Flight Report

HALO-AC3_HALO_20220320_RF07

Cold Air Outbreak 1 — Day 1

Jointly with Polar 5 and Polar 6

Objectives:

- Characterize atmospheric and surface conditions before a cold air outbreak (expected for the next day), with still mostly southerly wind, including a cirrus moving northward, extended Sc fields, and cloud-free areas
- Fly parallel to the MIZ, over homogeneous sea ice close to Greenland, then over the MIZ itself, and over open ocean.
- Look at cloud properties over the different surface types.
- Characterize surface reflection and emission properties in cloudless conditions.
- On the way to the main measurement area and back, we wanted to sample curtains providing vertical slices through warm air moving northward, that would not intrude into the Arctic.
- Test the coordination with Polar 5 and Polar 6 during their first research flights within this campaign.

HALO Crew:

Mission PI	Manfred Wendisch
HAMP	Lutz Hirsch
WALES	Manuel Gutleben
SMART/VELOX	Michael Schäfer
specMACS	Anna Weber
Dropsondes	Max Ringel
Camera	Sebastian Schmidt
Pilots	Marc Puskeiler Michael Grossrubatscher
Engineer	Thomas Leder

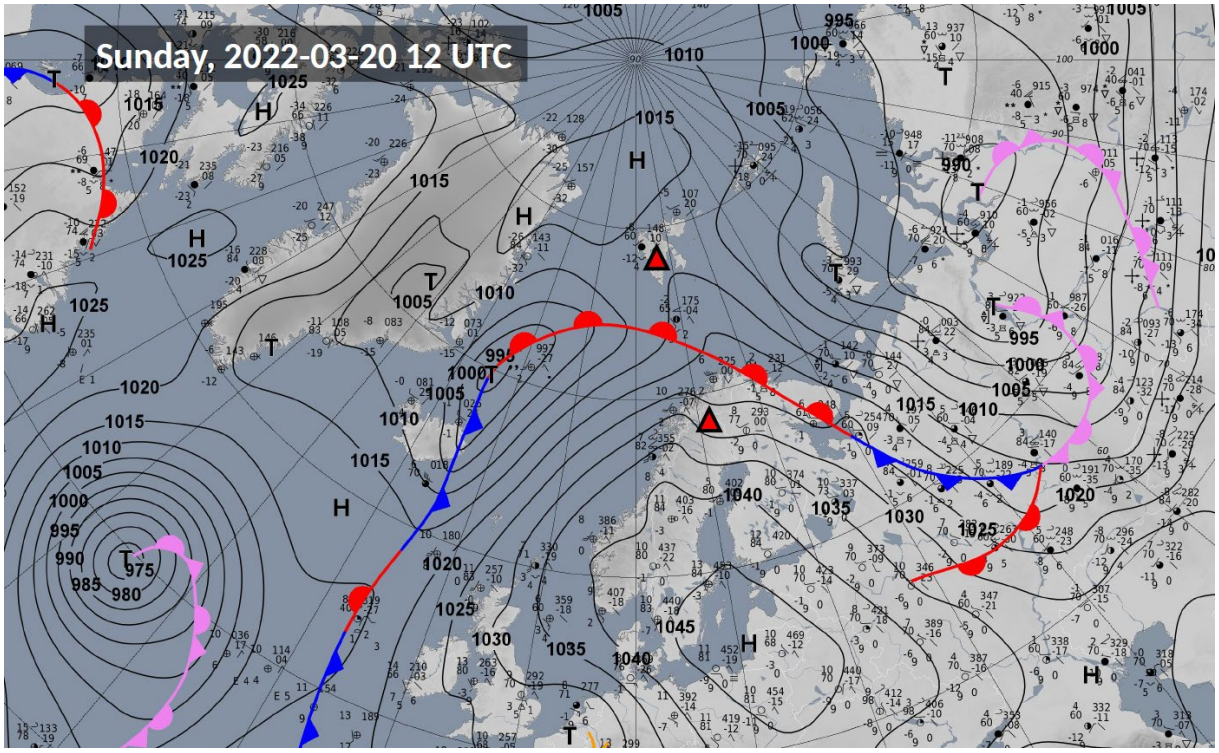
Flight times:

