

COMPEX-EC Flight RF06 – Polar 5 – 2025/04/13



Pilot	Kyle McLenaghan
1 st Officer	Bailey Pegels

Mission PI	Marcus Klingebiel
Basis Data	Dennis Ludwig
SMART/ Eagle/Hawk	Joshua Müller
MiRAC-A / HATPRO	Christian Buhren
AMALi / Dropsondes	Friedhelm Jansen

Flight times:

Take off	12:36 UTC
Touch down	17:40 UTC

Objectives:

- Precisely align with the EarthCARE satellite track north of Norway's northern coastline.
- Conduct frequent dropsonde launches along the satellite track to monitor the temporal evolution of atmospheric conditions associated with the anticipated cold air outbreak outflow.

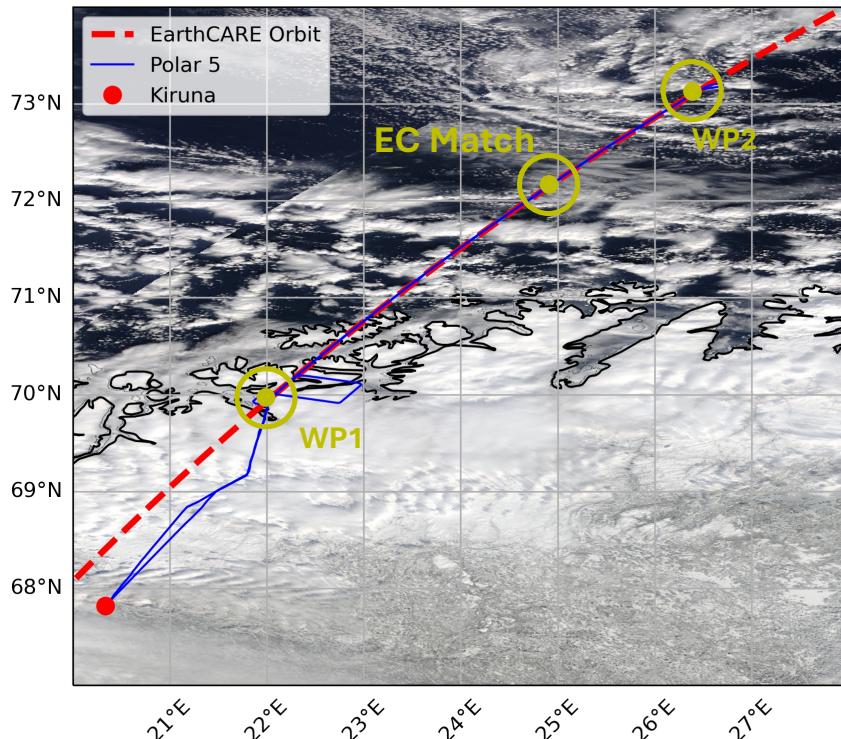


Figure 1: Flight and satellite track over MODIS RGB composite satellite image for RF06 on 13.04.2025.

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

On 13th April, the weather forecast showed cold air outbreak (CAO) conditions over the north Norwegian Sea. A low-pressure system was moving eastward, causing a northwesterly flow along the flight track. During the flight, we noticed clouds that started at 69°N. These clouds appeared at a relatively high altitude, and the degree of cloud cover was relatively high, which was not predicted by the models. According to the models, mainly lower clouds were expected, but also with a similar degree of coverage, which is why it can be assumed that the clouds themselves were predicted but at a different height. Over the coast, we observed some high convective clouds with tops of up to 5 km. These clouds were in connection with a convective cloud band of the low pressure system. We could observe that these clouds precipitated. Behind this zone, it cleared up with clear sky phases until more and more low-level clouds appeared at an altitude of around 2 km the closer we got to the center of the low-pressure system (at around 73°N). These clouds were predicted to some extent by both ICON and ECMWF. However, we were unable to observe the predicted higher clouds between 3 and 4.5 km near the center of the low pressure system.

