

HALO-(AC)³ – 2022/04/05 – POLAR 5 research flight 11

Objectives:

- Wing-by-wing flight maneuver for noseboom intercomparison
- Collocated flight with POLAR 6 to get data for retrieval algorithms
- Sampling the cloud structure between the lee of Svalbard and the Arctic ice

Mission PI POLAR 5:

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POLAR 5 Crew	
Mission PI	Marcus Klingebiel
AWI	Dennis Ludwig
AWI	Dirk Kalmbach
SMART/EAGLE/HAWK	Hanno Müller
MiRAC/AMALi	Imke Schirmacher
Drosondes	Nils Risse
Pilots	James Steward Noah Hladiak
Ground PI	Tim Sperzel

Flight times:

POLAR 5	
Take off	11:35 UTC
Touch down	15:55 UTC

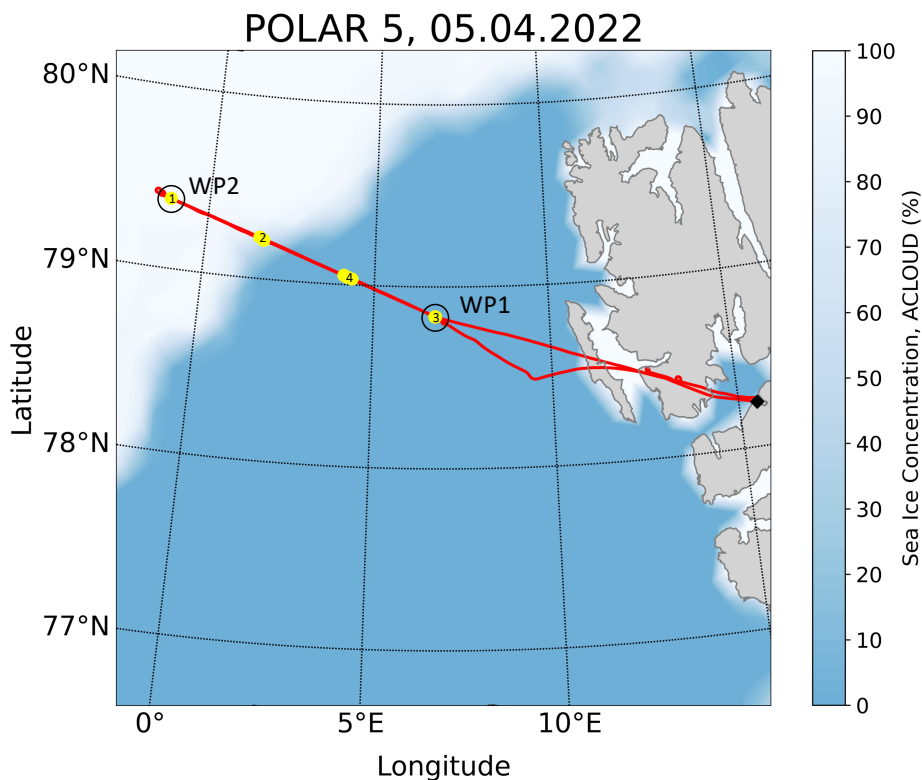


Fig. 1: Flight track with AMSR sea ice concentration and location and number of the launched drosondes.

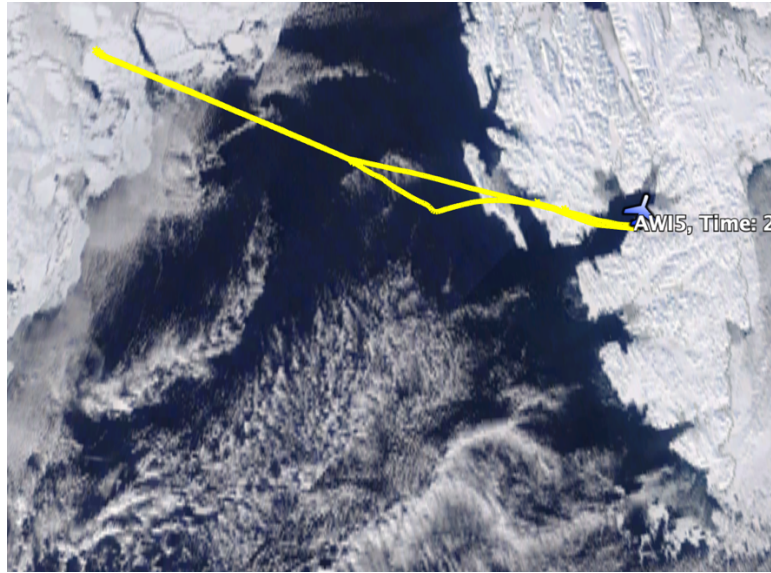


Fig. 2: Flight track with MODIS satellite image (from 05.04.2022).

Weather situation as observed during the flight:

The conditions during the research flight were different compared to the forecast. We expected more low level clouds in the target area than what appeared. In the following, we will describe the weather conditions from the forecast and compare them to the observed conditions.

