ACLOUD Flight #10 – Polar 5 – 170531

Mission PI P5: André Ehrlich

Objectives: Low level clouds above sea ice: Sea ice albedo and turbulence below clouds. Radiation profiles and remote sensing above cloud top. Microwave calibration.

Crew:

Polar 5	
PI	**André Ehrlich**
Basis Data Acq.	**Christoph Petersen**
SMART	**Michael Schäfer**
Eagle/Hawk	**Evi Jäkel**
MiRAC	**Tatiana Nomokonova**
AMALi	**Roland Neuber**

Flight times:

Polar 5	
Take off	**15:05 UTC**
Touch down	**18:57 UTC**

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

The initial plan of the flight was to map sea ice in cloud free conditions. A strong lee effect with easterly winds produced a large cloud hole west of Svalbard. Subsidence in a high pressure system was supposed to spread the cloud free area towards north over the sea ice, where the Polarstern position was predicted.
The cloud situation observed by satellite images during 31. May showed a different picture compared to the forecast. A larger cloud free area was observed in north-westerly direction already in the morning. North of Svalbard, a strip of clouds moved with the north-easterly flow into the observation area. These clouds did not dissolve during the late afternoon. Therefore, low level clouds were present during the entire flight. The clouds started some NM south of the sea ice edge. The sea ice edge was much sharper during this flight as observed before. The low clouds were partly broken with sunny spots. In the north-easterly box clouds were thicker compared to the location of Polarstern closer to the sea ice edge.
Cirrus fields were present mostly over Svalbard but not over the open ocean and the measurement area over the sea ice.

Overview:

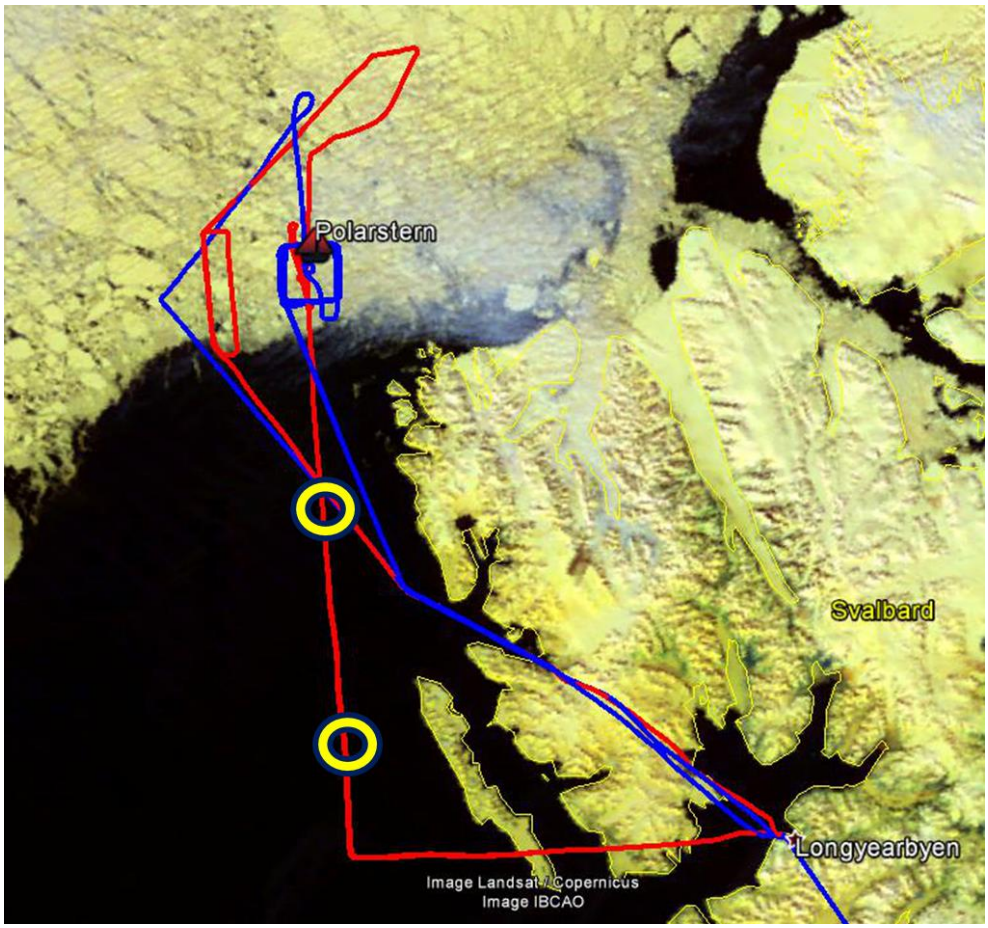
The first part of the flight worked as planned including a long 1000 ft above ground overflight of the Sveabreen for albedo measurements and a low flyby of Ny Alesund along the fjord in 1000 ft above the water for the lidar comparison. Towards the ice edge still cloud free conditions were present, which allows to measure the surface albedo of open water. Close to the sea ice edge a field of low

level clouds started and no cloud free spot was visible over the sea ice. Therefore, we changed the plan for the first box slightly. Surface albedo was measured below the clouds with cloud base reaching 300ft altitude or sometimes also the surface. The clouds partly were broken and the Sun could shine through. The sea ice cover was about 80% with larger floes but also many leads. The leg was flown twice below the clouds and a third leg at 3000 ft above the clouds for remote sensing of the clouds. All legs should give a good picture of the inhomogeneous scene with both sea ice and cloud inhomogeneities.

