AFLUX Flight 07 – Polar 5 – 30.03.2019

Mission PI: Dmitry Chechin

Objectives:

Turbulent and radiative fluxes and cloud microphysics in the low-level clouds in different conditions: 1) in the absence of mid-level clouds and 2) in their presence. Thus, a staircase pattern is planned in two locations: with mid-level clouds in the west and without the mid-level clouds in the east.

Crew:

	Polar 5
PI	**Dmitry Chechin**
Basis Data Acq.	**Cristina Sans Coll**
SMART	**Elena Ruiz Donoso**
Radar/Lidar	**Birte Kulla**
Cloud probes 1	**Olivier Jourdan**
Cloud probes 2	**Christophe Gourbeyre**

Flight times:

	Polar 5
Take off	**10:13 GMT**
Touch down	**GMT**

Overview

The focus of the flight is on in-situ flux and coud microphysics measurements in low-level clouds, boundary layer and mid-level clouds. According to the weather forecast, low-level clouds were expected to the north from Svalbard, while mid-level clouds and low-level clouds were predicted to the north west, over the Fram Strait.

It was planned to fly to the north and do the first staircase pattern over sea ice with 6 horizontal legs in the location where only the mid-level clouds were present. On the way to the north one dropsonde was planned. After that, it was planned to go west doing the saw-tooth ascents and descents to the location over sea ice where the mid-level were present. There, another (second) staircase pattern was planned with at least two legs in the mid-level clouds, one leg in between the mid-level and low-level, and three legs in the boundary layer and the low-level clouds.

After that, it was planned to fly back to Longyearbyen with a saw-tooth pattern on the way and overpass the Ny-Alesund for the lidar intercomparison.

The flight was executed as planned, but instead of just one, three dropsondes were released.

Weather (predicted and observed during the flight)

The measurement region was in the north-easterly flow on the north-west periphery of a cyclone, whose center was located over the Barents Sea. However, the north-easterly flow was advecting not the very cold and dry Arctic airmass, but a “moderately” cold air. Downwind of Svalbard a lee effect (foehn) clear sky area was predicted. The mid-level clouds in the northwest were probably associated with some weak occluded front.