Weather forecast:

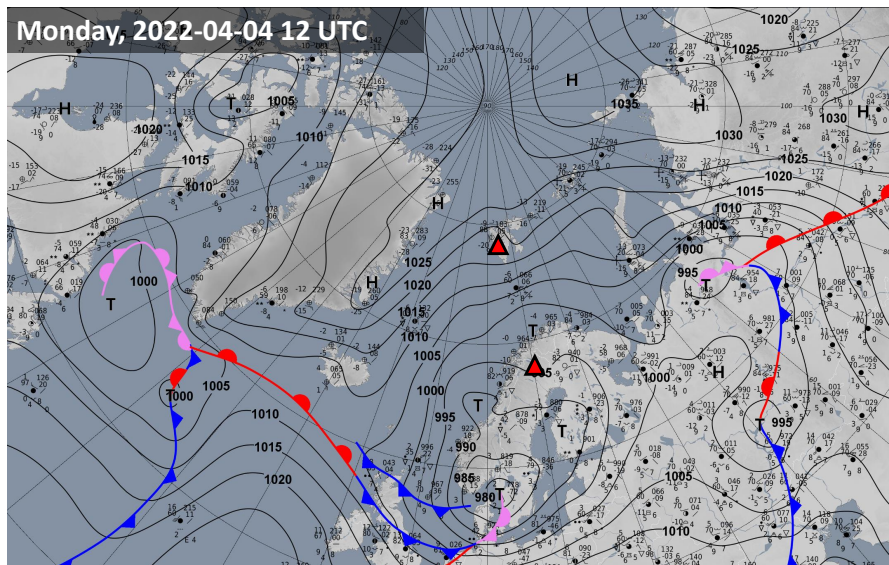


Fig. 3: Weather situation on Monday, 04.04.2022 at 12 UTC, one day before the research flight.

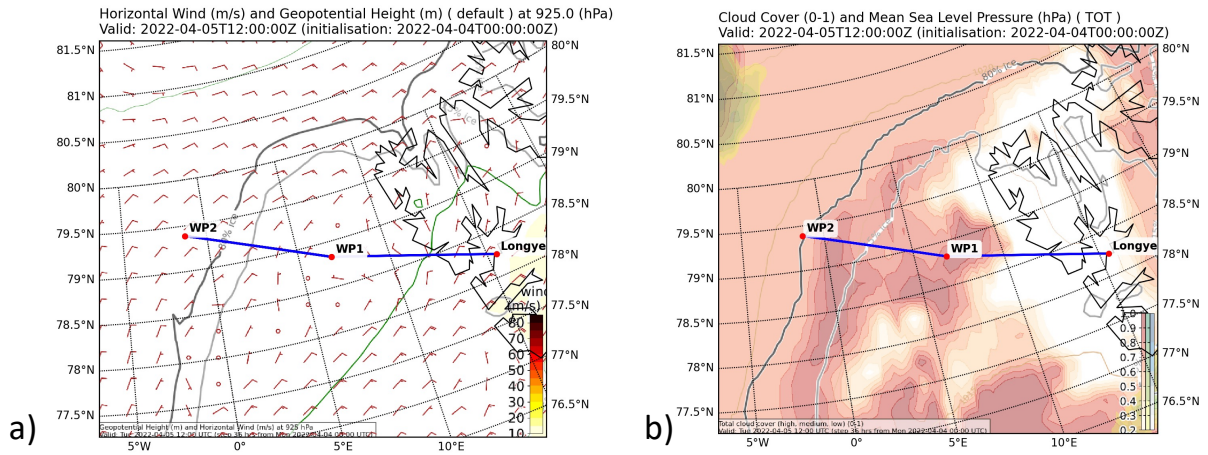


Fig. 4: a) ECMWF forecast of the meridional wind valid for 05.04.2022, 12 UTC (from 04.04.2022, 00:00 UTC).
 b) ECMWF cloud cover for the same times. Both maps include the planned flight track for POLAR 5.

The weather conditions in the target area were dominated by a high pressure system located over Greenland (see Fig. 3). The flight leg between WP1 and WP2 was located perpendicular to the forecasted wind (see Fig. 4a) and according to ECMWF, low level clouds should have been present along the whole flight leg (see Fig. 4b). The side view in Fig. 5 displays the expected clouds with a decreasing cloud top height towards the ice.

