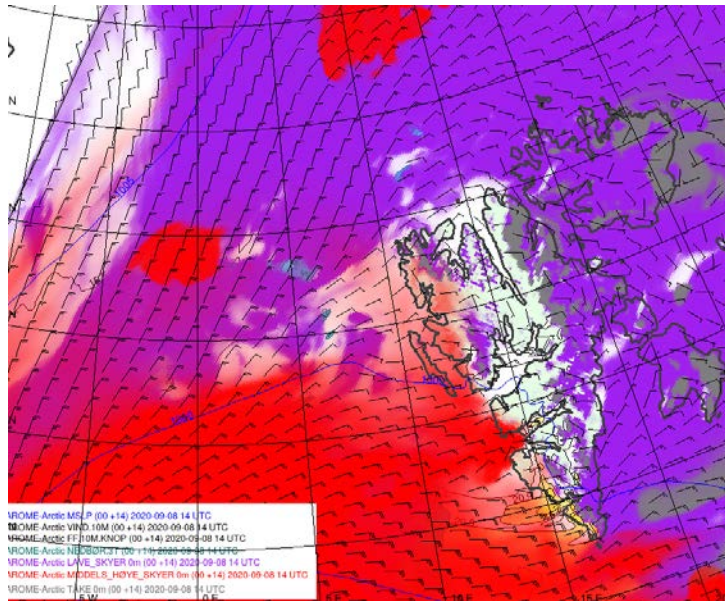
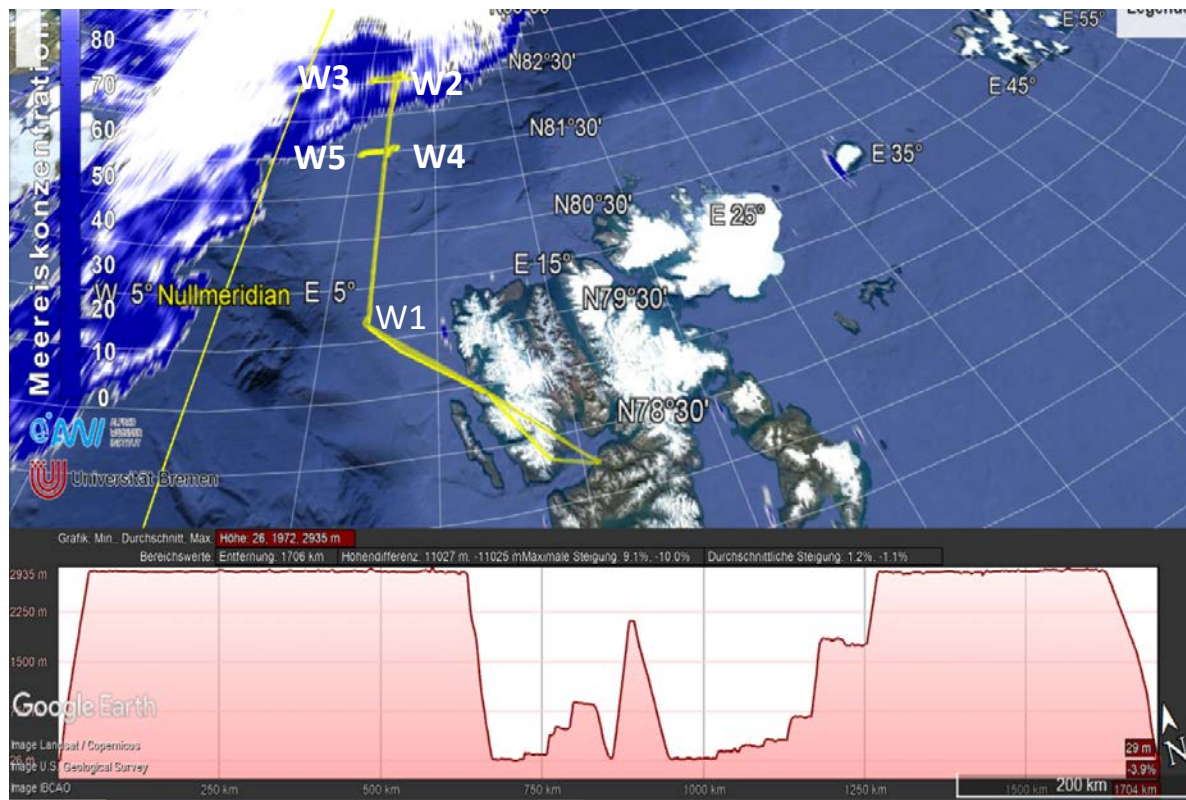