Flight pattern

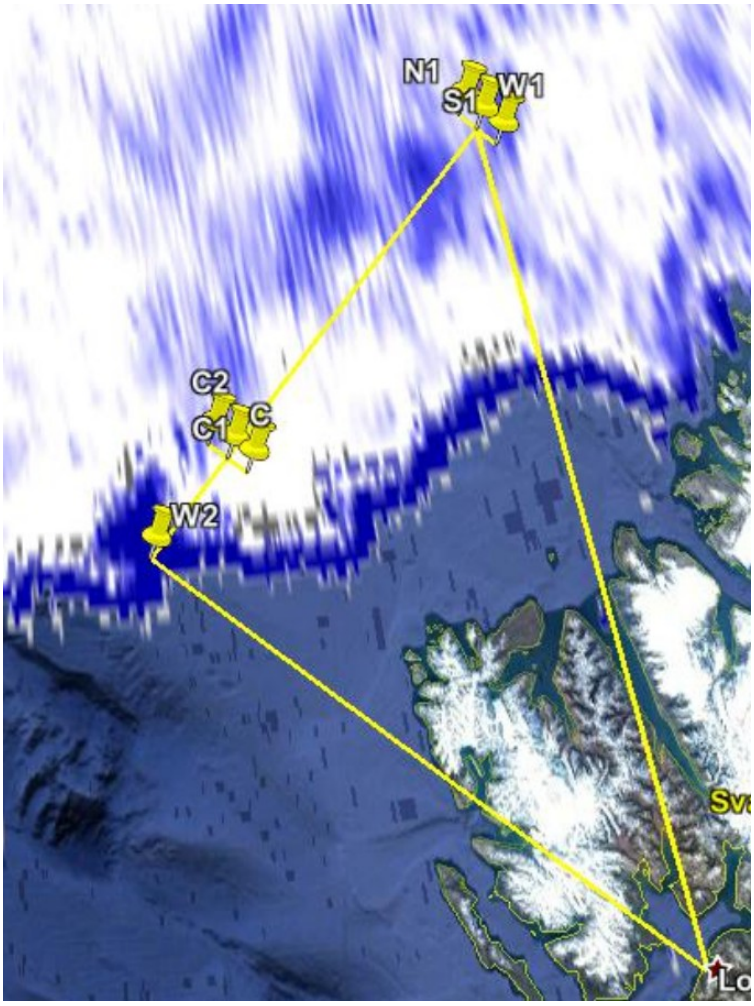


Figure 1. Planned flight track.

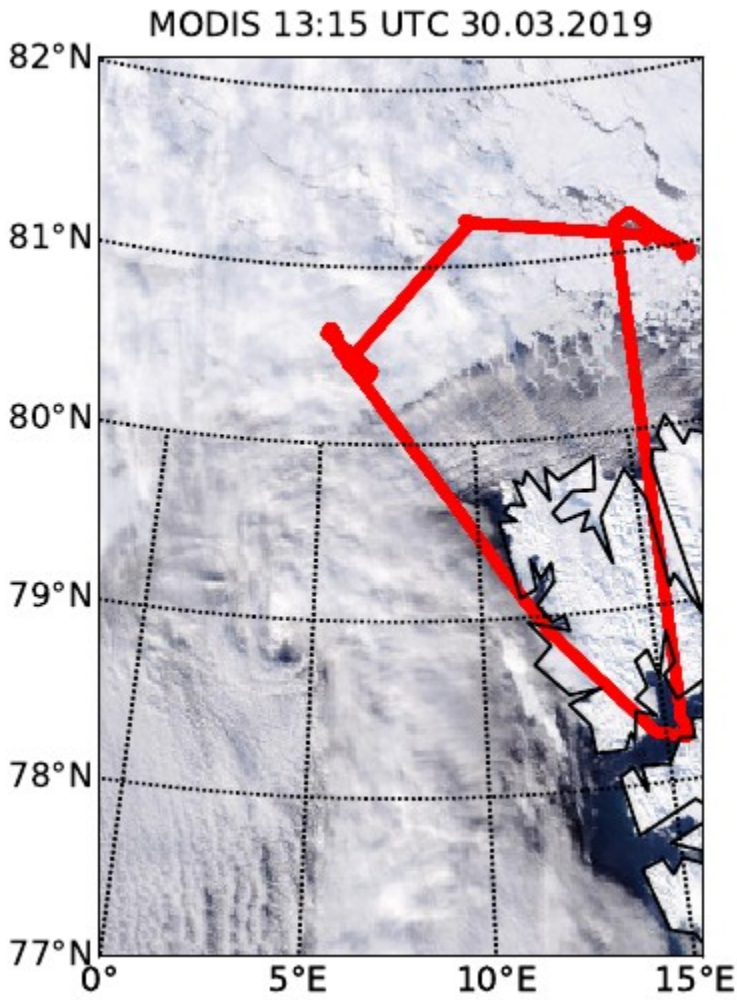


Figure 2. Flown flight track.

Detailed Flight Logs

10:13 UTC take off

10:16 flying over the fjord and observing the roll cloud which stays there for days

10:28 on the way to W1 over Svalbard: mid-level clouds above us, scattered, many clouds over mountain tops.

10:42 flying through precipitation or thin clouds over Svalbard on the way to W1

10:53 flying over the Whalers Bay Polynya with nice stratocumulus clouds over large open water area

11:01 Dropsonde 1 release over polynya

at 89o30' 15o30 we are crossing the northern edge of the polynya

we see almost no low-level clouds upwind of polynya

11:13 Dropsonde 2 release upwind polynya over the sea ice

11:16 there large leads around

Ascending before W1 and changing heading to easterly, south-easterly searching for a good low-level cloud. Low-level clouds to the south-east from W1 look better and thicker, althoug they are still optically thin compared to those over open water

During descent: cloud top approx at 2000ft, but we cannot find this cloud later.