Take off	07:58 UTC
Touch down	16:44 UTC

Weather situation during the flight:

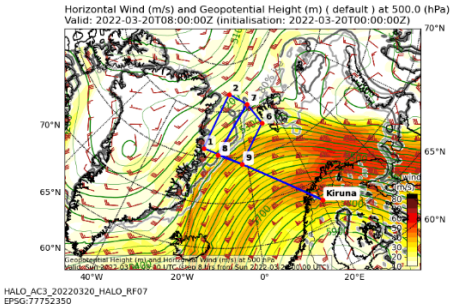
A high pressure ridge extends from northern Scandinavia towards Svalbard. On its western flank warm air is transported northward, but it is not reaching the Svalbard area. At the northern part of the ridge a closed high pressure system has evolved appearing in the surface pressure plots, which prevents the warm air from the south to intrude into the Arctic. It initiates weak transport of cold air southward. This situation characterizes a transition between the transport of warm air from the south typical for the days before, and the conversion into a situation with mostly meridional transport of cold air from North to the south that is expected to begin during the next days.

Surface Analysis: 20 March 2022, 12 UTC

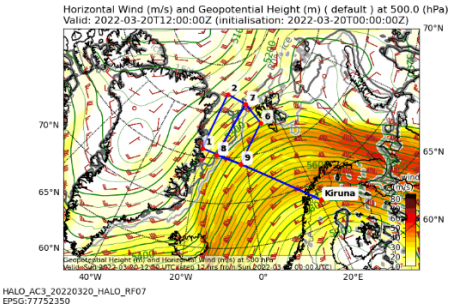


500 hPa Wind and Geopotential, 20 March 2022

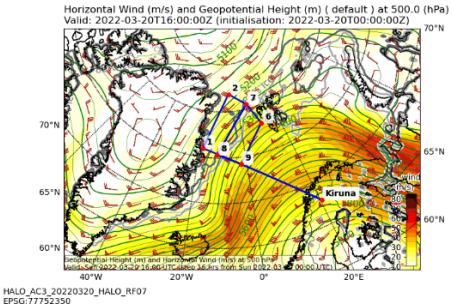
08 UTC



12 UTC

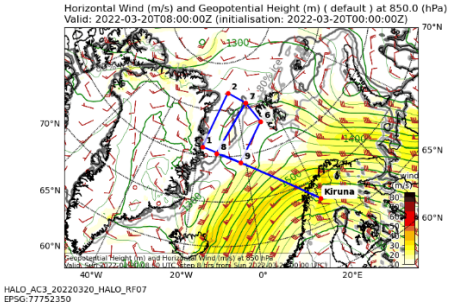


16 UTC

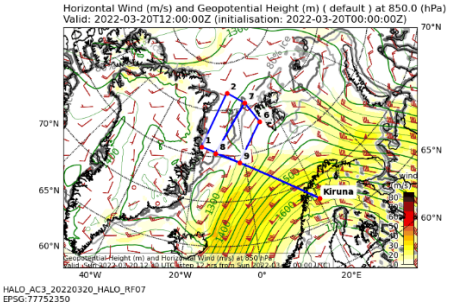


850 hPa Wind and Geopotential, 20 March 2022

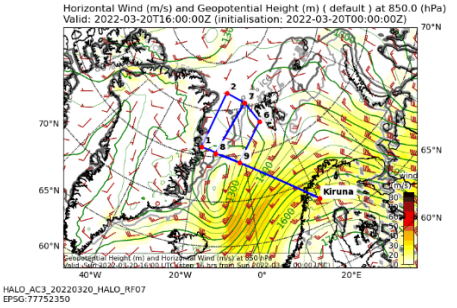
08 UTC



12 UTC

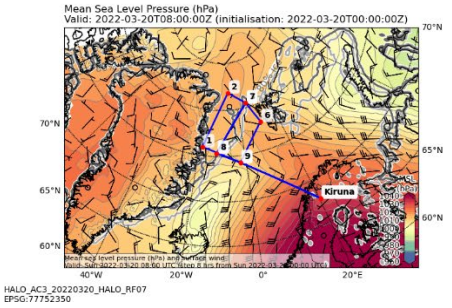


16 UTC

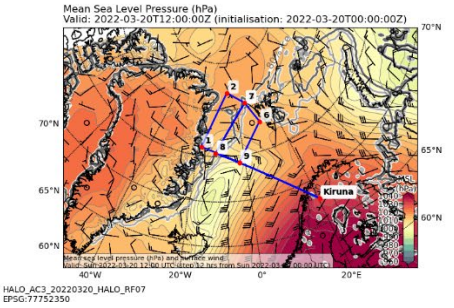


Sea Level Pressure and Wind, 20 March 2022

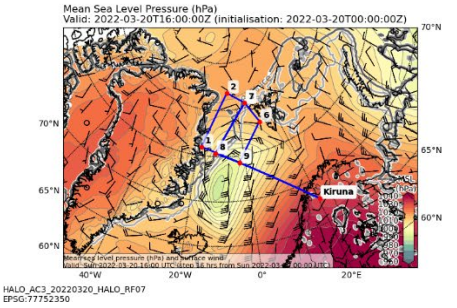
08 UTC



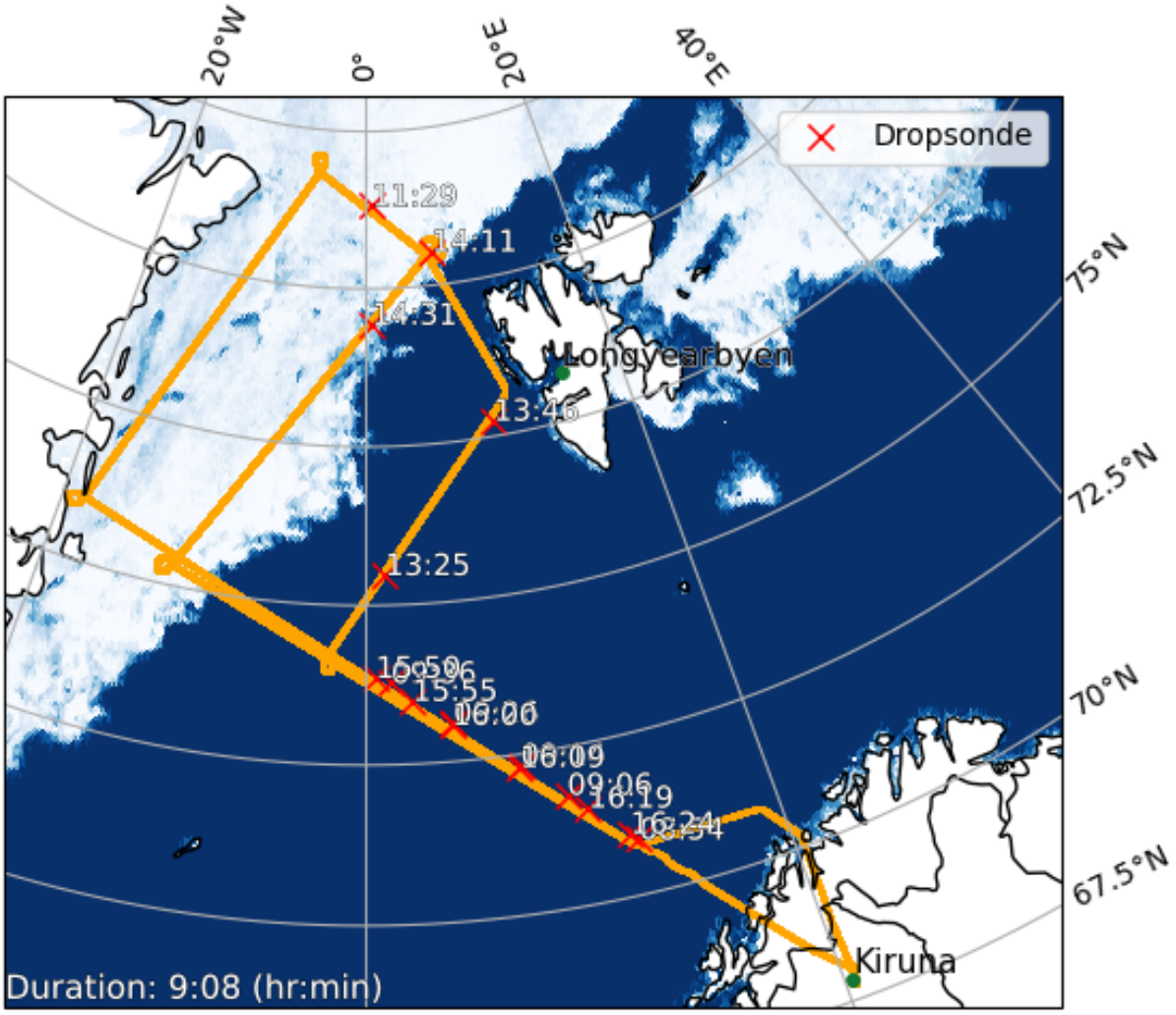
12 UTC



16 UTC



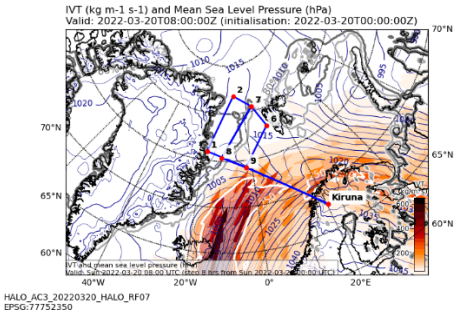
Overview of flight:



After take-off we had to take a small detour because of the restricted military area at the northern coast of Scandinavia. Then