After the box Polar 5 descended below the clouds again and performed the calibration pattern (different flight speed) for the nose boom. Having the calibration finished, we climbed above the cloud to search for a cloud free area but did not see any. Therefore, we stuck to the flight plan and tried to sample cloud profiles in Box 2, performing continuous descends and ascends. The clouds in Box 2 have been thicker without gaps. Therefore, also icing was stronger and only one profile could be flown. We then cancelled the pattern in Box 2 and headed for Polarsten which was further south than expected. At Polarstern the cloud cover was again more broken with only thin clouds ranging from roughly 300 ft to 800 ft altitude. Parallel to Polarstern 5 legs with ~5min length were flown in different altitudes, 200/500/800/1500/3000ft. This data can be used for comparing the Polarstern measurements and also for studies of thin low level clouds.

The last part of the flight was flown in 10 000ft to perform a calibration of the microwave radiometer over open water and a cloud free area including two drop sonde releases.

Flight track and pattern:



Yellow circles mark the launched drop sondes

Left: Sun glint over open water with relative low Sun due to the late start. Right: Sea ice edge seen below clouds. Edge was much sharper than before.

Thin low clouds over sea ice as observed in Box 1. The two images had been made in almost the same area only into different directions. Left: Towords the Sun. Right: aways from Sun. This illustrates, that the Sun still influences the radiative field below the thin cloud layer.

The same clouds as seen from above (left) and just at cloud top (right). Very smooth cloud top structure.


Thin cloud layer in the area of the Polarstern meeting.

Some precipitating?? clouds little south of Polarstern.

Instrument Status:

Polar 5	
Basis data acquisition	
Nose Boom	
MiRAC	
HATPRO	
AMALi	Pointing zenith
SMART	
Eagle/Hawk	
Sun Photometer	
Drop Sondes	2 launched

Comments:

All instruments run without serious problems.

Detailed Flight Logs (Name of author… more than one is possible):

André Ehrlich (times UTC)

14:42 Cirrus at the airport
15:06 Still cirrus above
15:18 Glacier overpass: in center of some cirrus
15:22 Summit of glacier, cirrus ahead
15:27 C1 still cirrus. 6.5km altitude indicated by AMALi
15:31 strong sun glint
15:33 no cirrus ahead of us
→ AMALi does not see cirrus anymore
15:38 C2: cloud free
15:40 AMALi: cirrus band at 7km altitude
15:45 low clouds ahead
→ climb → later descend below clouds
15:59 sea ice edge
16:00 C3: now below clouds
16:05 thin broken clouds
16:09 to north-east clouds get thinner
16:12 turn 4 NM to east
→ then go back south until sea ice edge
16:20 clouds sometimes touching the surface
Clouds still thin and broken
16:22 perfect 3D World: 2D sea ice + 3D thin cloud layer
16:25 end of sea ice
→ climb above clouds
→ climb was unfortunately flown in a turn
16:34 in 3000 ft altitude, above low level clouds: cloud top estimated at 800 ft
16:38 C4: descend to 200ft
16:41:40 100kn
16:43:30 120kn
16:45:40 140kn
16:47:35 160kn
16:49:30 140kn
16:51:30 120kn
16:53:15 100kn
→ climb above clouds → dense cloud field
→ goto C5
→ one single dive through cloud layer → icing → turn to Polarstern
→ ferry below clouds
17:20 200ft below clouds, 10 NM to PS
→ cloud layer getting thinner
17:25 PS on left. P6 at 200 ft
Scattered clouds, some touching the ground
17:28 turn → 500 ft
17:36 turn → 800 ft already on top of clouds

17:39 turn → 1500 ft
17:42 clouds look thin and with a lot of gaps
17:45 turn → 3000 ft
17:49 at PS still scattered low clouds
No cirrus
17:53 climb to 11 000ft heading to C7
18:03 at 11 000ft
18:08 looks moist in low levels looking towards west
18:11 DS#1
18:17 all clear air and no sea ice
Some cirrus over Svalbard and in south
18:21 DS#2
18:27 turn → go home

<u>Roland Neuber</u> (times UTC corresponding to AMALi Data filenames)

15:13 AMALi Start 15:13
15:29 Ny-Aalesund passing by
15:45 start climbing above low level clouds
15:53 Down to FL 200 ft , below clouds
16:01 HV reduced to 550 V
16:11 C4, turning towards east for first block pattern
16:13 turning right, bank 30°, return to C3
16:23 C3, start climbing above clouds
cloud top at ca. 1000 ft, ascending to 3000 ft,
patchy, very thin cirrus at high altitude
HV increased
16:31 on the way N again C3 - C4
16:37 C4, start heading for C5 for 200 ft
16:39 HV adjusted for below cloud run
16:40 for ca. 10 min various speeds for calibration purpose
16:53 start climbing above clouds again
HV adjusted for flying above low level clouds
C5 descending again, diving through thin clouds; rain!
17:01 HV reduced
17:03 above clouds, turning from the N towards RV PS
17:13 approaching PS
17:25 passing PS at 200 ft
17:27 turn, ascending to 500 ft for 2nd pass by