11:36 start of a staircase pattern. There are almost no mid-level clouds above us.

Leg 1 @ 200ft: in one part of the leg small-to-medium leads, in another part at 11:38 we cross a large lead

Leg 2 @ 400ft: the leg is still in the foggy layer, it is turbulent, at 11:46 crossing the large lead

Leg 3 @ 600ft: crossing the plume over the lead, the leg is still turbulent, but it is very close to the top of the foggy layer, wind and turbulence intensity are variable

Leg 4 @ 1800ft: we expected to have a thin cloud layer at this height, but there is nothing at this height

Leg 5 @ 3000ft: nothing special at this height

After the staircase, we fly first west and then in the direction of W2 doing the saw-tooth (ST) ascents and descents:

ST 1 descent:

at 1500ft is the cloud top, cloud is thin and patchy

at 600ft turbulence starts

at 200ft we are over a large ice floe, we spend some time (10 miles) at 200ft

ST 2 ascent:

turbulent below 800-900ft

ST 3 descent:

At 2200ft we cross a patchy cloud layer

radar sees a thicker cloud below us

small clouds are observed at a certain height above the mid-size leads, while right over the leads there is sea smoke

12:47 leg at 200ft (approx 10 miles), some turbulence, but not strong

After that, turn to W2 and start an ascent, cross a thin cloud layer at 3000ft

Approach and enter mid-level clouds on the way to W2 and start the staircase 2:

Leg 1 @ 10,000ft below the cloud top, it looks like the cloud is glaciated. Ice crystals are observed

Leg 2 @ 8,000ft again ice crystals. Clouds seems to be thinner on one side of the staircase

Leg 3 @ 5,000ft still measuring ice crystals

Leg 4 @ 2,000ft part of the leg is outside of the cloud (southern part of the leg)

Leg 5 @ 200ft northern part of the leg is more foggy (ice cloud), southern part is outside of this low-level cloud, southern part is downwind of a relatively large lead, ice consists of small ice floes in the southern part

Leg 6 @ 500ft is still turbulent

Heading to the south, starting saw tooth profiling:

ST1: ascent to 10,000ft; we fly clearly between two cloud layers at height 3000-3500ft; observing some cloud particles at 8000-9000ft

ST2: descending towards open water. Ice edge is sharp and has a wavy structure: 14:31 crossing the ice edge at 80o.

At 7000ft flying in between the cloud layers

at 2500ft crossing the cloud top of the stratocumulus over open water

approx at 1200ft – cloud base

snow showers below the cloud base

leg at 200ft, not very long, approx 2 min

ST3: ascent to 10,000ft

6000ft a burst of turbulence, probably mountain waves

8000ft a little bit of mid-llevel cloud. Mid level clouds are observed to the west

Sea ice conditions

At the first staircase location there was a large lead, part of the legs were flown over it. In the region around, there were large leads, which contributed to the cloud formation. At the same time, the ice floes were also large.

Figure 3. Sea ice conditions on the approach to W1, before the staircase 1.

Figure 4. Sea ice on the way to W2 during the saw tooth pattern. Leads downwind from the flight track.

Figure 5. Cloud formation over a lead on the approach to W2. Mid-level clouds are visible.

Figure 6. Roll clouds over the Wailers Bay polynya on the way to W1.

On the way to W2, there were large leads observed, with sea smoke and small cloud forming over a lead. But also, there were large ice fields without any leads.

The second staircase was flown more in the marginal sea ice zone. Around, there were more leads of different sizes and also smaller ice floes.