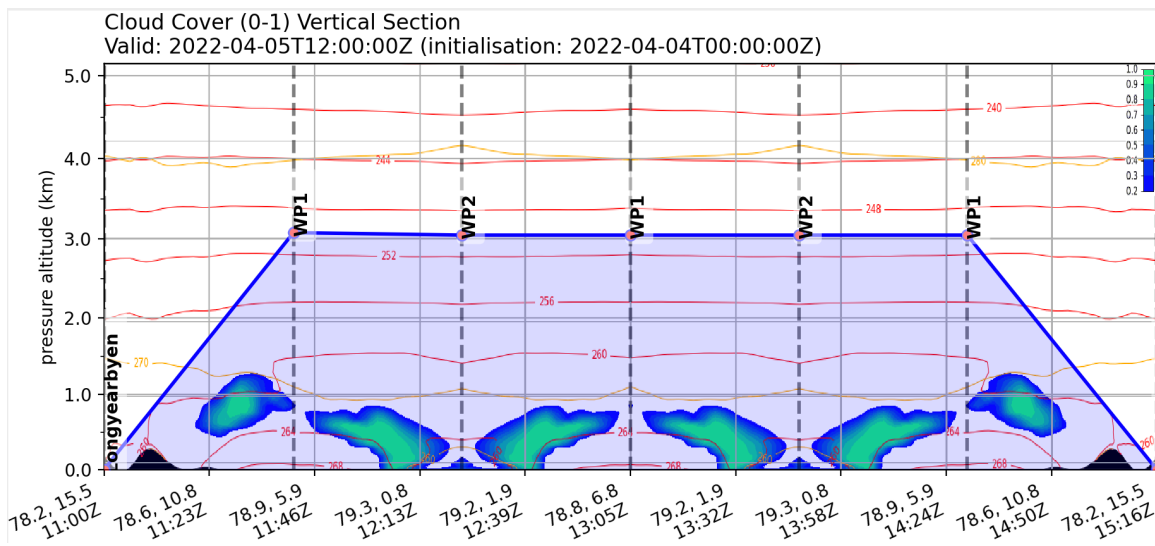


Fig. 5: Side view of the predicted cloud cover valid for 05.04.2022, 12 UTC (from 04.04.2022, 00:00 UTC), including the flight track.



Fig. 6: Photograph of the POLAR 5, taken from the POLAR 6, during the wing-by-wing flight (courtesy J. Schneider).

Observed Weather:

On the way towards WP1, we had clear sky conditions and could perform the wing-by-wing maneuver for the noseboom intercomparison (see Fig. 6). These cloud-free conditions, which formed westward of Svalbard, were also expected in the model forecast (see Fig. 4b) and are caused by the lee of the island. On the way to WP2 we didn't see any clouds in the first half of this leg. Closer to the ice edge, cloud streets started to form. Directly over the ice, when we flew at an altitude of 200 ft, no clouds were present above the aircraft (see Fig. 7d). Towards the sea ice edge, clouds started to form again (see Fig. 7f).

Differences between Forecast and Observations:

The main difference was that we saw fewer low level clouds than expected. Only close to the ice edge, the clouds appeared and we sampled them in collocation with POLAR 6. Based on the ECMWF forecast from the day before, these low level clouds should have been present on the whole leg (WP1 <-> WP2).



a) 10:38 UTC, left window



b) 10:49 UTC, left window



c) 12:37 UTC, left window (H. Müller)



d) 12:19 UTC, left window (H. Müller)



e) 12:33 UTC, right window



f) 12:41 UTC, right window

Fig. 7: Pictures from the cloud situation during different times of the flight.

Overview:

All the objectives of this flight (see first page of this report) were achieved. During the ferry to WP1, we flew next to the POLAR 6 to perform the wing-by-wing maneuver for the noseboom intercomparison (see Fig. 6). After that, the POLAR 5 climbed to 10000 ft and reached WP1 on this altitude. On the first leg from WP1 to WP2, we stayed close behind the POLAR 6, which performed in-situ measurements, to collect data for the development of retrieval algorithms. After this leg, the POLAR 5 turned around and flew independently of the POLAR 6 back to WP1 and did there a procedure turn to fly again on the same leg. Ten minutes before reaching WP2 again, we decreased to 200 ft. From WP2 towards the ice edge, we stayed at this altitude, as requested by the Sun photometer operators. After reaching the ice edge, we climbed up to 10000 ft again, and after reaching WP1, we headed back to Longyearbyen. During the whole flight, 10 dropsondes were launched (see locations in Fig. 1). All key instruments worked well, except for the noseboom where not all sensors were working correctly.

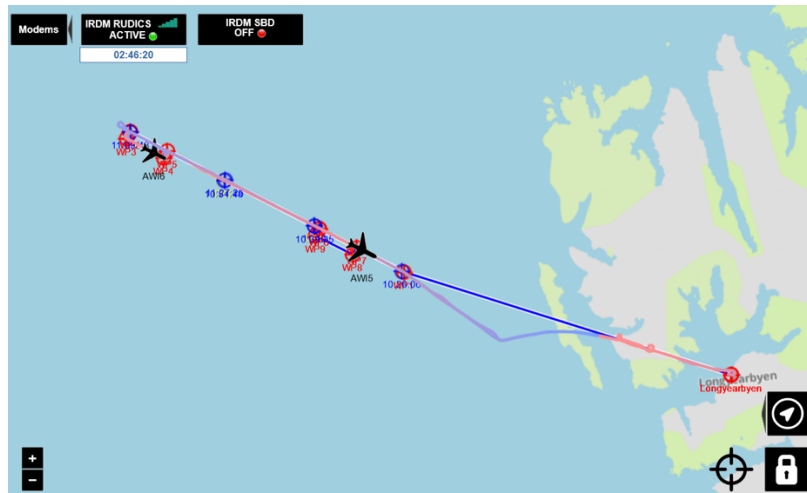


Fig. 8: Position of POLAR 5 (AWI5), POLAR 6 (AWI6) on 05.04.2022 at 13:46.

Instrument Status:

POLAR 5	
SMART	
EAGLE	
HAWK	
MiRAC	
AMALi	
Noseboom	Few sensors didn't work
HATPRO radiometer	
Broadband radiation	
Sunphotometer	
Nikon Camera	
Dropsondes	10
GoPro	

Table 1: Instrument status as reported after the flight for all instruments on POLAR 5.