17:35 return again, level 800 ft, just above clouds

17:37 HV increased for flight over clouds
17:45 returning at 3000 ft
17:51 start southbound leg for calibration, climbing
18:11 Drop Sonde 1

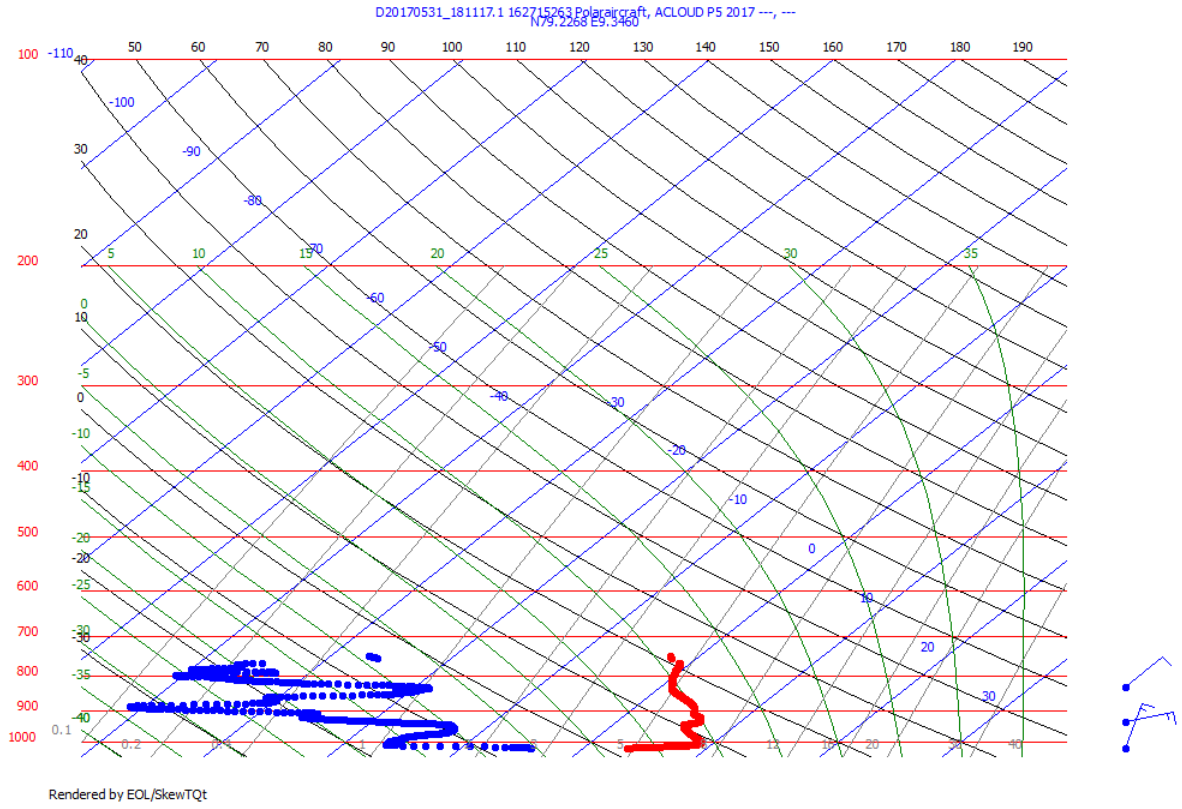
10 min after DS 1 follows DS 2