Instrument Status:

Polar 5

Basis data acquisition

Nose Boom

MiRAC

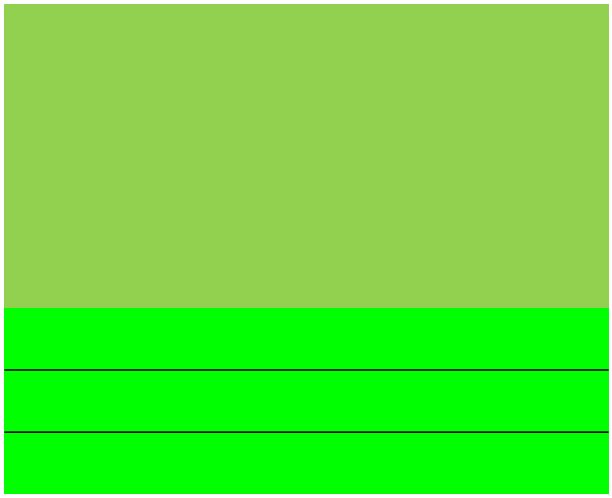
AMALi

Cloud probes

SMART

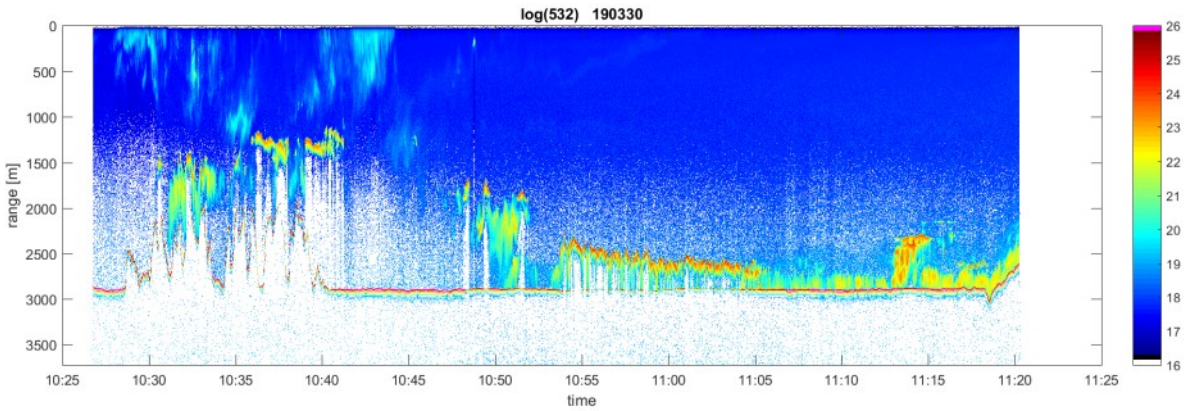
Eagle/Hawk

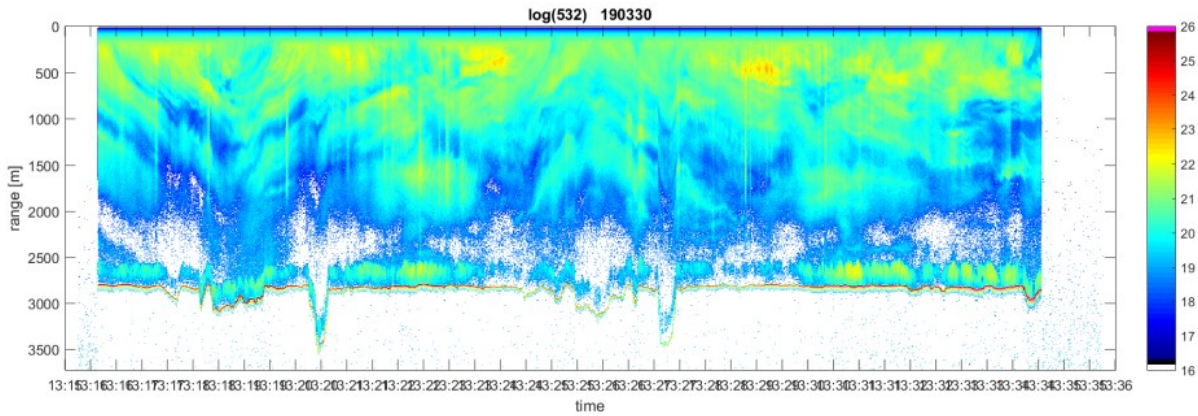
Drop Sondes