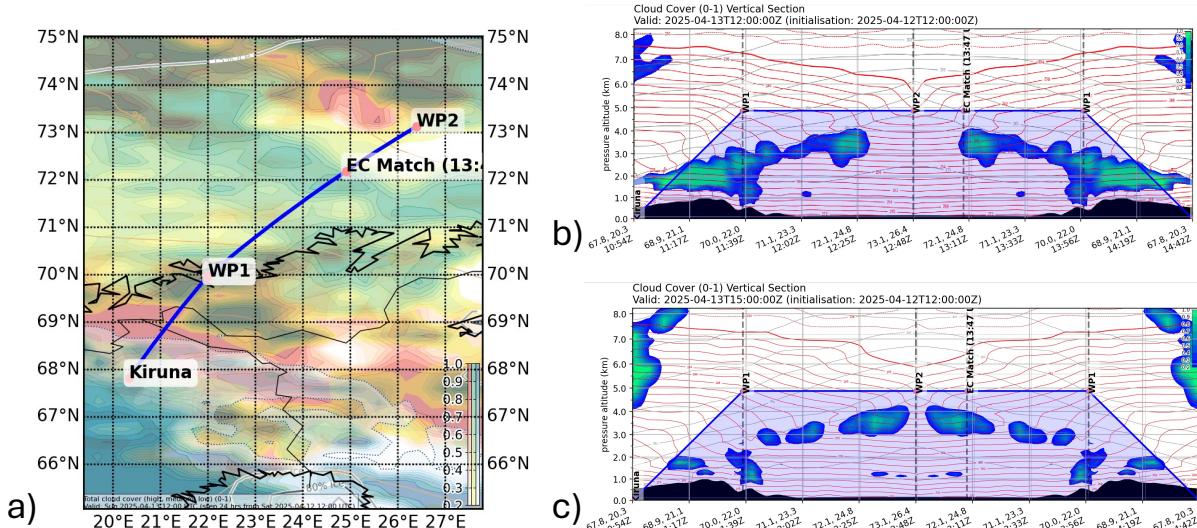


Figure 2: Forecasted cloud conditions from ECMWF in the area of the planned flight track (a). Vertical cross sections of the ECMWF cloud forecast along the flight track for 12:00 UTC (b) and 15:00 UTC (c).

Figure 3 shows the cloud conditions during the flight for different times. At WP1 we observed a continuous cloud layer below us, which is also visible in the radar reflectivity (see Fig. 4 around 12:00 UTC). As we continued northward between WP1 and WP2, the cloud cover began to break up, revealing shallow cumulus clouds with relatively low cloud tops (see Fig. 3c). Closer to WP2 another closed cloud layer occurred with cloud top heights around 2 km (see Fig. 4 at 13:30 UTC). On the return leg toward WP1, the cloud conditions remained largely unchanged from those observed earlier.



Figure 3: Photos taken during RF06 to the left side of the plane (a - e) and to the right side (f).

Mission Summary:

Overall, the mission proceeded as planned. We took off approximately 18 minutes ahead of schedule, which gave us time to fly a radiation square at WP1, where there were no cirrus clouds present. Prior to reaching WP1, we experienced a delay in deploying the SMART Albedometer, but this issue was resolved shortly afterward.

Between WP1 and WP2, we maintained an altitude of 14000 ft to remain above the cloud tops. Four dropsondes were launched on the leg to WP2, and five more were launched on the return leg to WP1. All nine dropsondes functioned as expected.

We achieved a precise match with the EarthCARE satellite at 13:47 UTC at the designated “EC Match” waypoint, exactly as planned. Following this, we returned to WP1 and then proceeded back to Kiruna.

Throughout the flight, cloud cover was consistently higher than forecasted. Additionally, no cirrus clouds were observed during the mission. All instruments performed well between WP1 and WP2, particularly during the satellite overpass.

Instrument Status:

Polar 5	
Basis data acquisition	
MiRAC-A	
HATPRO	
AMALi	
SMART	
Eagle/Hawk	
Dropsondes	9 launched

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

Comments:

- The SMART Albedometer didn't move down after takeoff. After a few tries it moved down and worked.
 - Nine dropsondes were launched between WP1 and WP2
-

Detailed flight logs:

10:21 UTC	Engines on
10:32 UTC	Rolling to runway
10:36 UTC	Takeoff (18 minutes before planned)
10:40 UTC	Albedometer does not move down
10:49 UTC	Altitude: 3480 meter
10:54 UTC	Albedometer is working now
10:58 UTC	Indicated airspeed 162 kn Reaching WP1 earlier than expected. No cirrus above, starting radiation square at WP1.
11:29 UTC	Radiation square leg 1
11:34 UTC	Leg 2
11:39 UTC	Leg 3 (14 000 ft)
11:44 UTC	Leg 4
11:52 UTC	Reaching WP1 (Radar now on, couldn't do it earlier because of military restricted areas Continuous cloud layer ahead. Much more than expected from forecast
12:37 UTC	Dropsonde 1 launched. Now the clouds are clearing up. No closed cloud layer anymore. Shallow cumulus clouds.
12:44 UTC	Cloud top height much lower than before.
12:53 UTC	Dropsonde 2 launched. Still shallow cumulus. Cloud layer ahead.
13:09 UTC	Dropsonde 3 launched. Takes about 6 minutes to reach surface. Closed cloud layer.