Detailed Flight Logs (Times in UTC):

- 08:48 Doors closed
- 09:35 Takeoff
- 10:00 Wing-by-wing flight maneuver (see Fig. 6)
- 10:10 End wing-by-wing flight maneuver
- 10:26 1. Dropsonde (no clouds below and in sight)
- 10:39 2. Dropsonde (clouds ahead, nice collocation with P6)
- 10:54 3. Dropsonde (clouds below)
- 11:09 4. Dropsonde (no clouds over the ice, reached waypoint)
- 11:27 5. Dropsonde (clouds below)
- 11:39 6. Dropsonde (no clouds)
- 11:52 7. Dropsonde
- 12:07 8. Dropsonde (clouds start, sonde couldn't find a GPS signal)
- 12:20 Descent to 200 ft
- 12:42 Ascent to FL100 (10000 ft)

13:02 9. Dropsonde (no GPS)
13:14 10. Dropsonde, heading now back to LYR
13:55 Touchdown

Quicklooks:

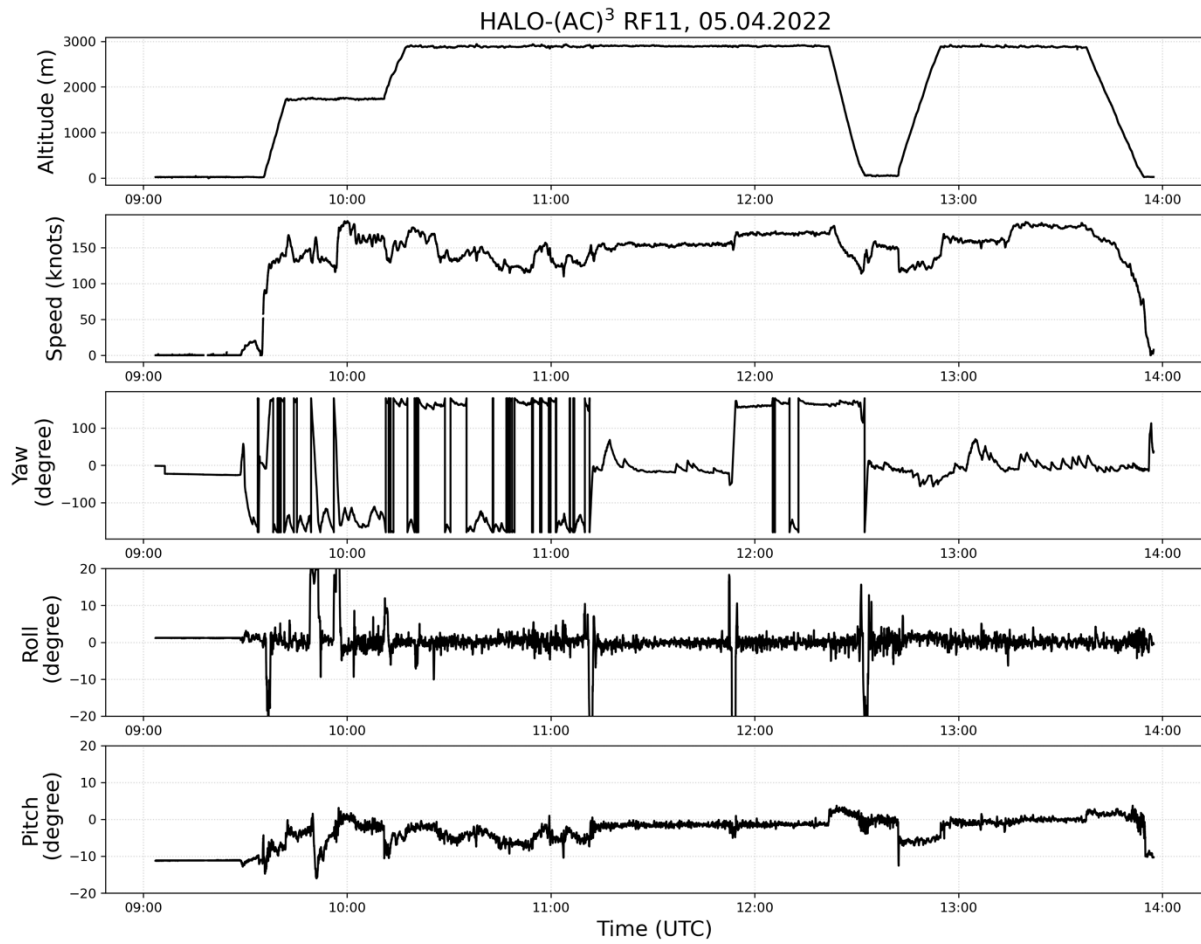


Fig. 9: Altitude, speed and attitude measurements.

