

HALO-(AC)³ – 2022/03/24 – Polar6 research flight #03

Objectives:

Perform profiling for the in-situ cloud measurements in the southern part of the flight track, and for the aerosols in the northern part. The third objective was to sample at higher altitudes for the trace gas measurements.

Mission PI P6:

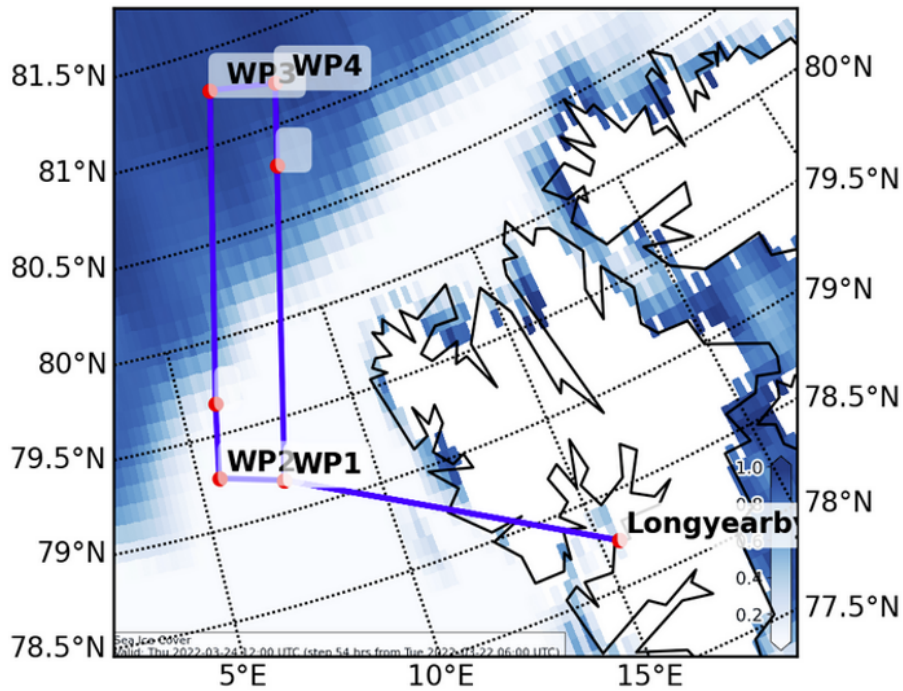
Stephan Borrmann

Polar 6 Crew	
Mission PI	Stephan Borrmann
AWI 1	Max ?
AWI 2	Christina Sans Coll
CVI/Aerosol/HERA	Bruno Wetzel
ALABAMA/trace gas	Oliver Eppers
PMS	Johannes Lucke

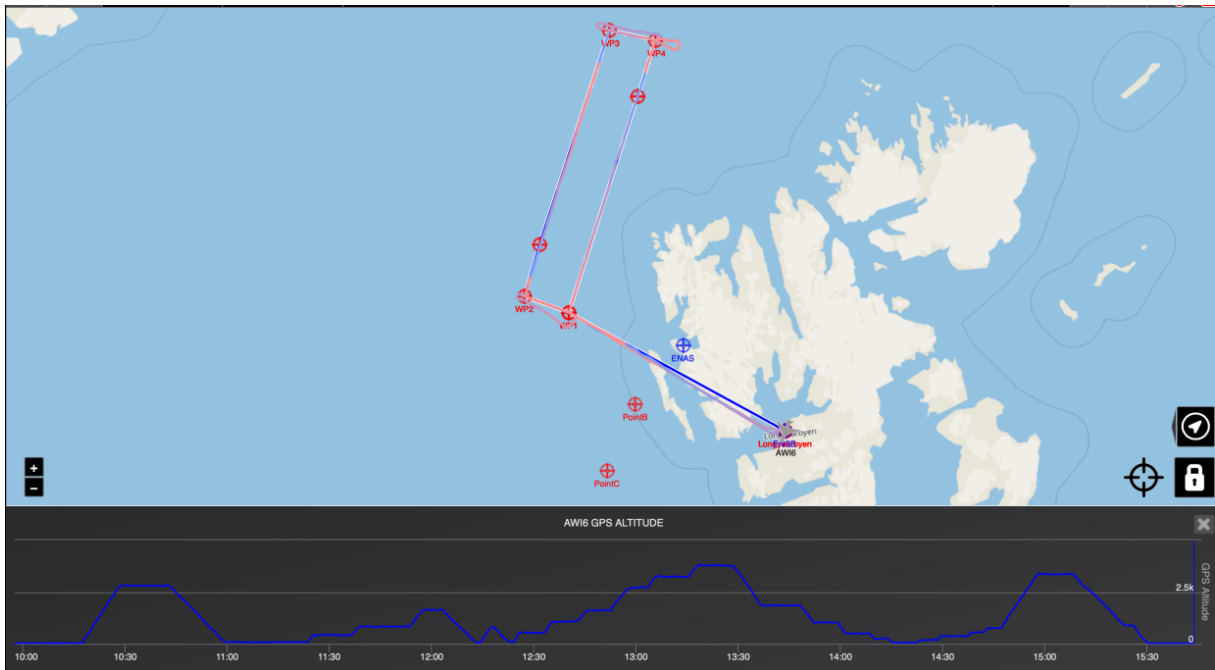
Flight times:

Polar 6	
Take off	10:16 UTC
Touch down	15:40 UTC

Intended flight plan:



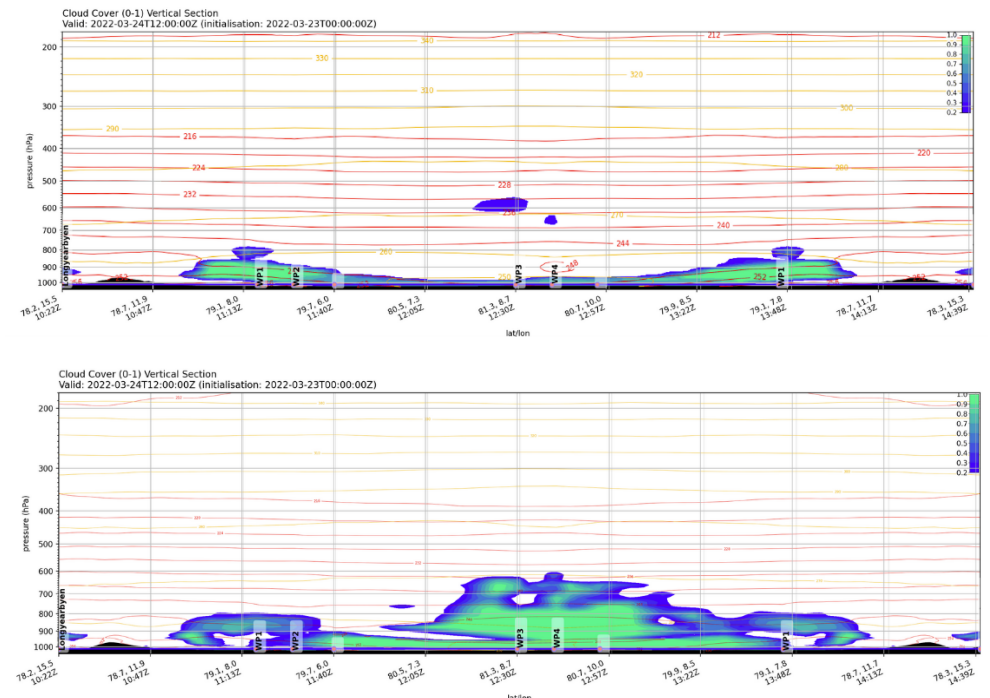
Executed flight plan:



Flight track as executed with altitude profile

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

Contrary to the ICON (upper panel) and ECMWF (lower panel) forecasts there were no clouds above the ice in the northern part of the sampled region. Note that the two forecasts widely disagree. The cold air outbreak with the northerly flow persisted.



Overview:

Initially this flight plan was devised to have the P5 and the P6 fly above each other on the long legs between WP2 and WP3, and between WP4 and WP1. The flight plan was laid out clockwise such that the P6 would have had tail wind while the P5 has headwind between WP4 and WP1. This way the time for both planes being over each other would have been maximized. Since the P5 did not fly, P6 executed the planned pattern with some modifications. According to the observation of the timing at the various waypoints and steps by the mission PI this plan would have worked out well, had the P5 been in the air.

In order to optimize the sampling of the clouds between WP1 and WP2 a step ladder pattern was flown with 4 steps starting at 200 ft. The highest step was oriented perpendicular to the line WP1-WP2 pointing towards WP3. In this area there were clouds like a stratocumulus deck



as shown in the upper picture. This cloud deck was sampled in a saw tooth pattern. However, after the descent to 200ft only one such “tooth” could be executed, and then the clouds disappeared.

Thus, the aerosol sampling pattern was initiated with staircase steps up to 12000ft. Between WP3 and WP 4 a step ladder was flown for the aerosol measurements including one “step” at 14000ft. The high step was performed for the trace gas measurements, because the PIs had requested an occasional sampling there. We used this opportunity of relatively clear air for this purpose.



The situation between WP3 and WP4 is shown in the second photograph. Looking closely one can see that a haze was present at the high altitudes around 12000 and 14000ft. Quite possibly the aerosol instruments will have detected this layer, and especially its chemical composition is interesting. The mission PI suspects that this could be a case of the

“arctic haze” although the color does not have a brownish enough hue. Between WP4 and WP1 more stair case steps were executed plus one saw tooth for the clouds near WP1 over

the open water. There only were scattered cumulus humilis and cumulus mediocris clouds. Thus, the cloud sampling includes “voids” of nearly cloud free air.

In summary, during this flight 7 minute (or longer) legs were flown at 14000ft, 12000ft, 10000ft, 7000ft, 6000ft, 4000ft, 3000ft, 2000ft, 1000ft, and 200ft. This is a highly resolved vertical profile for the aerosol and also for the trace gases in the sampled area.

Between WP1 and LYR one more ascent to 12000ft was performed for the trace gas measurements.

Instrument Status:

CVI was working and used inside the clouds.

Trace gas was working continuously delivering useful data.

Polar nephelometer was not operating.

ALABAMA delivered data, although with intermittent failures due to problems with the laser power supply and cooling. The noise interference problem of the previous flight had been solved and did not persist.

PMS instruments were working.

HERA sampler was not activated because of the lack of 25 min long legs in the flight plan.

Aerosol (in particular SMPS) was working well and continuously. The timing of the steps for the ladders and stair cases were coordinated between mission PI and instrument PI such that each step contained at least one, if not two full SMPS sampling cycles (of 5 minutes each). This is important and needs to be considered in the following flights because otherwise the instrument measures part of the time in one altitude step and the other part of its cycle in the following higher or lower step. Then it is not possible to reconstruct a vertical profile as the steps are “mixed”.