13:19 UTC	Next dropsonde does not initialize
13:25 UTC	Dropsonde 4 launched
13:35 UTC	Dropsonde 5 launched
13:43 UTC	Dropsonde 6 launched
13:47 UTC	Reaching EarthCARE match point. Perfect on time
13:52 UTC	Dropsonde 7 launched
14:00 UTC	Dropsonde 8 launched
14:09 UTC	Dropsonde 9 launched
	Closed cloud layer with precipitation
14:31 UTC	Radar off
14:46 UTC	Reaching WP1
14:57 UTC	AMALi off
15:14 UTC	Roller doors closed
15:40 UTC	Touch down (5 hours 4 minutes flight time)

Quicklooks:

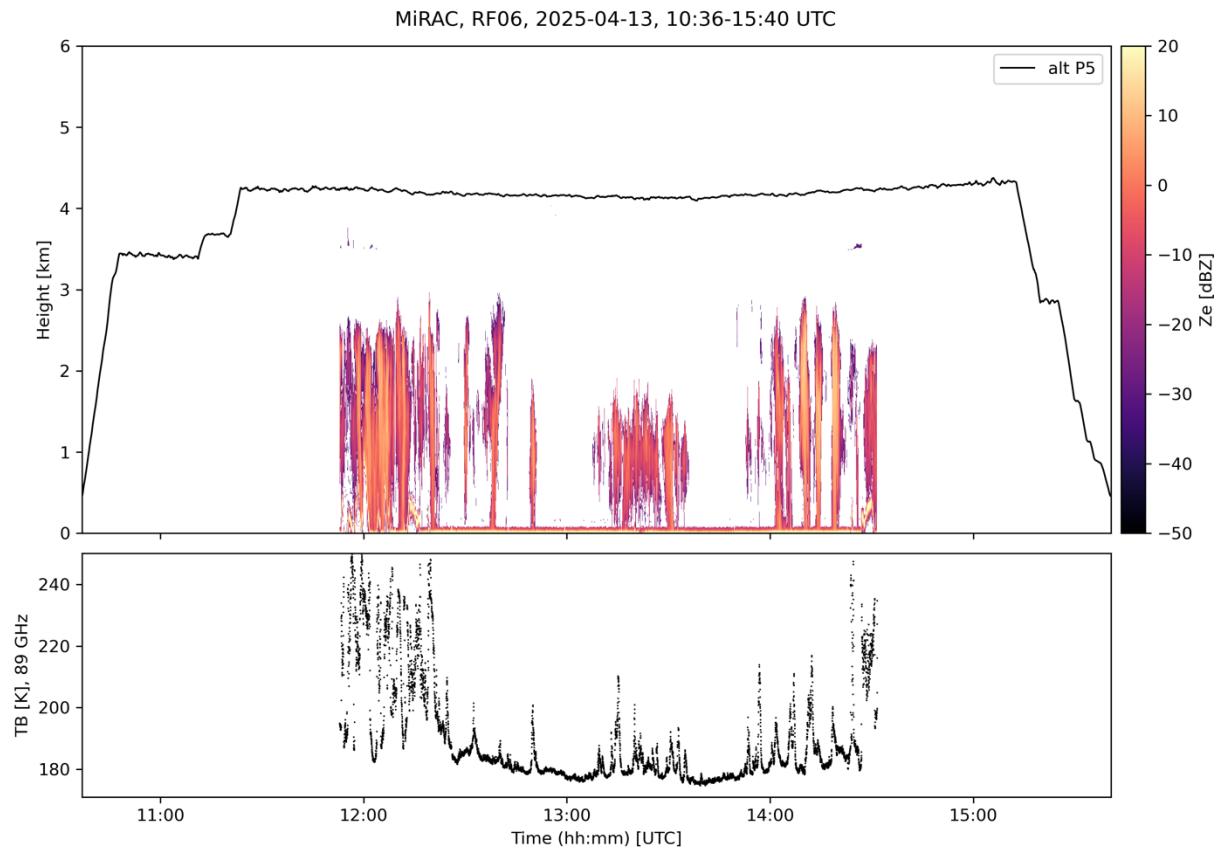


Figure 4: MiRAC radar (upper panel) and 89 GHz brightness temperature (lower panel).