Drosondes POLAR 5 05.04.2022 RF11

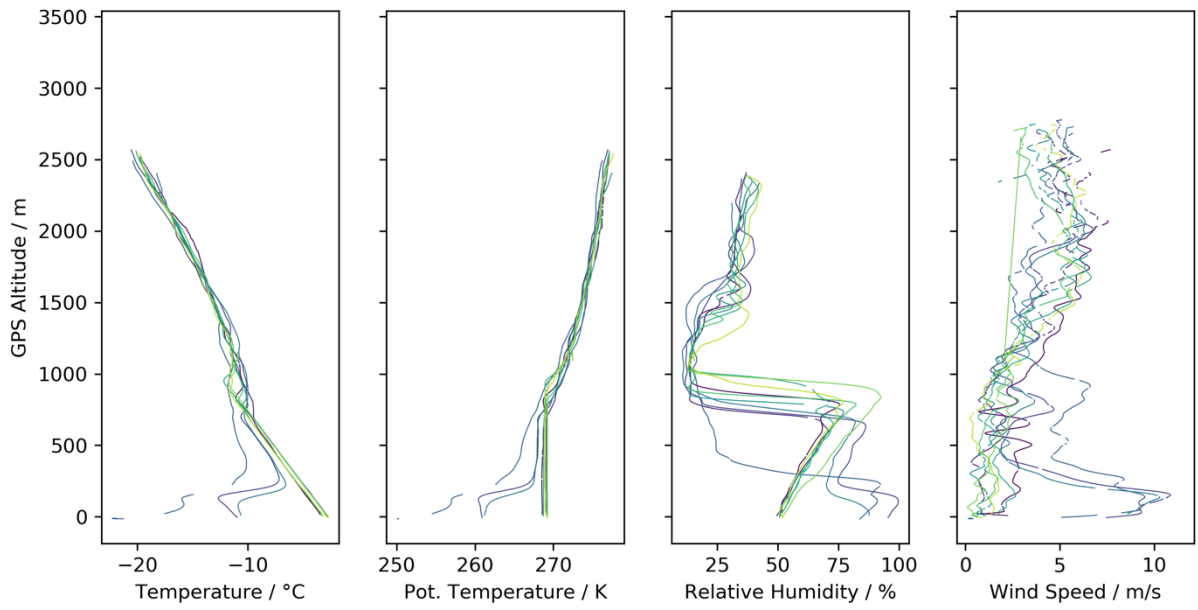


Fig. 10: Profiles of all launched drosondes.

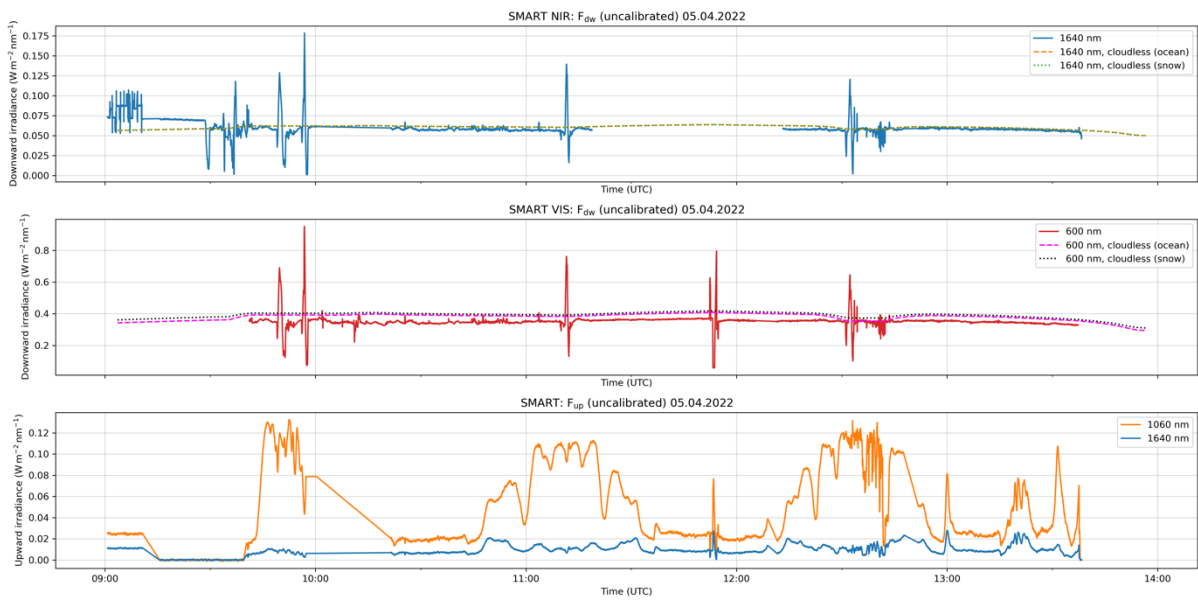


Fig. 11: SMART measurements along the flight.