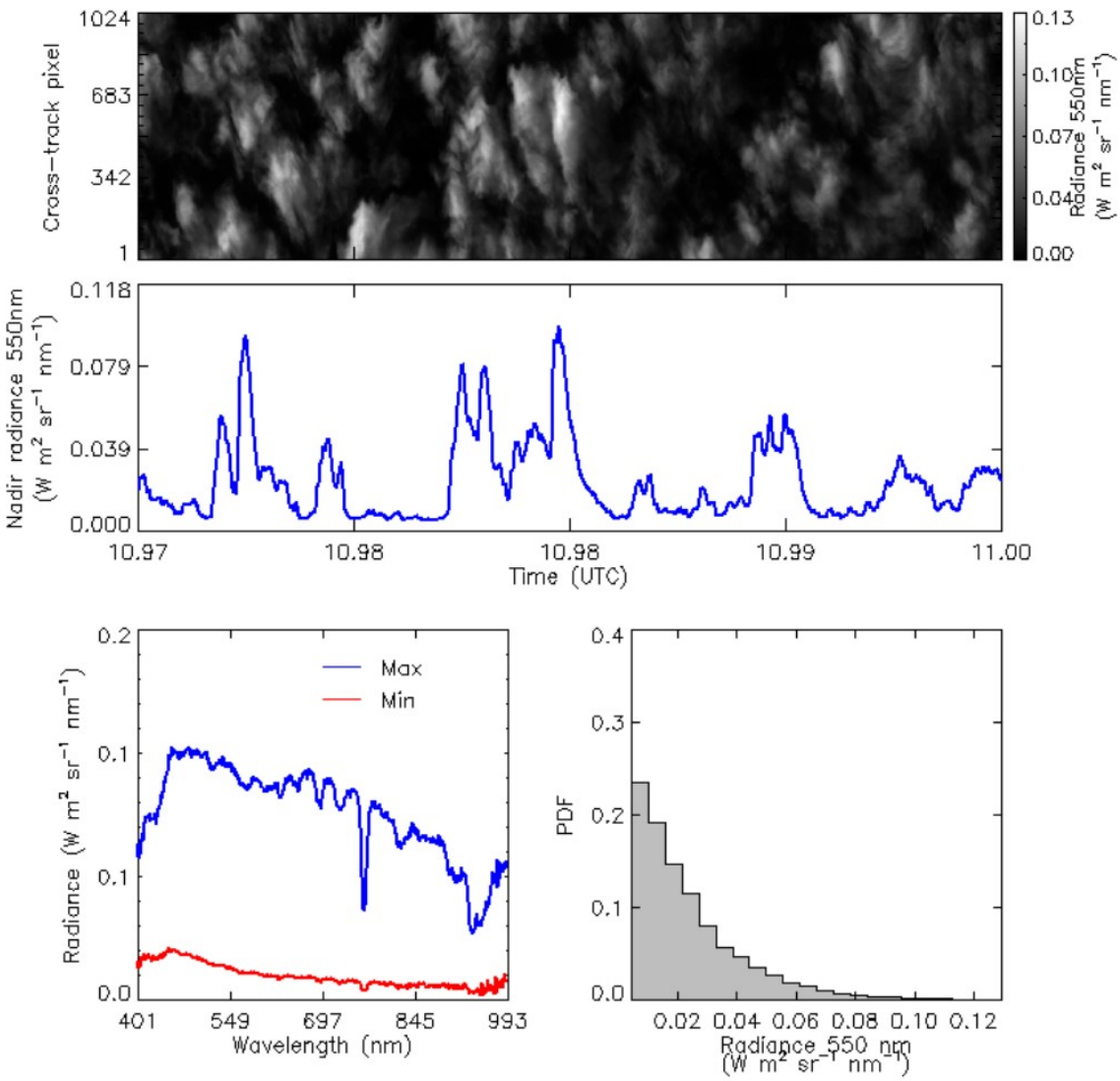
No problems with the instruments

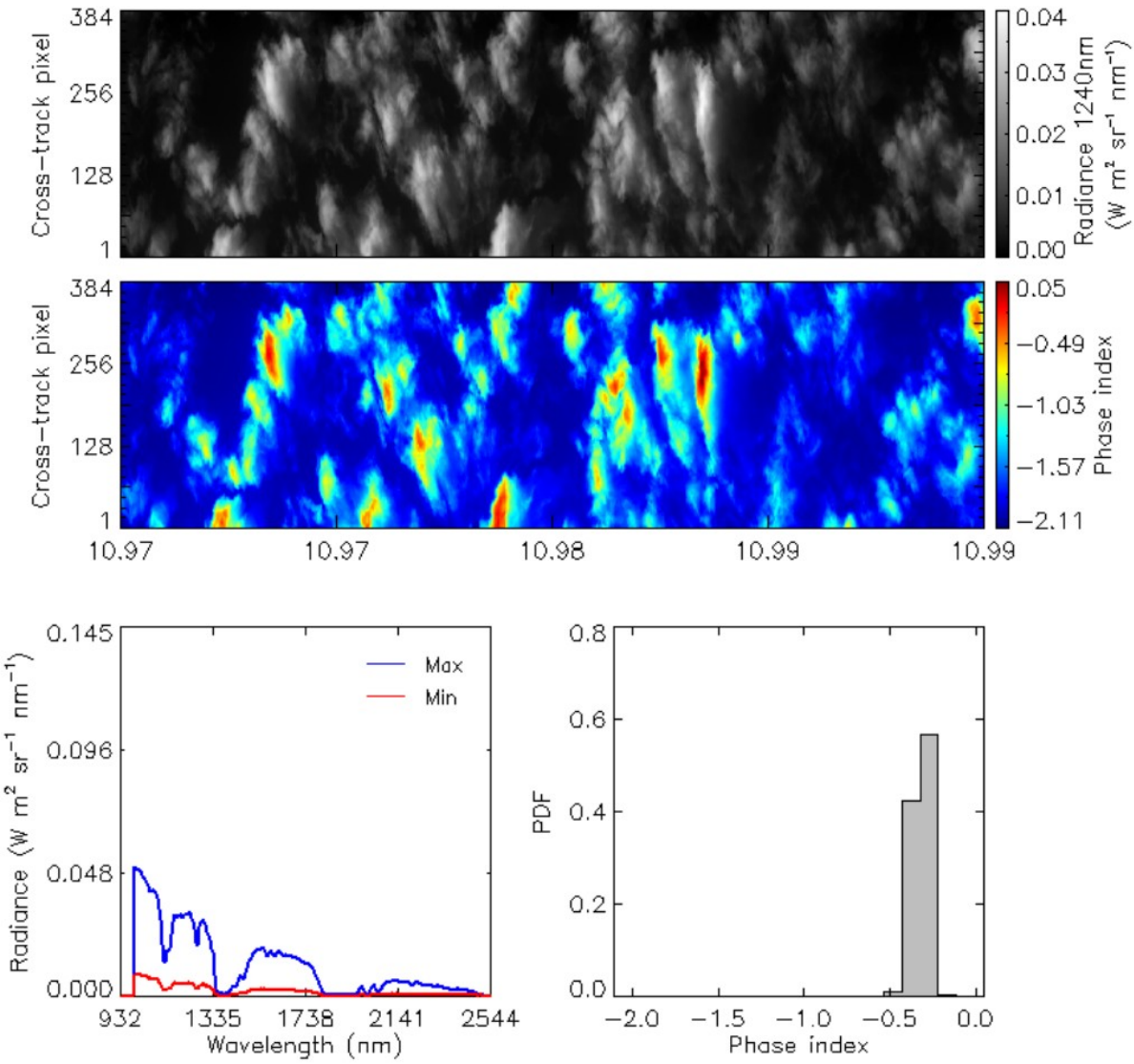
Quicklooks:





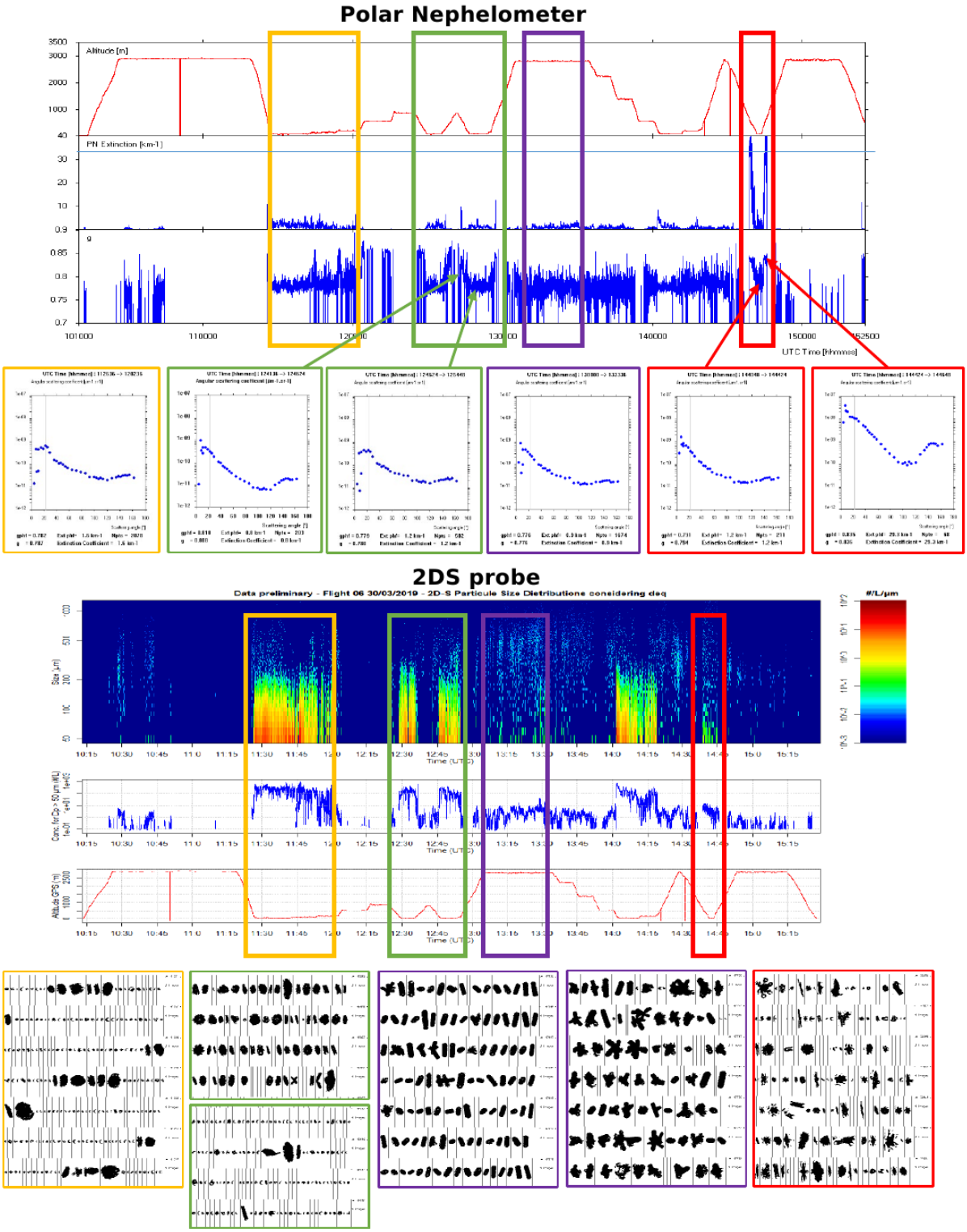
Quicklook 1. A quicklook from Amali.