we crossed the warm and moist air with vertically thick clouds and went into the direction of the Greenland coast. There we observed closed sea ice including cracks. Clouds thinned on our way to Greenland over the sea ice sheet. Afterwards we performed longer tracks parallel to the MIZ over closed sea ice, the MIZ and open ocean with variable cloud conditions ranging from Sc, mid-level clouds, and even cloud-free areas. On our way back we crossed the warm/moist air close to the coast of Scandinavia a second time. Altogether we released 18 dropsondes.

Vertically Integrated Water Vapor Transport (IVT), 20 March 2022

08 UTC



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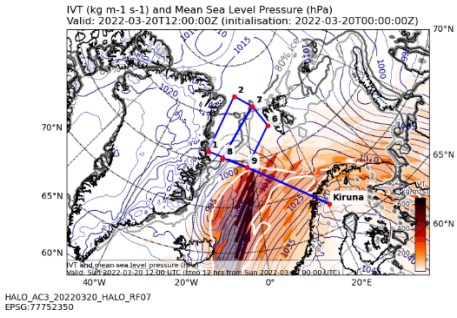
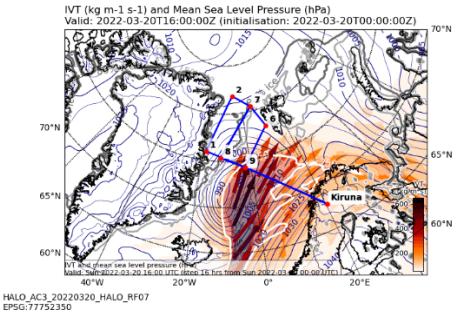
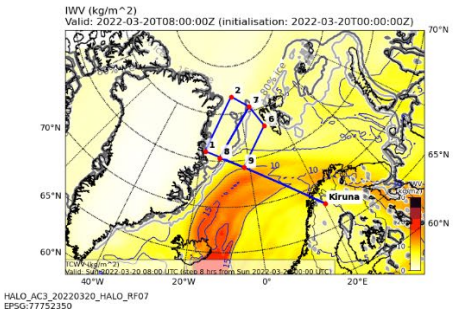


