COMPEX-EC Flight RF07 – Polar 5 – 2025/04/15



Pilot	Kyle McLenaghan
1 st Officer	Bailey Pegels
Mission Pl	Lena Bruder
Basis Data	Eduard Gebhard
SMART/ Eagle/Hawk	Joshua Müller
Mirac-a / Hatpro	Lars van Gelder
AMALi	Christian Buhren
Dropsondes	Marcus Klingebiel

Flight times:

Take off	12:54 UTC
Touch down	17:43 UTC

Objectives:

- Precisely align with the EarthCARE satellite track between WP2 and WP1+WP3 and being overflown at 13:35.
- Launch 5 dropsondes along the satellite track at the same locations on the ascending



MODIS image and RF07 from 2025-04-15

Figure 1: Flight and satellite track over MODIS RGB composite satellite image for RF07 on 15.04.2025.

Weather situation as observed during the flight (compared to forecast):

On April 15, two low-pressure systems were situated southwest and northeast of Kiruna. Warm air was advected from the south toward Kiruna along a warm front. However, for this flight, the latter (northeastern) low-pressure system played a more significant role, as cold air prevailed over the ocean region we were flying in. Low-level clouds were forecast along our flight path, with higher clouds reaching up to 4.5 km. We noticed that, overall, the models underestimated the amount of low-level cloud cover and overestimated the thickness of the higher clouds. Especially towards waypoint 2 (WP2), we observed more low-level clouds, likely associated with a weak cold air outbreak induced by the northward flow around the low-pressure system. In addition, we encountered convective clouds reaching heights of up to 4.5 km that were precipitating but not captured by the models. These clouds were associated with a small-scale disturbance moving southward as we approached the northern Norwegian coast. On our way back to Kiruna, we observed more high-level clouds, some even exceeding 5 km in altitude. These were linked to the warm front of the southern low-pressure system and were correctly forecast by ECMWF. Overall the models correctly forecasted the appearance of clouds along our flight path, also the low-level clouds over the ocean, but slightly overestimated the higher cloud cover and slightly underestimated the low-level clouds.



Figure 2: Forecasted cloud conditions from ECMWF in the area of the planned flight track (a). Vertical cross sections of the ECMWF cloud forecast along the flight track for 12:00 UTC (b) and 15:00 UTC (c).

Figure 3 shows the cloud development during the flight. Over land, there were more low-level clouds and fewer cirrus clouds towards the sea, so that over the sea, including at the time of the satellite overpass, there was a dense cloud cover below us and clear skies above us. The cirrus clouds reappeared on the return flight over land, so the spontaneous idea of flying a radiation square at WP3 was abandoned. The low-level cloud cover over land expanded during the afternoon, so we had to cross it for landing.



Figure 3: Photos taken during RF07 to the right side of the plane.

Mission Summary:

Overall, all objectives for the flight were achieved.

After launch, the HATPRO's receiver stability was too high, delaying the start of its measurements by 10 minutes. These measurements nevertheless covered the entire ascending and descending segments of the satellite path.

The flight was maintained at a constant flight level of 150. Three dropsondes were launched between WP1 and WP2, and two more between WP2 and WP3 at the same coordinates as the first and second dropsondes to ensure a regular spatial grid for the temporal evolution of the atmosphere.

Between WP2 and WP3, the EarthCARE satellite overflowed us as planned at 15:35 UTC. The corresponding signal from Polar 5 can also be seen in the EarthCARE radar data in Figure 8. After reaching WP3, we returned to Kiruna.

Cloud cover over the sea became denser and higher than predicted. However, the cloud top heights were lower than predicted, so it was decided to stay at flight level 150. Only in a short section after the EarthCARE match did we blur a few clouds, preventing the radar from measuring the low-level clouds there.

Otherwise, all instruments performed well, especially on the satellite track.

Instrument Status:

Polar 5	
Basis data acquisition	
MiRAC-A	
HATPRO	
AMALi	
SMART	
Eagle/Hawk	
Dropsondes	5/5 launched

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

Comments:

- Five dropsondes were launched between WP1/WP3 and WP2
- HATPRO receiver 1 stability value was 0.5, so measurements had to be started 10 minutes later, when the value decreased to below 0.05 K. Should cause no issues in the data.
- Flying through some single clouds before 14:00 UTC causing the stronger signals in radar data at 4 km and no signal for low-level clouds below.

Detailed flight log:

10:45 UTC	Preparations done, crew ready to fly
10:54 UTC	Takeoff (6 minutes before planned)
10:56 UTC	Opening rolling doors
10:58 UTC	High instability for HATPRO receiver 1 (stability value at 0.5 K, ideally it should be 0, with 0.05 K it's okay to start measurements → waiting for value to decrease)
10:58 UTC	Flying through cloud layer at 5000 ft
11:08 UTC	Starting HATPRO measurements
	Reaching and staying at 15000 ft
11:29 UTC	Reaching WP1 (7 minutes earlier than planned)
	Decision to stay at flight level 150 (high enough to be above clouds)
12:10 UTC	LiDAR Q-switch (back) on
12:12 UTC	Starting MiRAC-A measurements (Couldn't be earlier due to restricted areas)
12:13 UTC	LiDAR Q-Switch (front) on and starting measurements (Couldn't be earlier due to restricted areas)
12:14 UTC	General dropsonde launching permission
12:31 UTC	Dropsonde launcher moved down
12:32 UTC	DS1 launched
12:52 UTC	DS2 launched
13:10 UTC	DS3 launched
13:13 UTC	Reaching WP2 (3 minutes later than planned)
	Procedure turn
13:35 UTC	Reaching EarthCARE match point on time
13:37 UTC	DS4 first try no GPS found, second try worked and DS4 launched at 13:37
13:50 UTC	Some turbulences
13:57 UTC	DS5 launched

14:00 UTC	Dropsonde launcher moved up
14:15 UTC	LiDAR Q-Switch off
14:16 UTC	MiRAC-A off
14:17 UTC	AVAPS Dropsonde Computer off
	Discussing wether to fly a radiation square but finally deciding to not fly due to appearing Cirrus clouds
15:01 UTC	Reaching WP3 (16 minutes later than planned)
15:15 UTC	HATPRO off
15:19 UTC	Closing rolling doors
15:43 UTC	Touch down (4 hours 49 minutes flight time)

Quicklooks:



Figure 4: MiRAC radar (upper panel) and 89 GHz brightness temperature (lower panel).

COMPEX-EC_P5_RF07



Figure 5: HATPRO brightness temperatures for different channels along the whole flight.



Figure 6: AMALi Lidar quicklooks. Upper panel for 355 nm and lower panel for 532 nm.

Dropsondes during COMPEX-EC_RF07



Figure 7: Vertical profiles of all launched dropsondes.



Figure 8: Quicklook from the EarthCARE radar. The Polar 5 is visible as an echo in the EarthCARE radar data.



Figure 9: SMART quicklooks of the upward and downward irradiances and radiances.