COMPEX-EC_P5_RF06

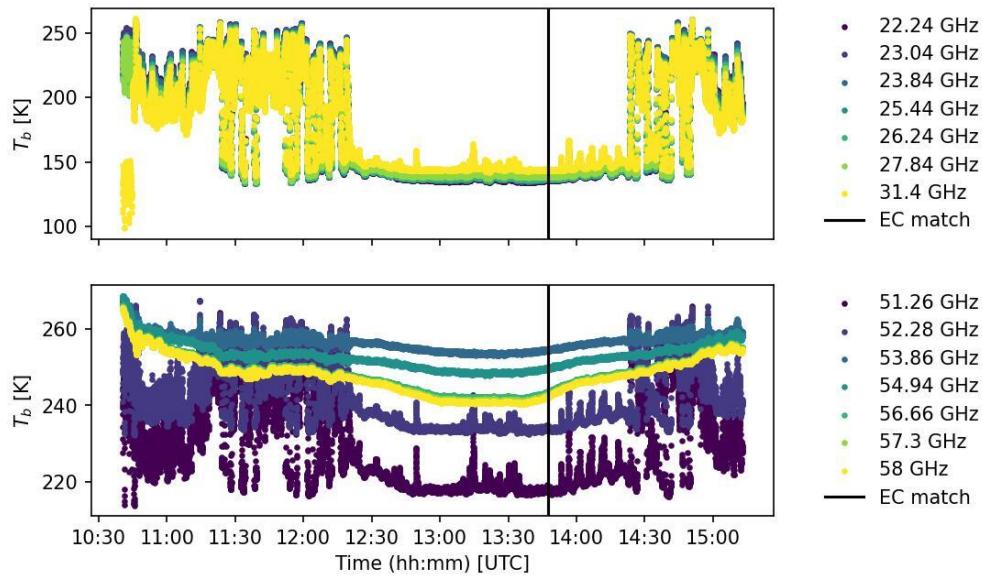


Figure 5: HATPRO brightness temperatures for different channels along the whole flight.