16 UTC

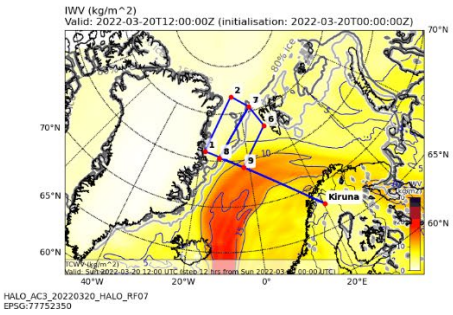


Vertically Integrated Water Vapor (IWV), 20 March 2022

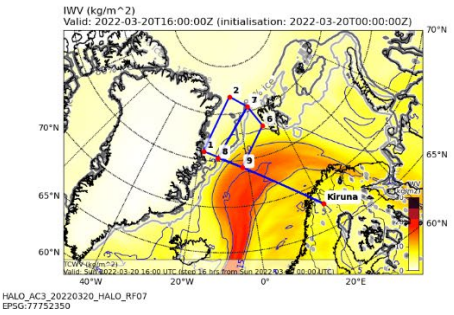
08 UTC



12 UTC

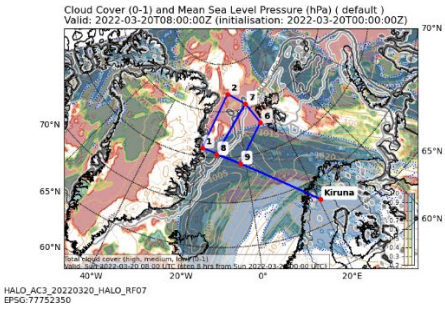


16 UTC

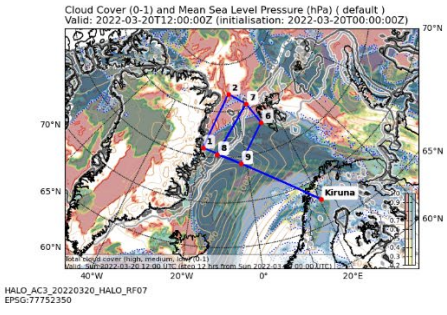


Cloud Cover and Sea Level Pressure, 20 March 2022

08 UTC



12 UTC



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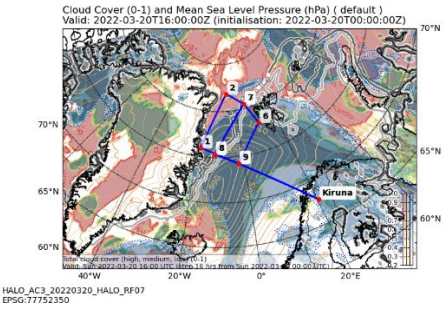
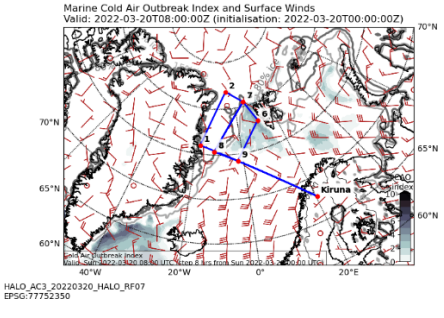


Cold Air Outbreak Index and Surface Winds, 20 March 2022

08 UTC



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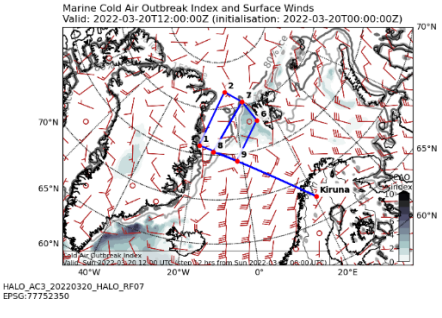
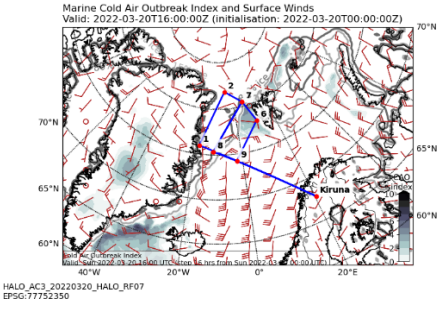


16 UTC



Instrument Status:

HALO	
BAHAMAS	
BACARDI	
HAMP Radar	
HAMP Radiometer	
WALES	
SMART	
VELOX	
specMACS	
Dropsondes	

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

Flight Logs (all times in UTC)