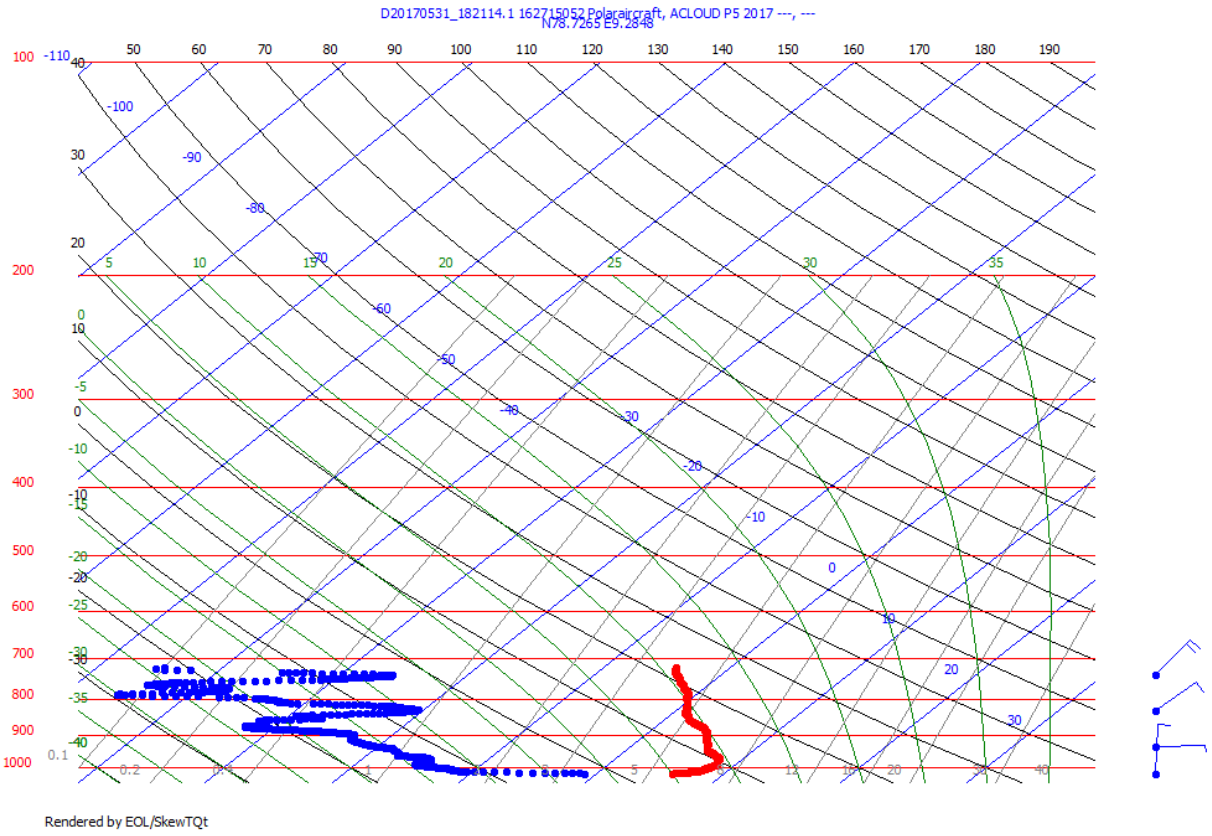
thereafter return directly to LYR, slowly descending

18:39 final HV adjustment perp channel

Quicklooks:

Drop Sondes




D20170531_182114.1 162715052 Polaraircraft, ACLOUD P5 2017 ---, ---
N78.7265 E9.2848
Rendered by EOL/SkewTQt