Figure: The AROME prediction for 14 UTC reflects well the situation found with different wind and cloud regimes in the North and on the western side of Svalbard (but almost no clouds were found along the coast west of Svalbard, light reddish area)

Flight track, pattern and clouds



The tracks from LYR to W1 and W2 and from W4 to W1 and LYR were flown in 10.000 ft

Northern staircase

A staircase pattern followed between W2 and W3 with the highest leg at 10.000 ft and the lowest one in 200 ft. The latter leg position was reached during descend from W3 to W2. During this descend we crossed a complex cloud structure with clouds occurring in four layers. However, clouds were not homogeneous with respect to coverage, cloud base and cloud tops, which varied strongly along the horizontal legs. Cloud base of the lowest (convective) clouds was in general at 300 ft, so that visibility during the 200 ft leg allowed mostly a clear view on drifting floes (see below). However, over leads some clouds were also surface based. After the near-surface leg a leg in the lowermost cloud layer followed and then two further legs in the upper cloud layers, but due the variability of the clouds, not the complete legs were either in or outside clouds.

Transect from W2 to W4

A sawtooth was flown towards W4 with top at 7000 ft. We crossed two cloud layers, the lowermost and mid-level clouds with tops around 6500 ft. But the uppermost cirrus was not reached. After the following descend we reached already position W4 at 200 ft below the lowest cloud layer whose base was at 300-400 ft.

Southern staircase

Two 200 ft legs were flown in opposite direction, the next one at 500 ft, thus above cloud base, and then the next one at 750 ft, and finally at 2000 ft, which was slightly above cloud top. Outside clouds we climbed up to reach the mid-level cloud and measured clearly above cloud base at 5400 ft and the next one in 5100 ft at cloud base, and sometimes slightly below. The 5100 ft leg was the one with the strongest turbulence.

Turbulence:

Turbulence during all low legs was weak or moderate, while it was stronger at the southern staircase in the two uppermost flight legs (in mid-level clouds). This corresponds to the structure of the potential temperature profiles with a well-mixed layer in this level (see quicklooks below).

Sea ice

The northernmost staircase was over sea ice, where drifting floes were observed with an estimated sea ice concentration of 70-90 % (in agreement with the satellite image obtained by the AWI sea ice group).

The sea ice edge could not be observed because of clouds. It probably occurred near 82N, where the staircase was flown. No sea ice occurred at the position of the southern staircase.



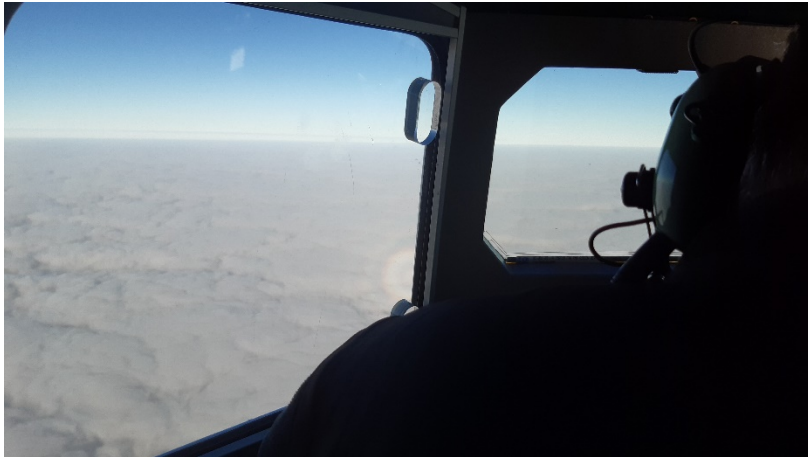
Typical sea ice conditions at the northern staircase position



Clouds



Approaching the western coast of Svalbard near Ny Alesund. Only high clouds were observed in this region.