07:53 Taxi
07:58 Take off
08:08 some cirrus above, no low clouds
We are climbing
08:13 FL300
08:15 All the time cirrus above, a lot of haze below
08:23 HALO is above clouds, no further clouds above us
09:27 FL410, cirrus below nothing above
08:34 We fly to the direction of our planned track. We have the permission to drop sondes wherever we like within Norwegian airspace
08:43 No change, homogeneous cirrus below, nothing above
08:51 Cirrus top slightly increasing
08:54 **DS01**
08:54 We have reached our planned track, cirrus below, nothing above
08:57 Clear air turbulence
09:03 **DS02→ failed**
Nothing above, cirrus below
09:07 **DS03**
09:09 Cirrus below, nothing above
09:14 **DS04**
09:15 Clear sky above, cirrus below
09:26 **DS05**

No changes, no cirrus above, below homogeneous clouds, atop of the cloud there seems to be some thin aerosol layer

09:35 Precipitation at the surface

09:36 **DS06**

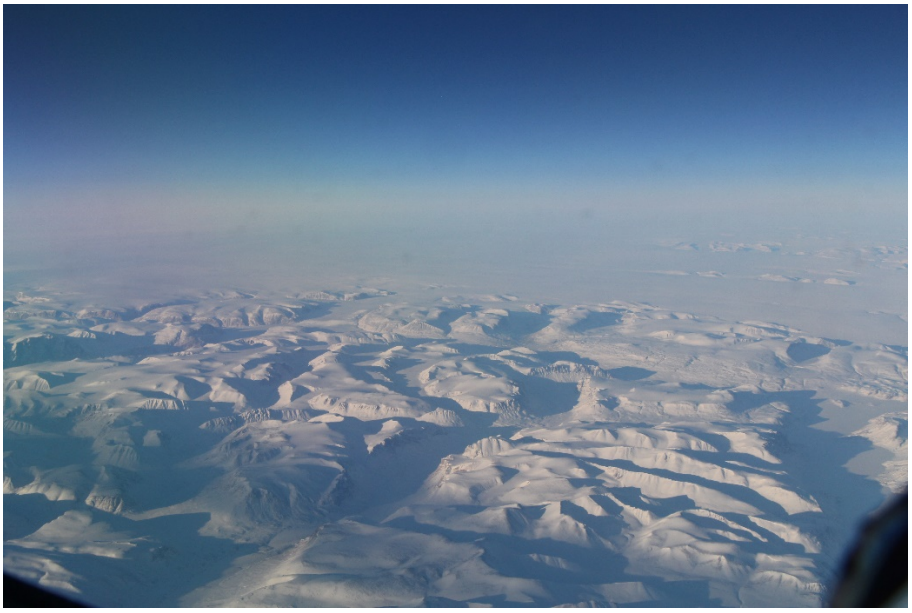
09:41 Cirrus 500 m below HALO flight altitude, almost okay. We have asked the pilots to climb as possible, they have that in mind

09:42 Polar 5 appears on Planet, including the flight plan and the markers

09:48 Clouds below get very thin, more inhomogeneous, nothing above flight level

10:14 First sea ice observed through the clouds, clouds quite thick with some holes