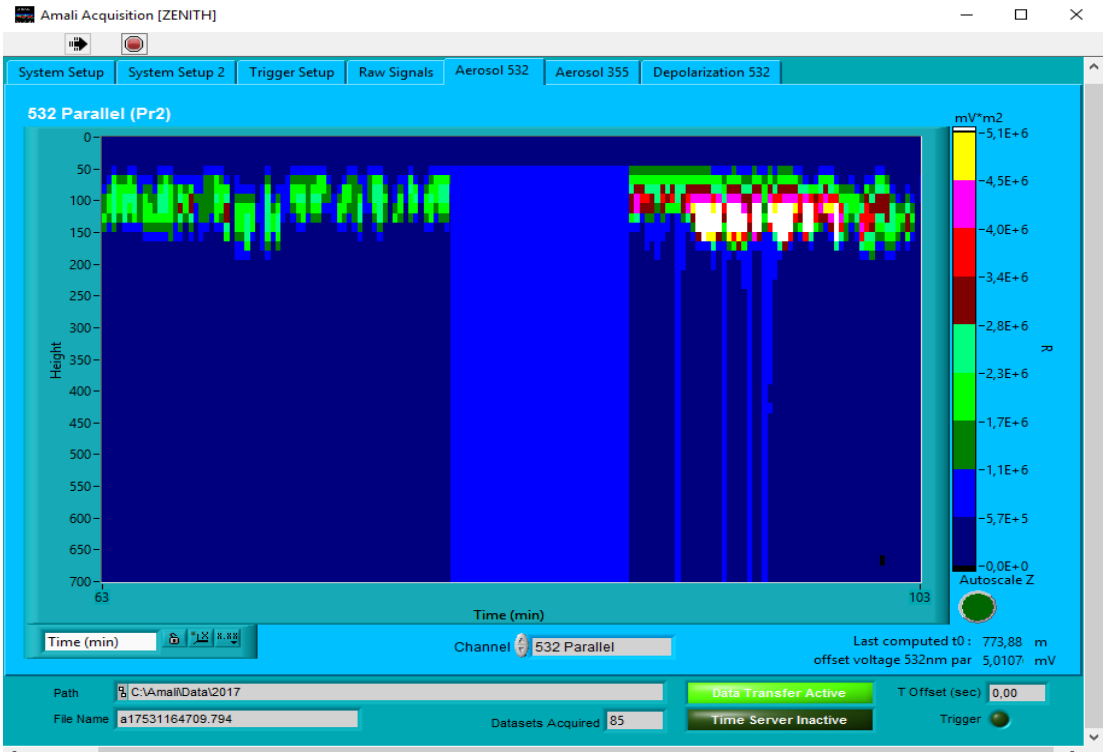
SMART

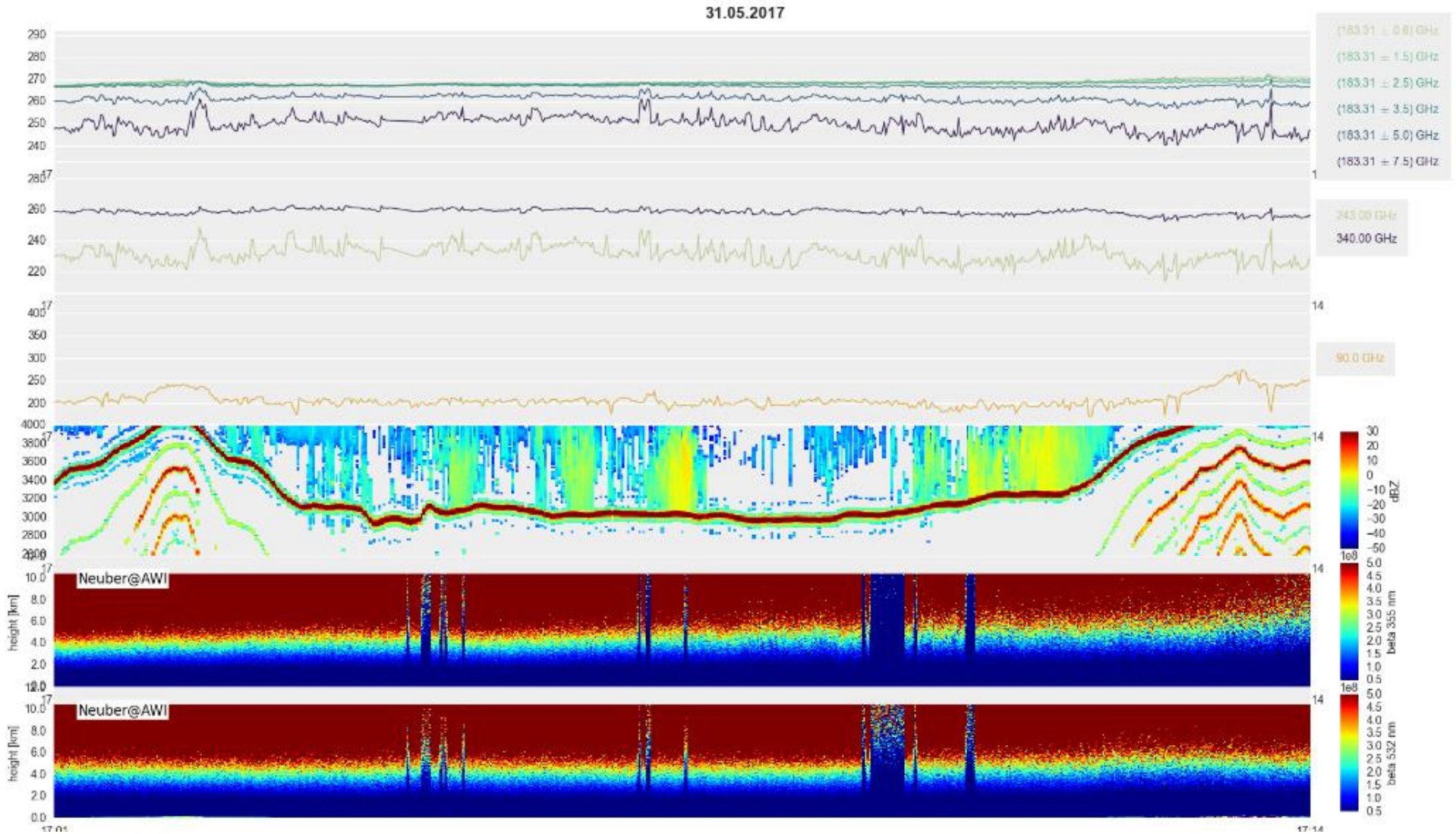
MiRAC & AMALi

Detailed AMALi Online Quicklooks (time axis in min after AMALi start)