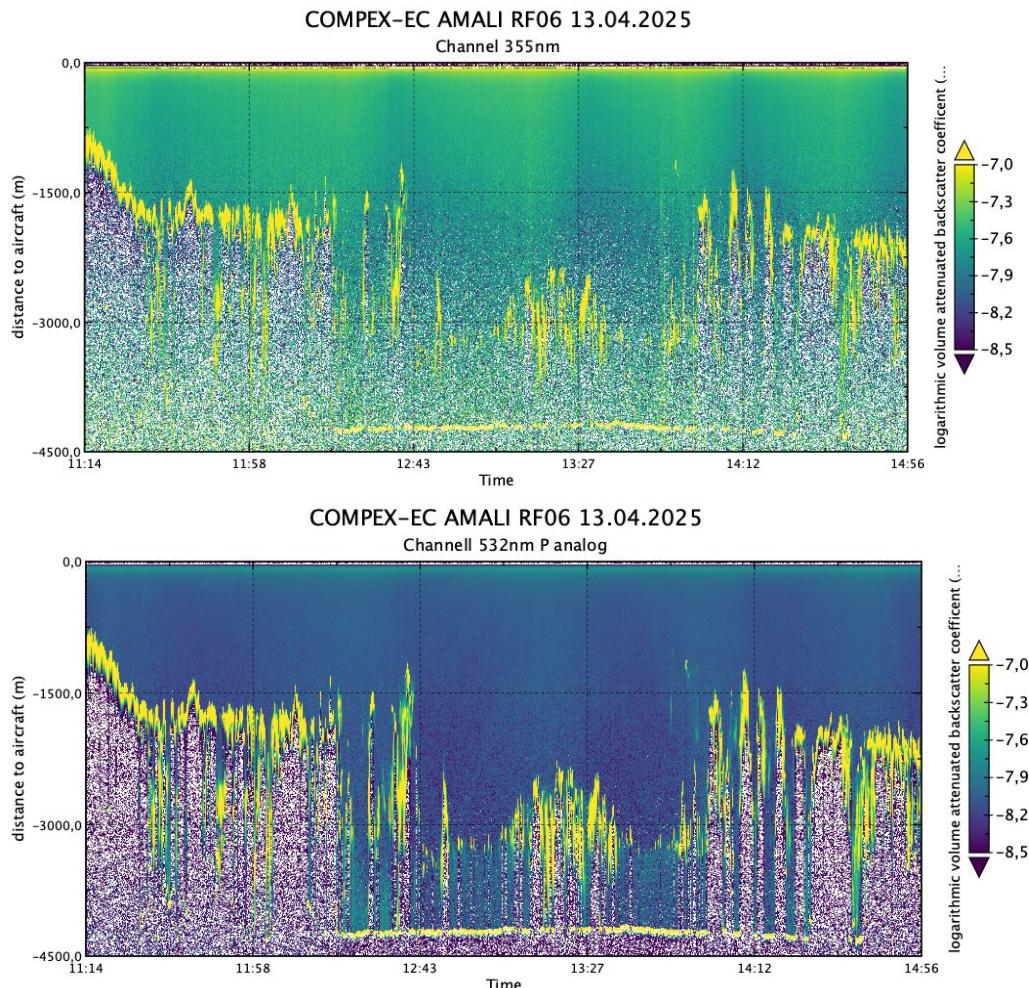


Figure 6: AMALi Lidar quicklooks. Upper panel for 355 nm and lower panel for 532 nm.

Dropsondes during COMPLEX-EC_RF06

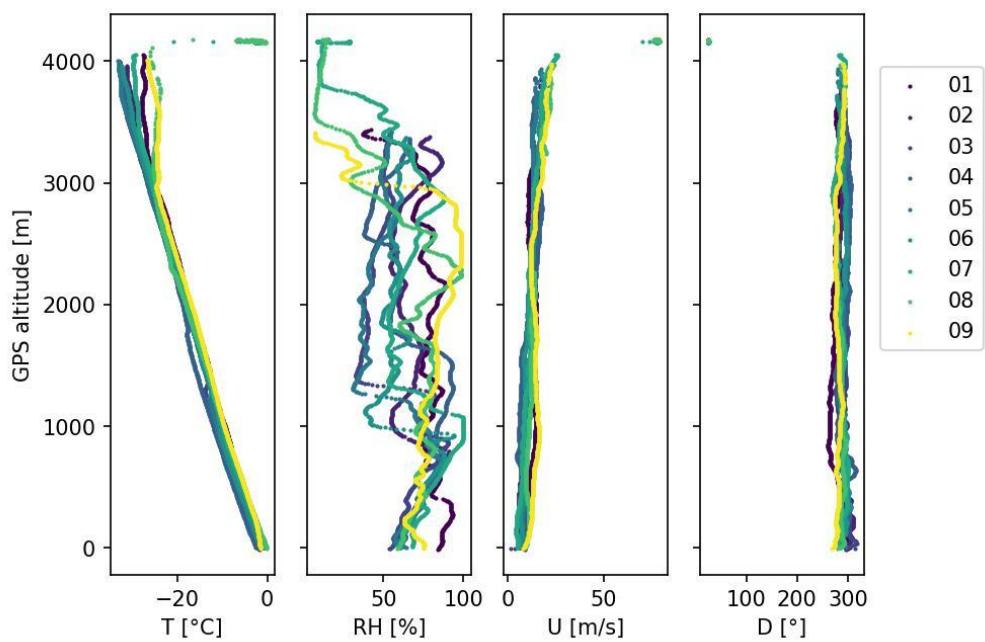


Figure 7: Vertical profiles of all launched dropsondes.

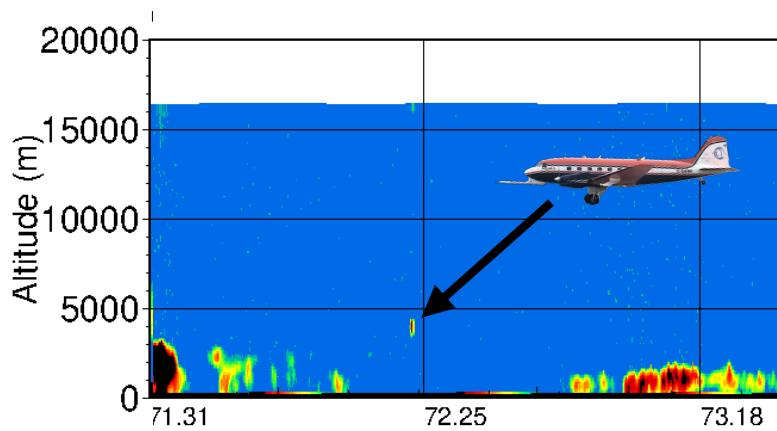


Figure 8: Quicklook from the EarthCARE radar. The Polar 5 is visible as an echo in the EarthCARE radar data.