Low and mid-level clouds on the track towards North.



In 200 ft, at the southern staircase position.



View over top of low clouds at the southern staircase position.



Slight icing at the highest leg at the southern staircase position in mid-level cloud.



Convective clouds over Svalbard on the way back.

Drop sondes

Four drop sondes have been thrown between W1 and W2 and another three ones during the way back towards South.

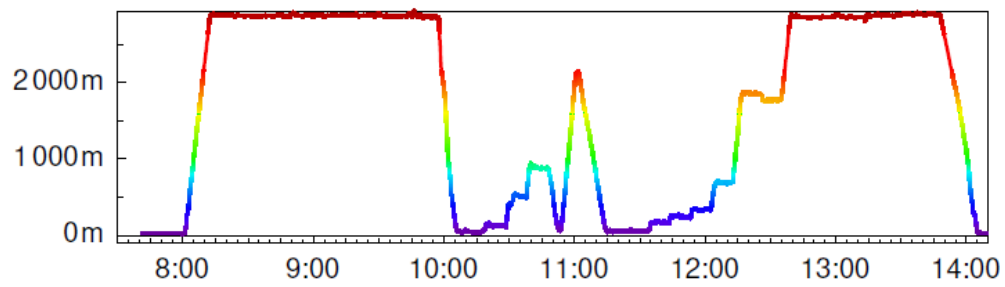
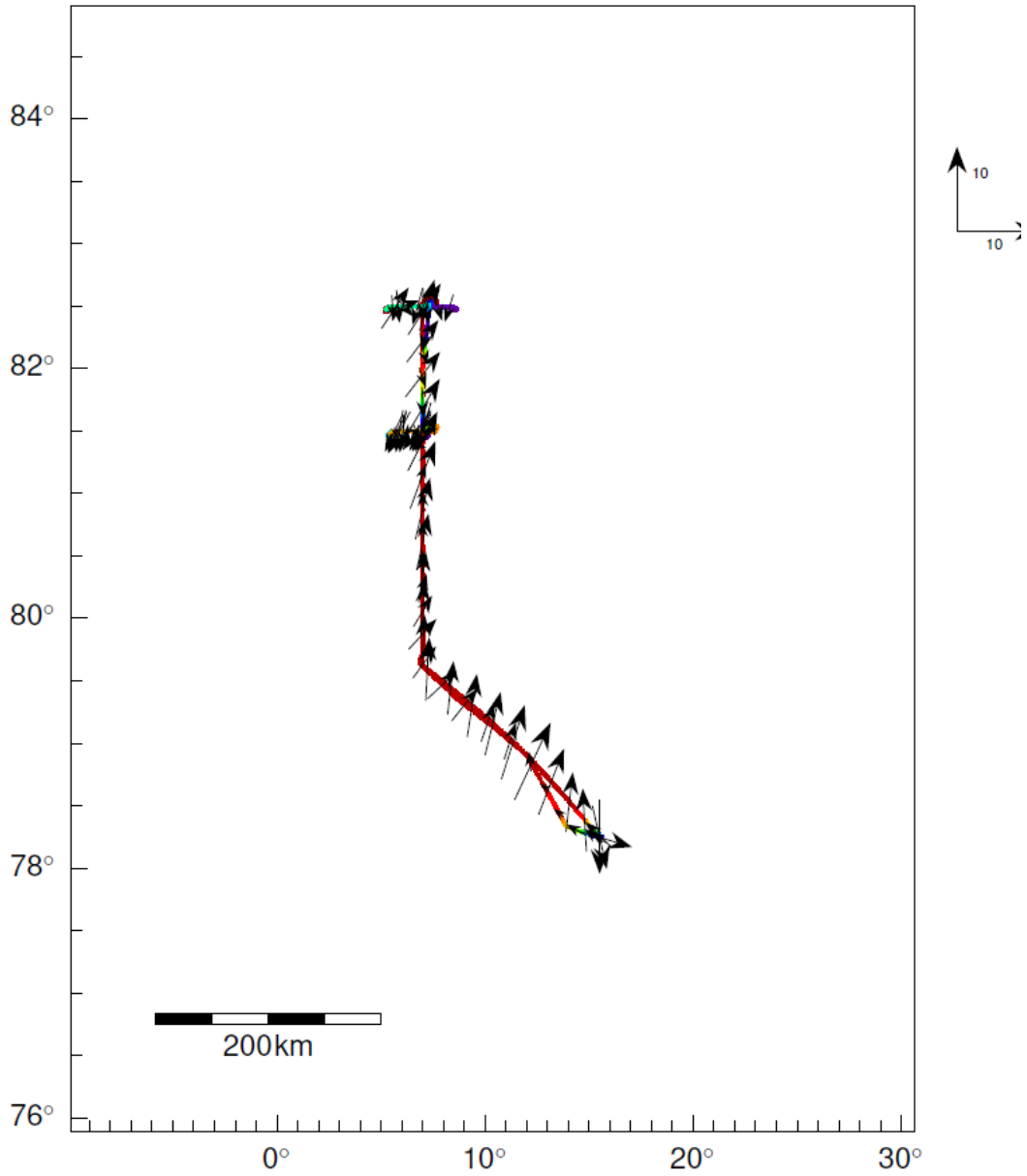
Instrument Status:

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

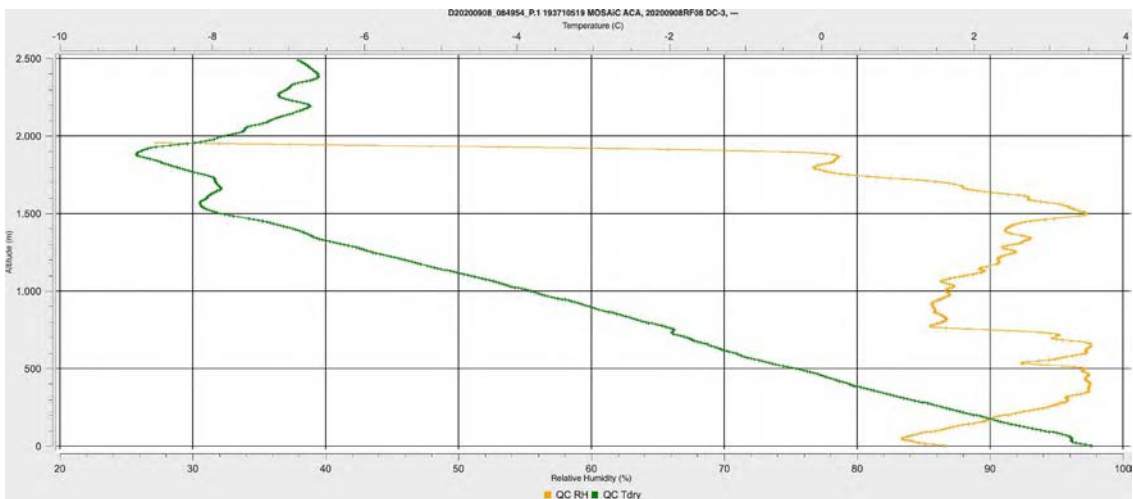
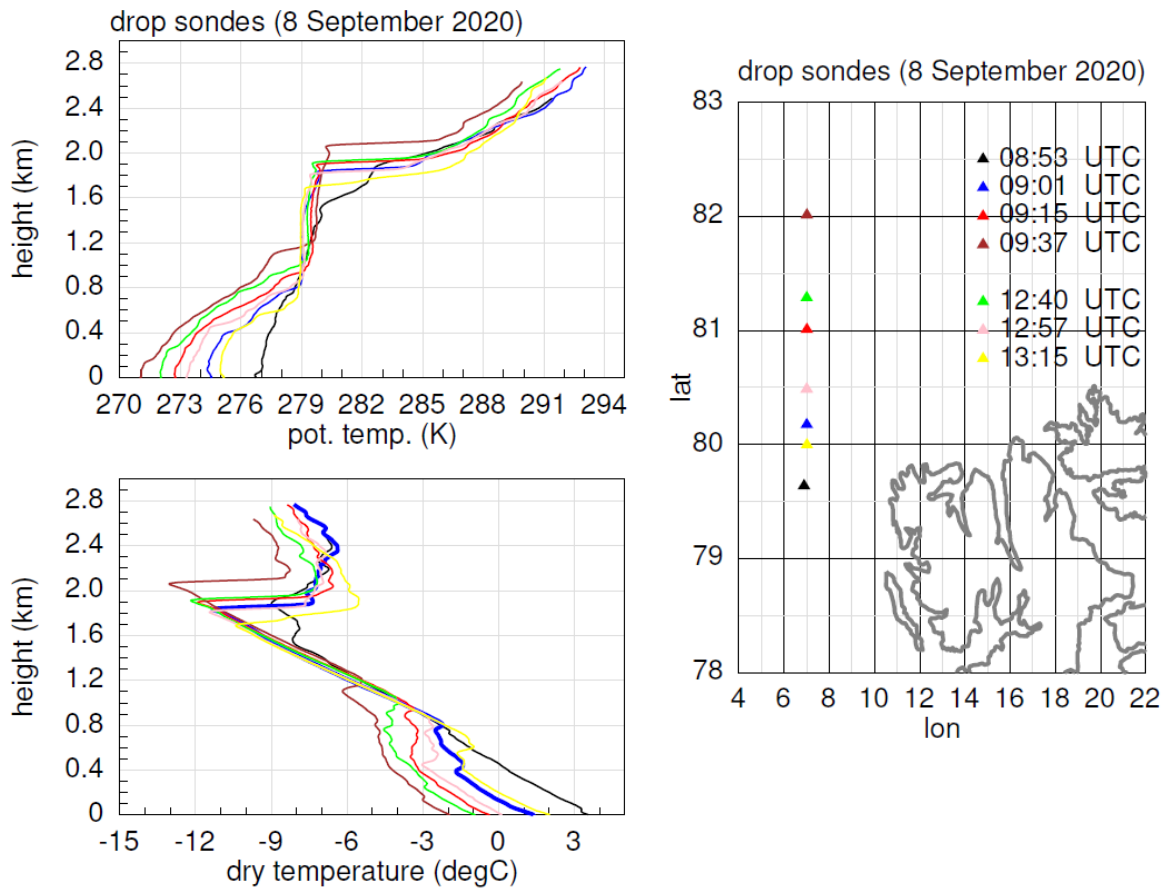
Quicklooks:

Noseboom data

20200908_P5_08



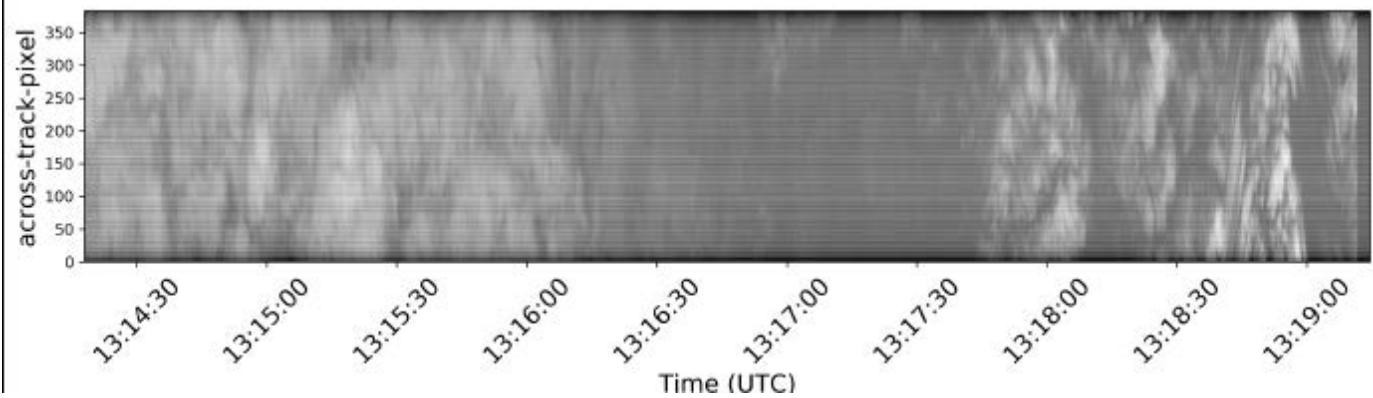
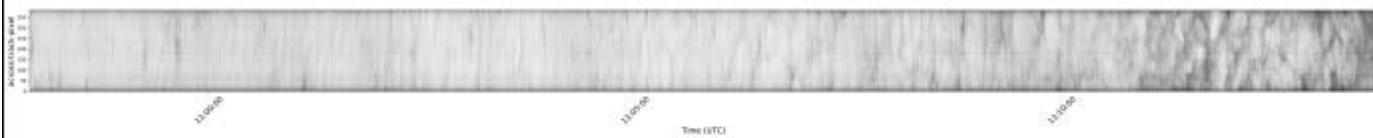
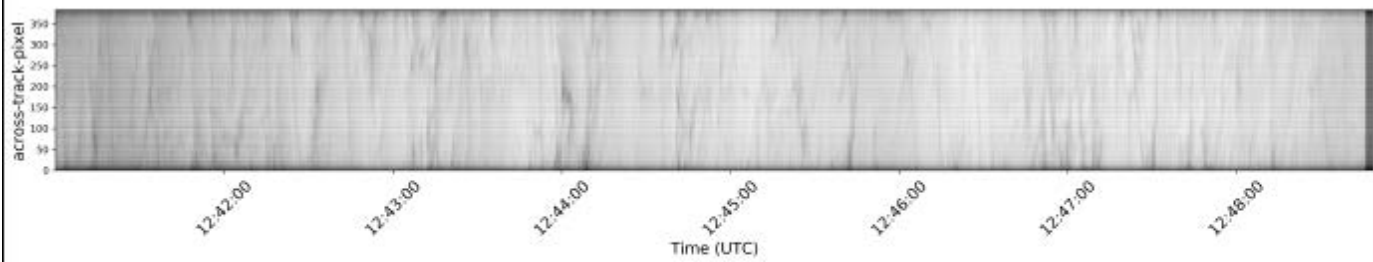
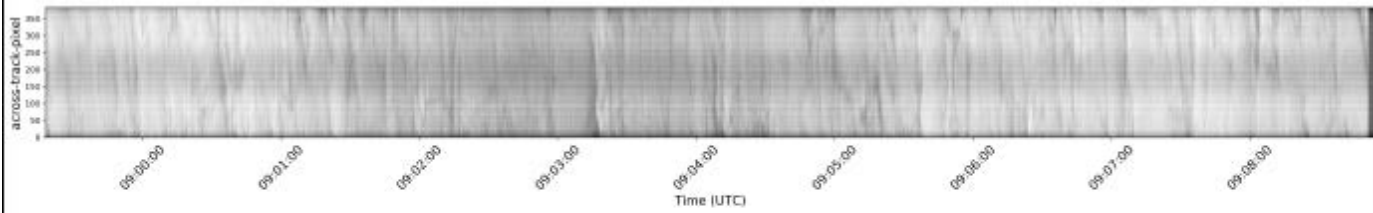
Dropsondes