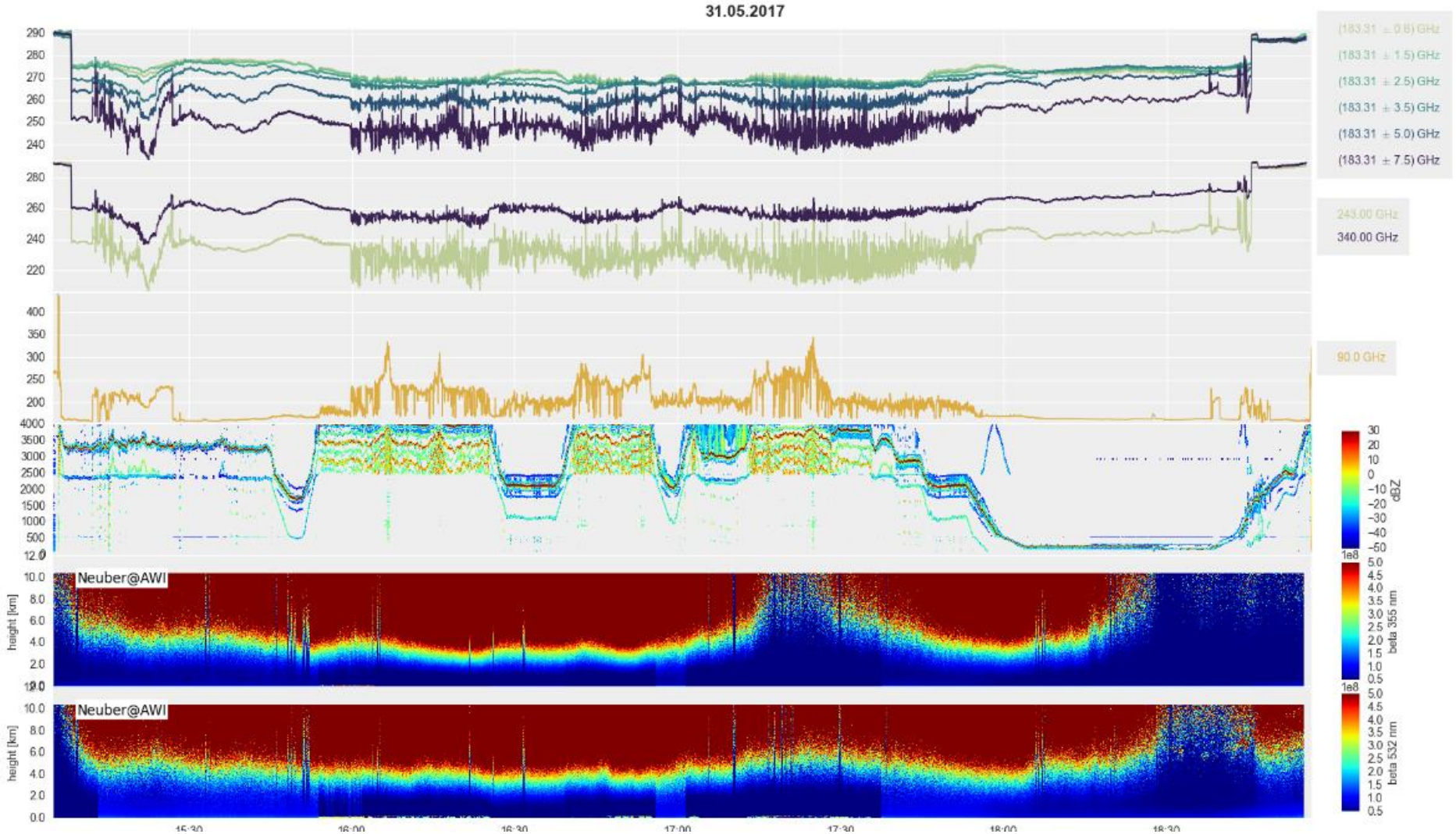
AMALi mounted pointing to zenith!

16:07 – 16:47 Example for structure of low level clouds, 532 nm (vertical axis is range above FL in m)