10:26 **WP1**, curve (procedure turn), we see Greenland



10:31 End of curve

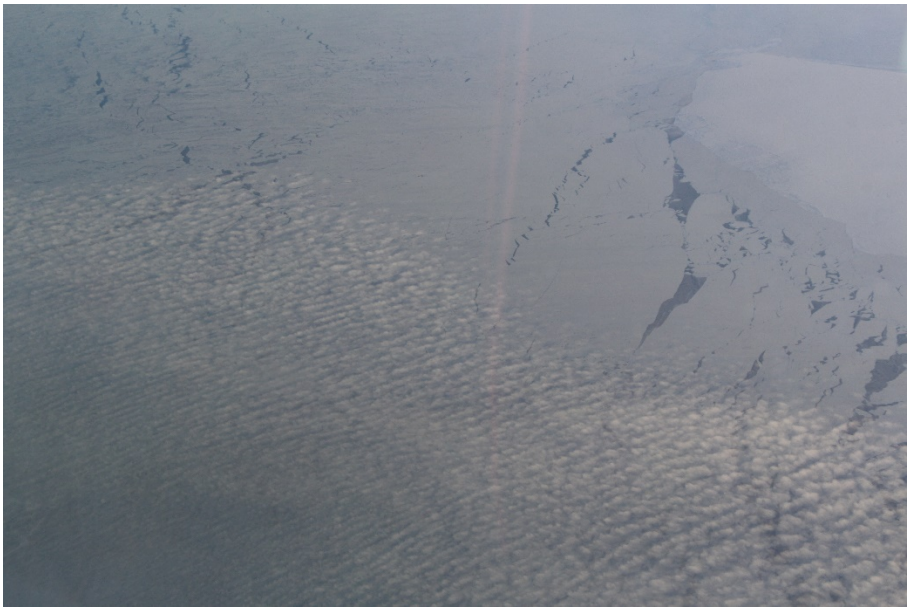
10:33 Beautiful view of Greenland, almost no clouds, but kind of haze

10:42 no more clouds, different surfaces below, new ice, ice covered with snow, land covered with ie/snow, well distinguishable from VELOX data

10:47 homogeneous ice surface below

10:51 Cloud-free, homogenous sea ice below

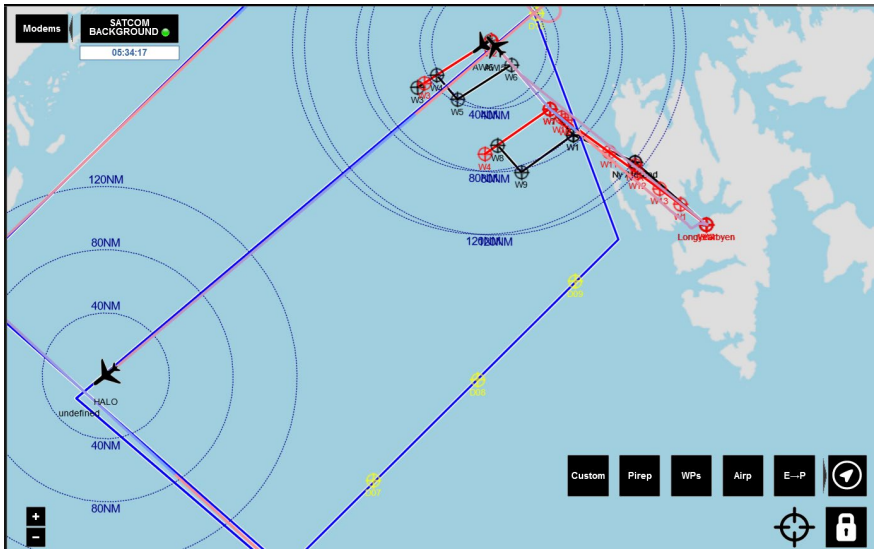
10:59 Sc below



11:12 Huge ice flows, broken, below us, just very scattered clouds below

11:15 Leads in sea ice

11:17 WP2 begin curve, sea ice, cloud field with shadow
11:22 end curve
11:20 P5 takes off, P5 not on Planet
11:30 **DS07**
11:35 Sc below, haze, sea ice below is scattered → MIZ
11:38 **WP3** Begin curve
11:43 end curve
12:07 clouds in different heights, 95% cloud fraction, sea ice fraction quite4 high
12:40 Three planes in the area!



12:44 **WP4**, begin curve, homogeneous clouds below
12:50 end curve
12:54 Homogeneous clouds below, 3 km lower than flight altitude
13:10 **WP5** begin curve
13:15 end curve, homogeneous clouds below
13:25 **DS08**
13:27 homogeneous clouds below, nothing above
13:35 **DS09**
13:37 homogeneous clouds below, nothing above