HATPRO, 2022-04-05, 09:35-13:54 UTC

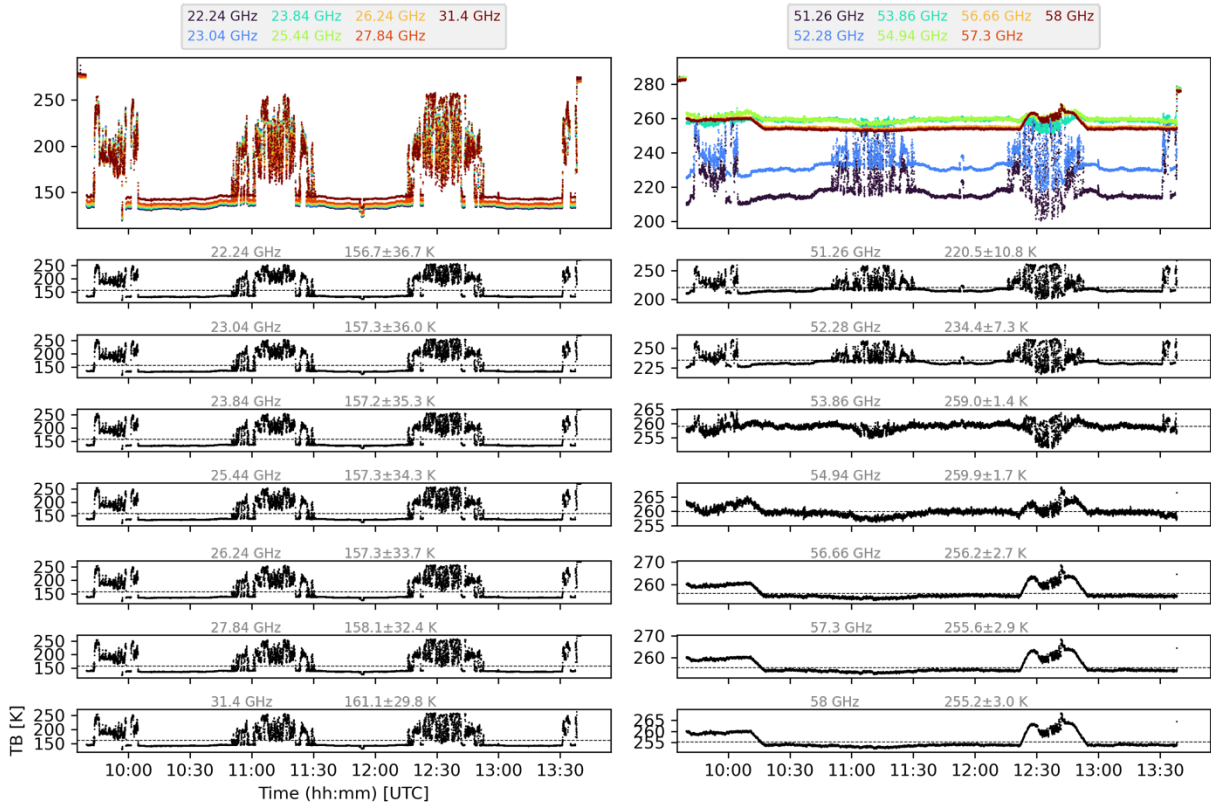


Fig. 12: HATPRO Radiometer measurements along the flight.

MIRAC-A, 2022-04-05, 09:35-13:54 UTC

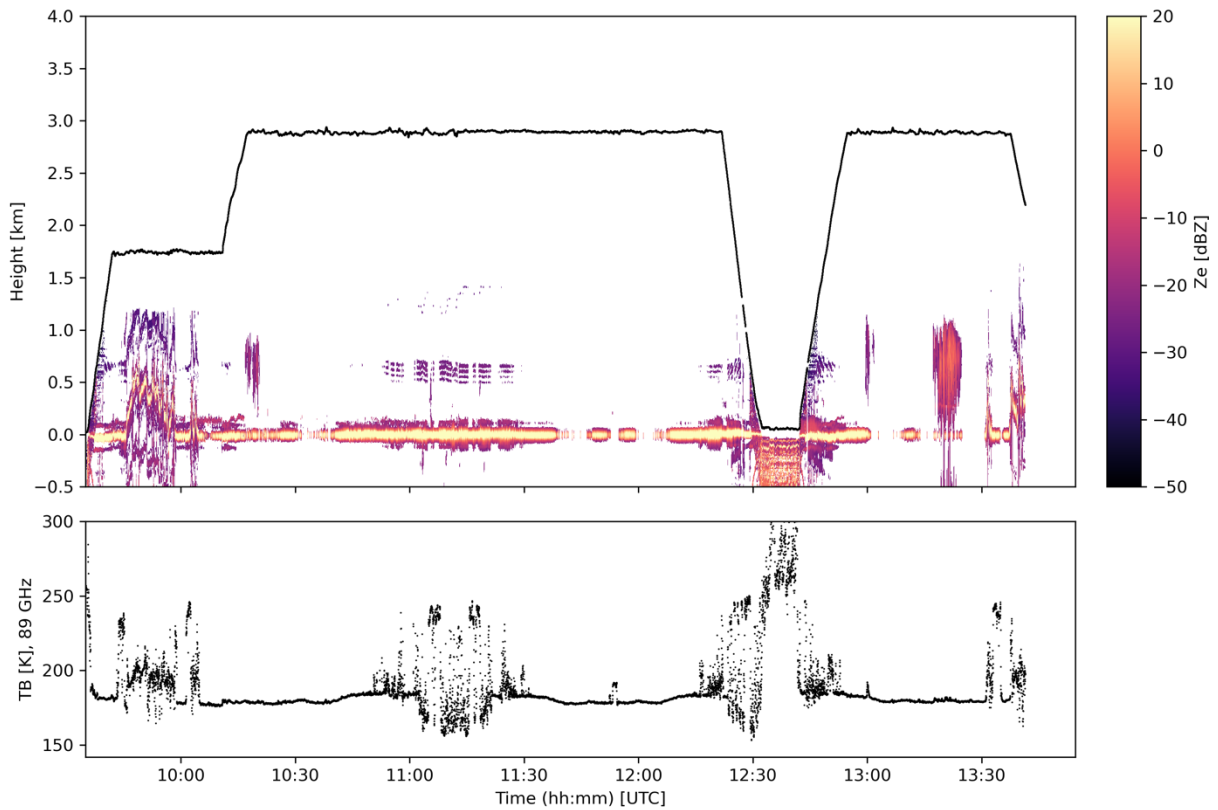


Fig. 13: MIRAC radar measurements.