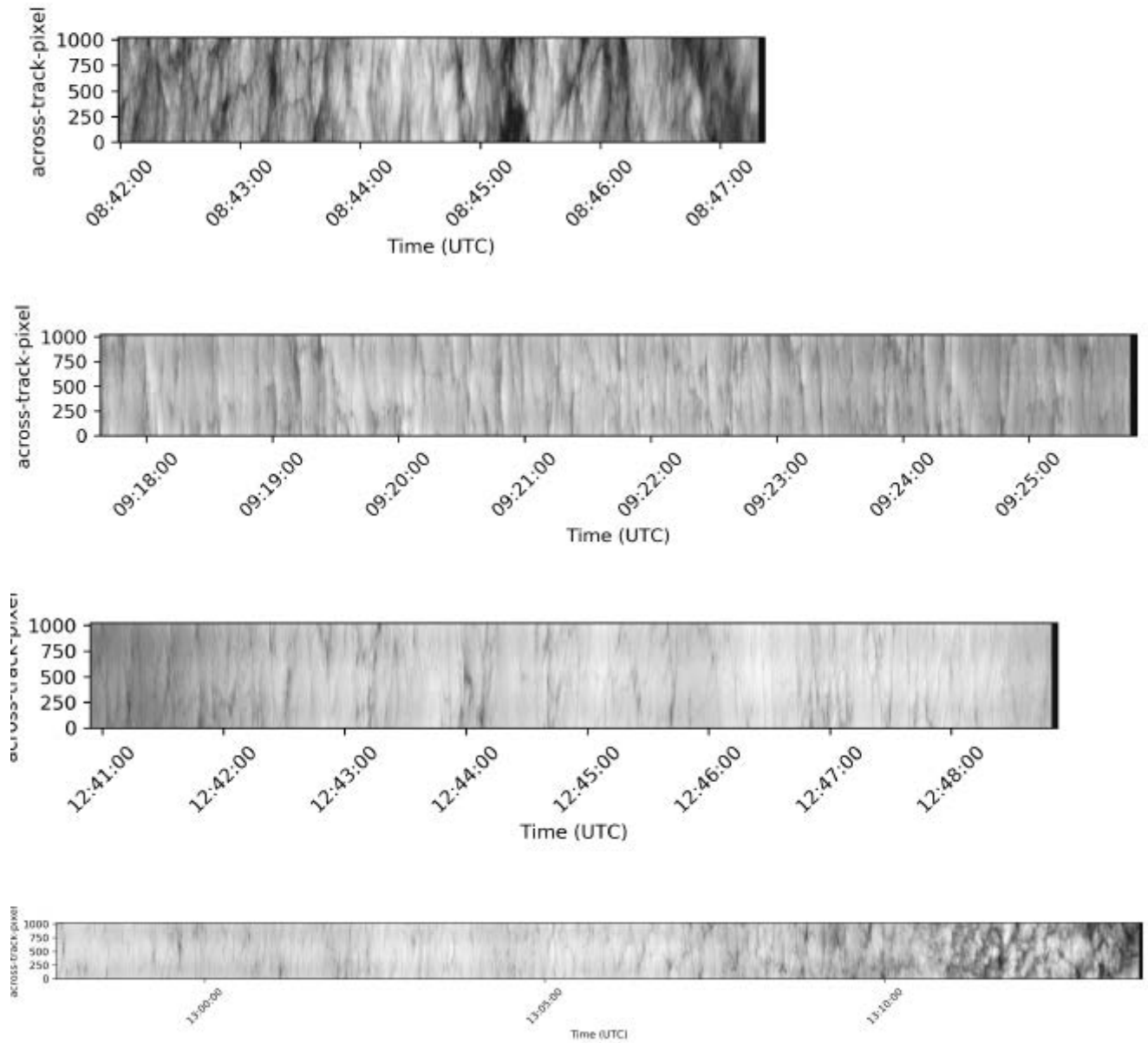
Example: Humidity and temperature.

Quicklook Flight 8, 08.09.2020

HAWK (Spectral imager)



EAGLE (Spectral imager)



PMS Probes