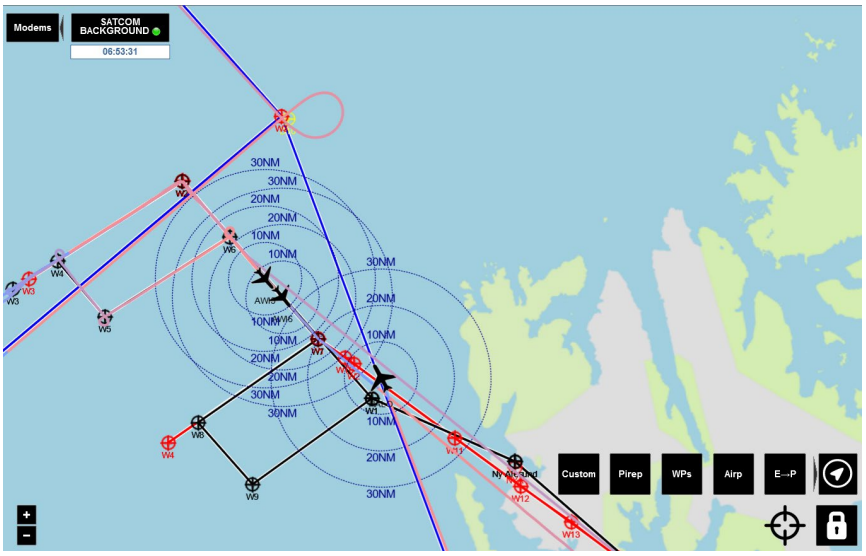
13:46 **DS10**

13:37 less homogeneous clouds below, nothing above

13:49 **WP6** begin curve (no procedure turn, short curve)

13:59 Sc below

14:00 three planes close by



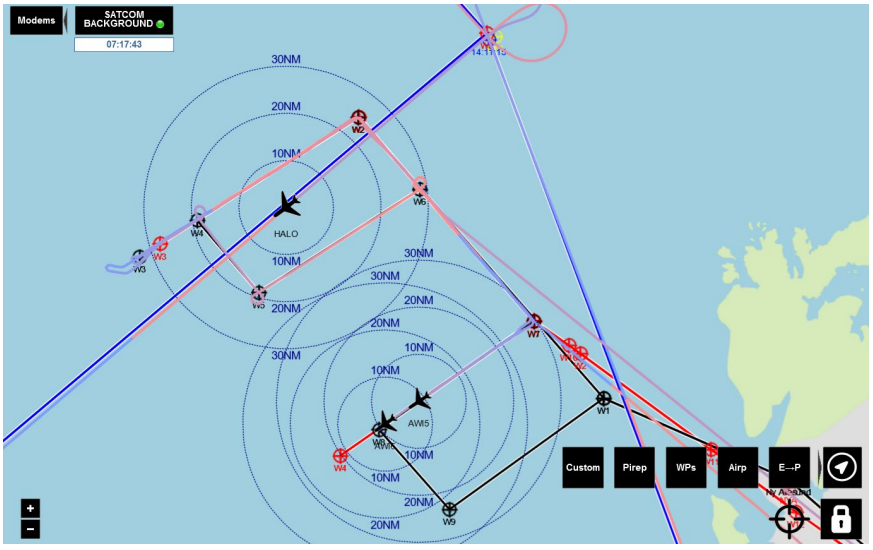
14:11 **DS11**

14:12 Sea ice with leads

14:12 **WP7** begin curve

14:17 End curve, nice Sc below

14:26 Three planes fly in the same direction



14:31 **DS12** (additional one, released spontaneously because we were allowed to do so)

14:33 Thin cirrus below, cirrus top at 8 km, we fly at 12 km

15:10 Not much change, cirrus below, cloud-fee above flight level

15:12 Polar 5 and 6 on their way to LYR

15:16 **WP7** begin curve

15:22 End curve, nice Sc below

15:36 Climbing to FL430 because of increasing to altitude of Cirrus

15:39 FL430 reached

15:42 homogeneous cirrus below. Nothing above flight level

15:50 **DS13**

15:55 **DS14**

Homogeneous cirrus below

16:00 **DS15**

16:09 **DS16**

Cirrus becomes thinner

16:19 **DS17**

16:25 **DS18**

16:27 Start plus-minus 20° roll calibration for radar, we do it twice

Only little clouds below

16:34 Radar calibration finished

16:35 Roll clouds below

16:43 Turbulence, lenticularis clouds

17:07 Touch down

16:44 Landing

Thanks to the team! **In particular, the Pilots!**


FAAM