1024
683
342
1
Cross-track pixel
0.13
0.10
0.07
0.04
0.00
Radiance 550nm
(W m^2 sr^{-1} nm^{-1})
0.118
0.079
0.039
0.000
Nadir radiance 550nm
(W m^2 sr^{-1} nm^{-1})
10.97
10.98
10.98
10.99
11.00
Time (UTC)
0.2
0.1
0.1
0.0
Radiance (W m^2 sr^{-1} nm^{-1})
Max
Min
401
549
697
845
993
Wavelength (nm)
0.4
0.3
0.2
0.1
0.0
PDF
0.02 0.04 0.06 0.08 0.10 0.12
Radiance 550 nm
(W m^2 sr^{-1} nm^{-1})

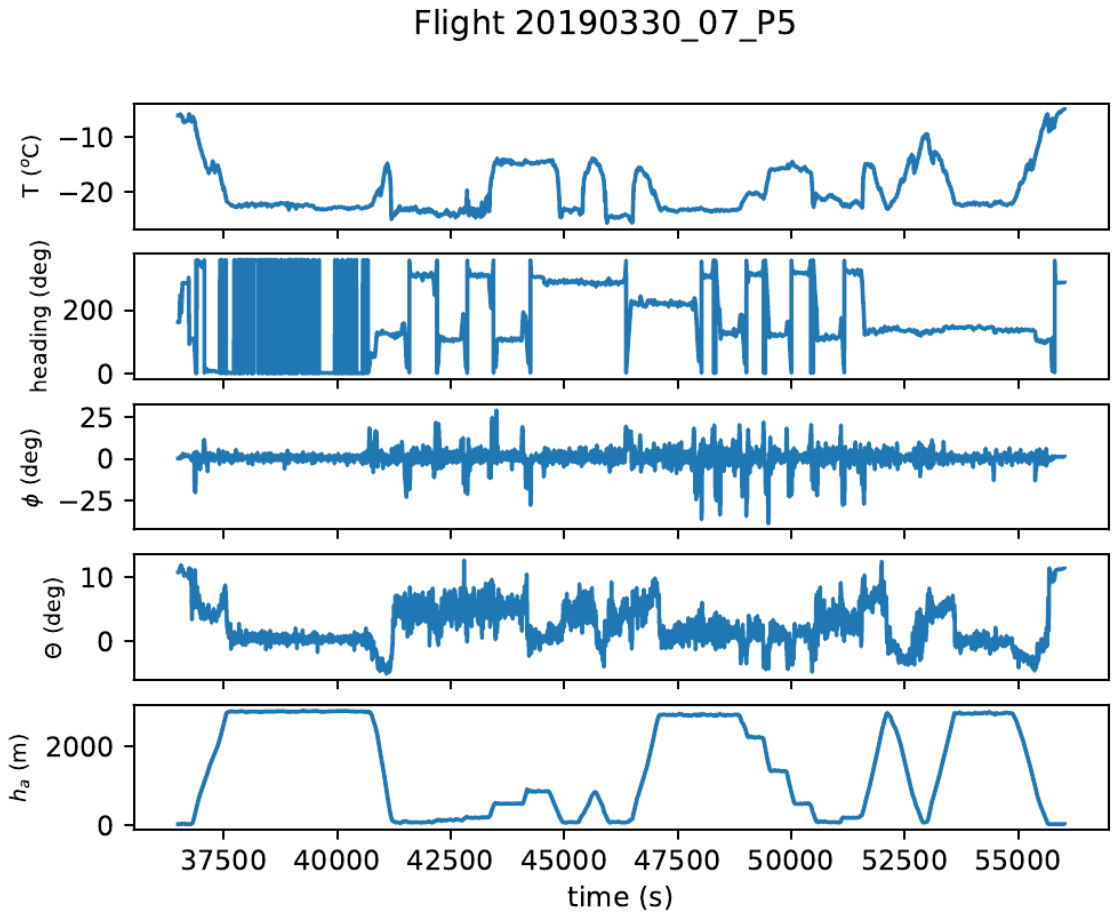


Quicklook 2. The quicklooks from Eagle and Hawk.

Flight #06 - 190330 – Quicklook Microphysics LaMP (Preliminary data)



Quicklook 3. The quicklooks from the 2DS and PN cloud probes.



Quicklook 4. Noseboom quicklook.