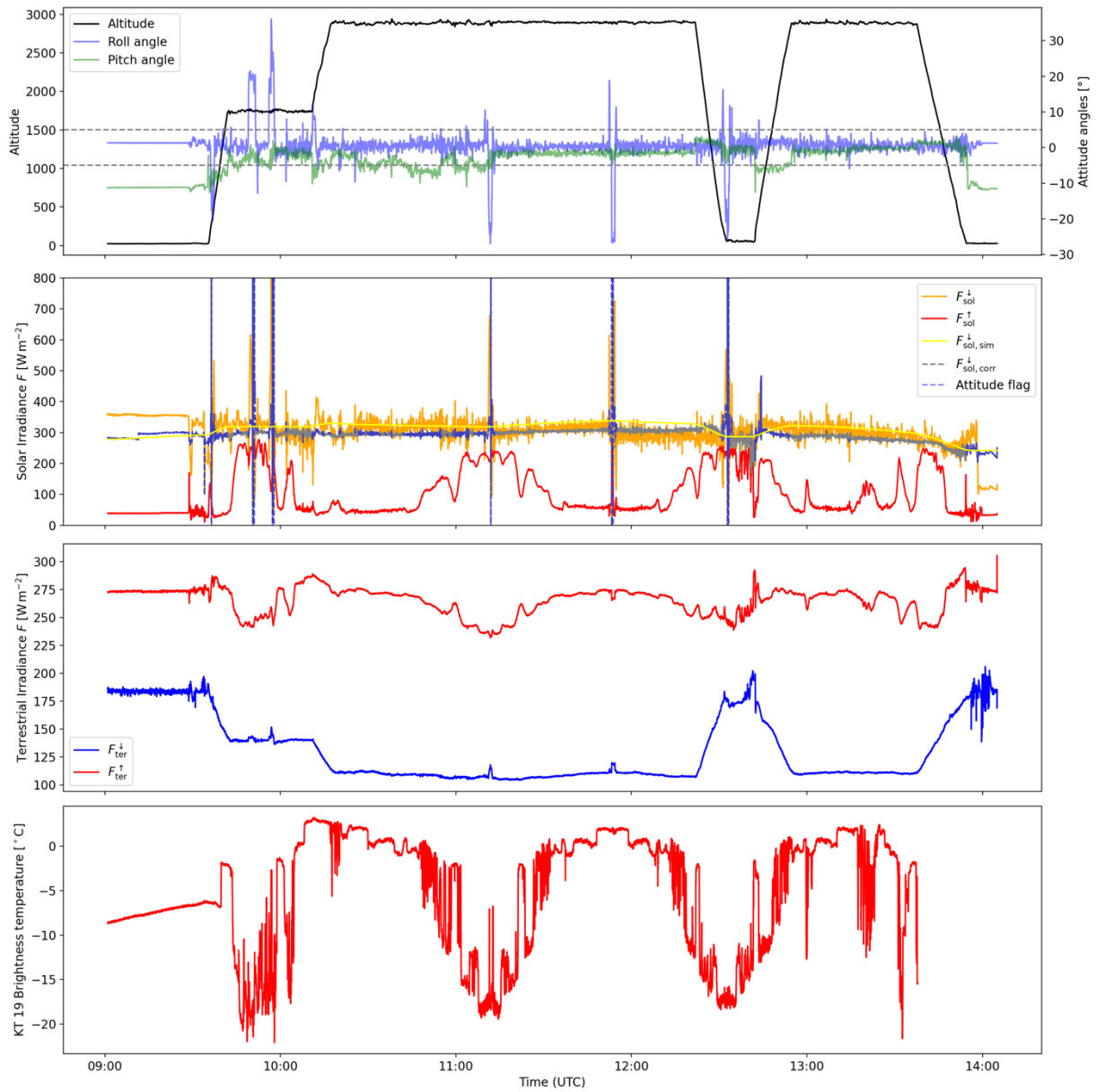


Fig. 14: Broadband radiation measurements along the flight.