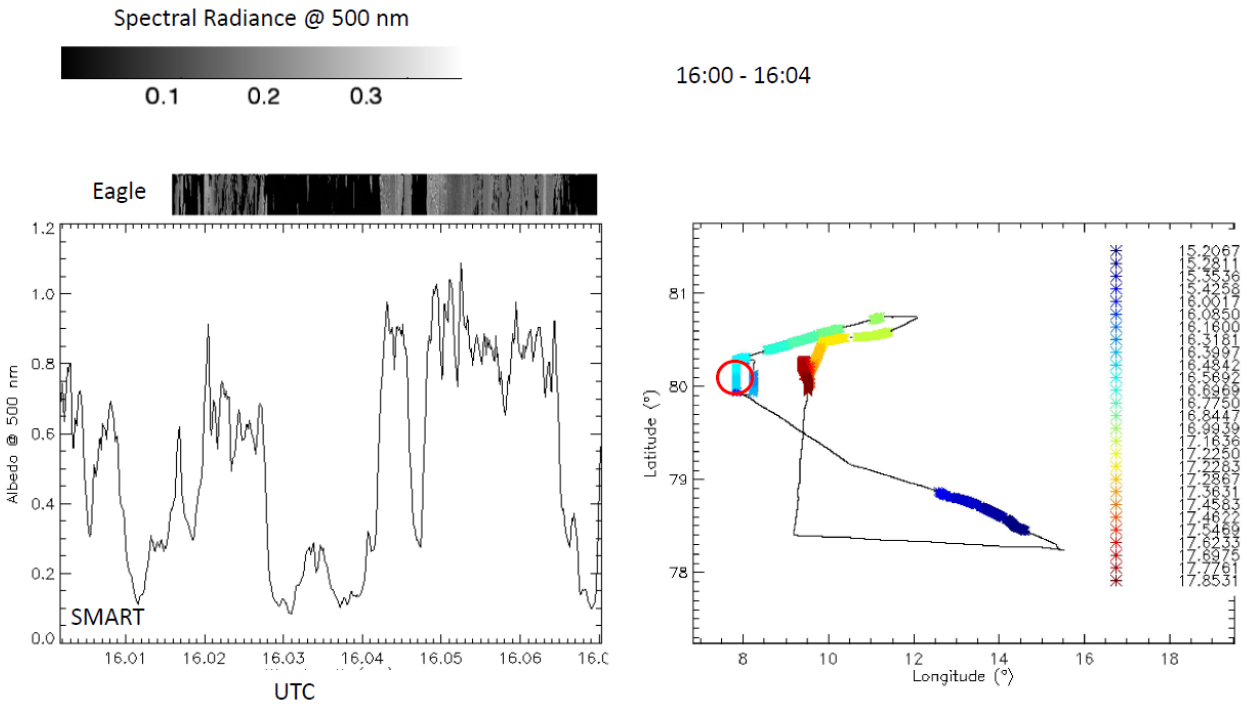


Vertical structure of clouds with some gaps from radar measurements before turn to Polastern from 17:04 t0 17.14 (UTC). AMALi looking zenith, aircraft above clouds.

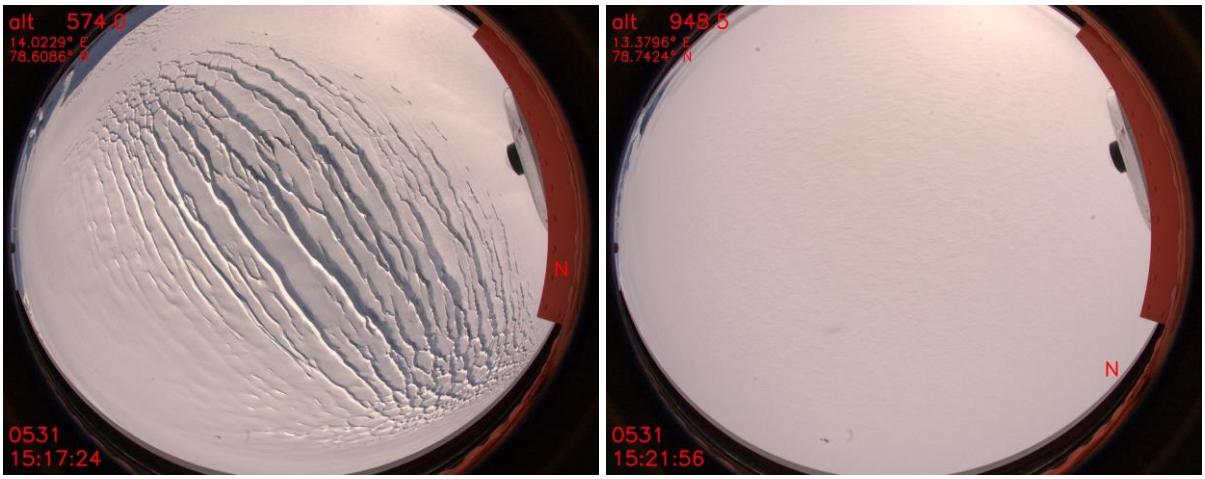


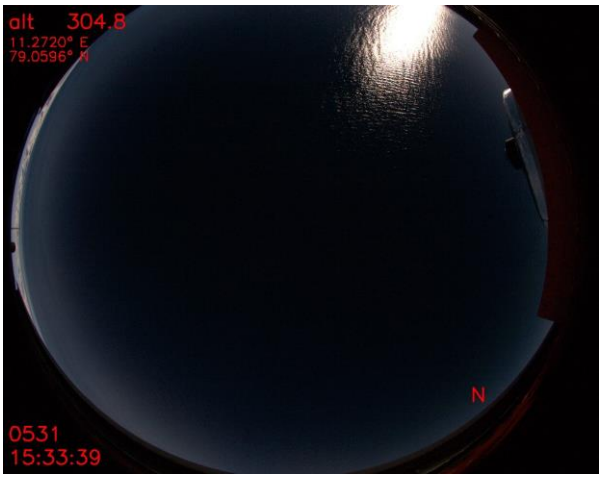
Quicklook of MIRAC (above) and AMALi (below) for the whole flight.