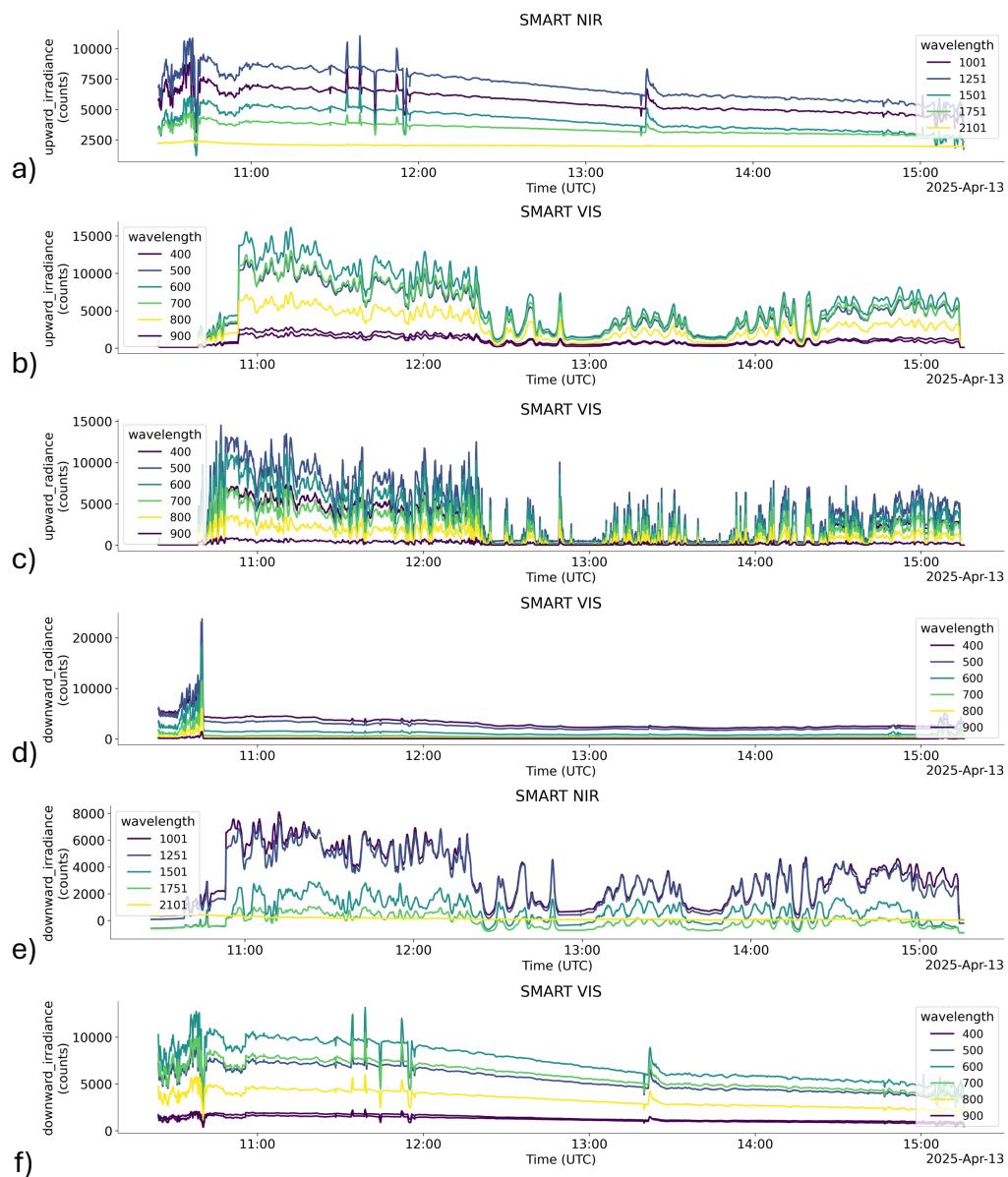


Figure 9: SMART quicklooks of the upward and downward irradiances and radiances.