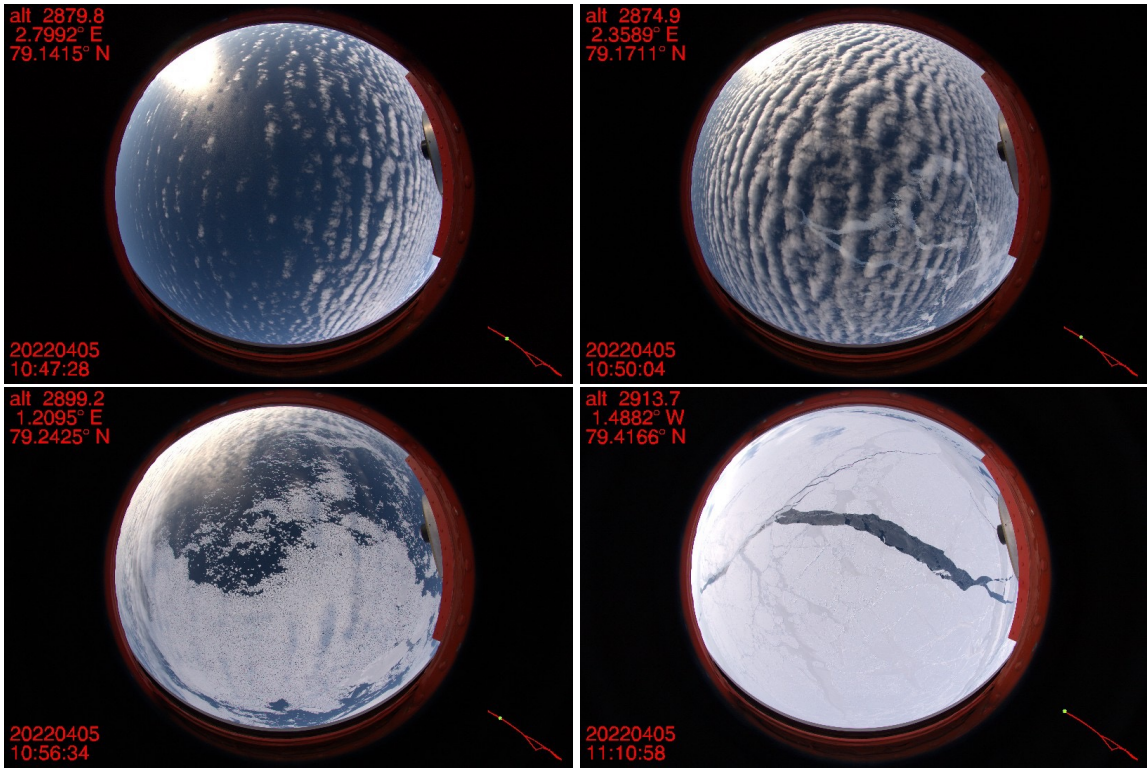


Fig. 15: Nikon camera pictures from different locations.

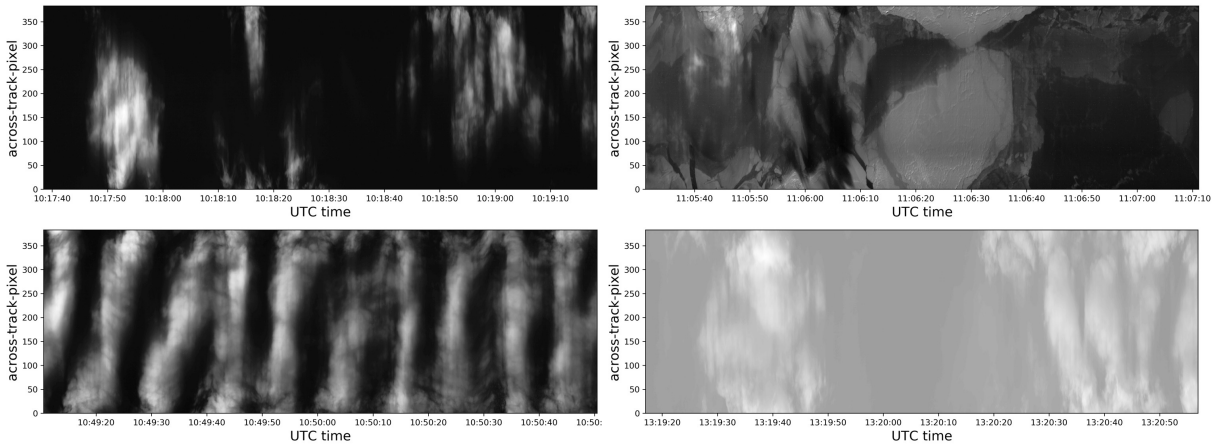


Fig. 16: Pictures taken at 1200nm by the spectral imager AISA Hawk at different times of the flight. The aspect ratio is not corrected yet.

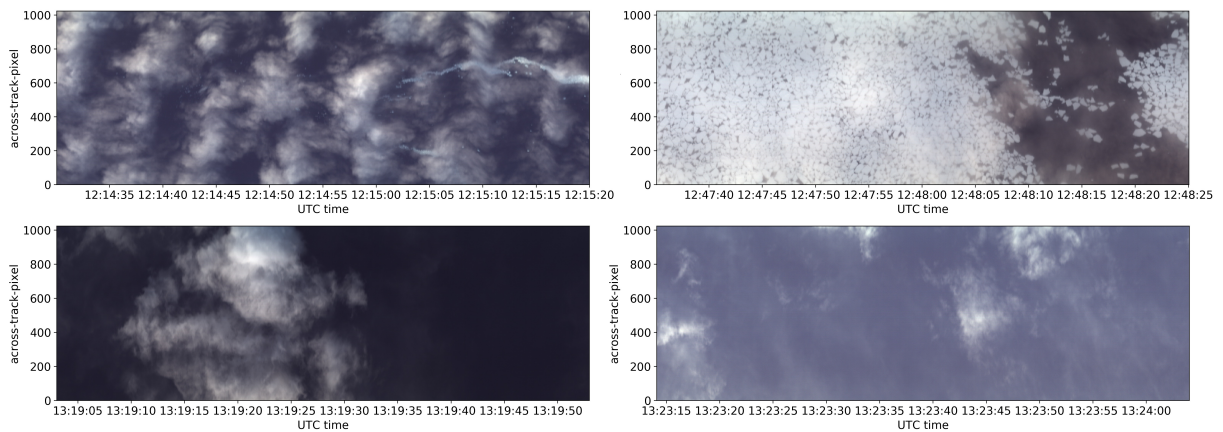


Fig. 17: RGB pictures taken by the spectral imager AISA Eagle at different times of the flight. The aspect ratio is not corrected yet.