Eagle/Hawk



CANON Fish-Eye

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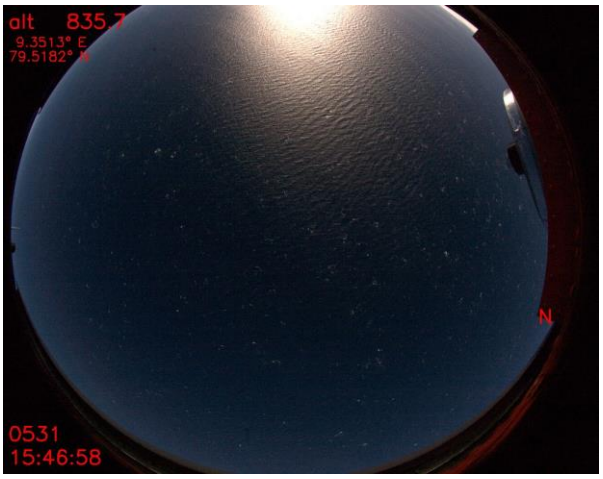
N
0531
15:33:39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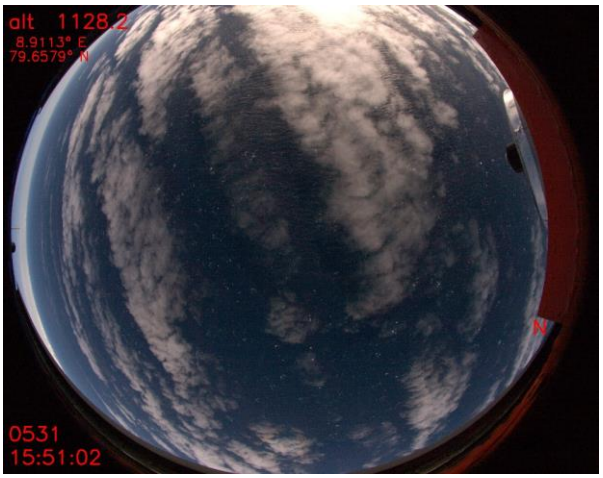
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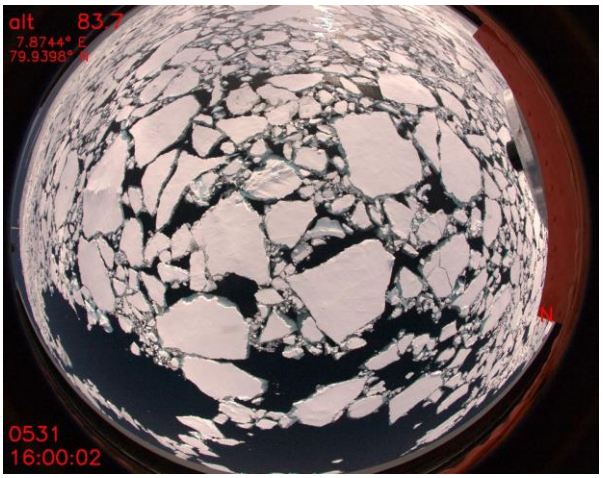
alt 83.7
7.8744° E
79.9398° N
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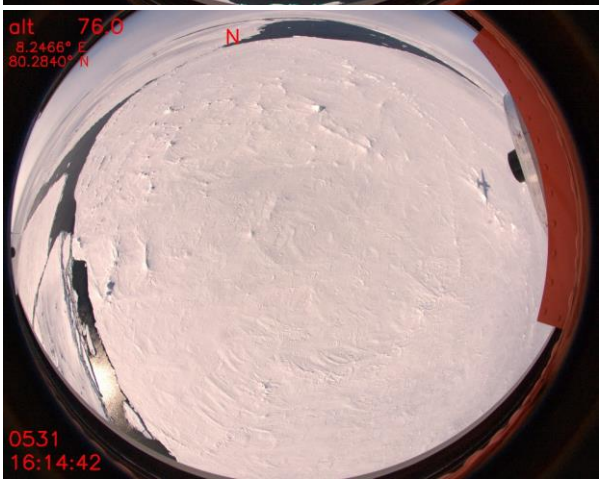
0531
16:00:02


alt 46.9
7.8406° E
80.1278° N
N
0531
16:06:46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N
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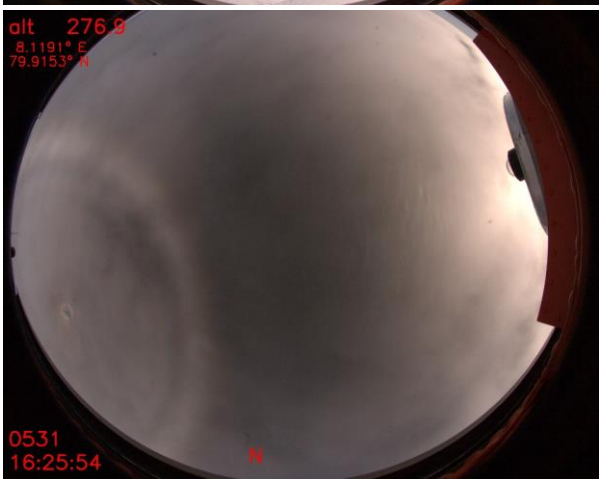
16:14:42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N
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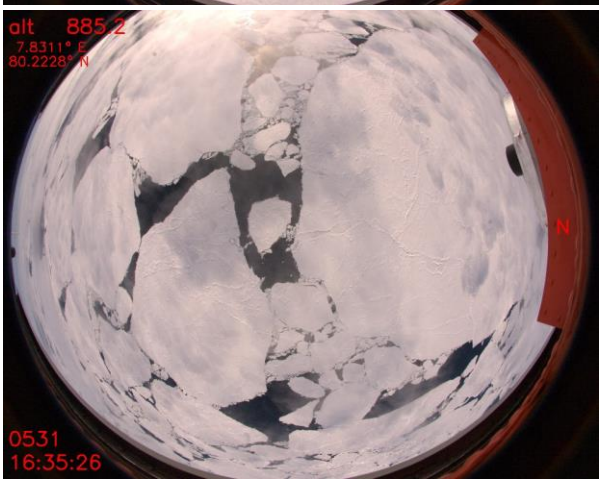
16:25:54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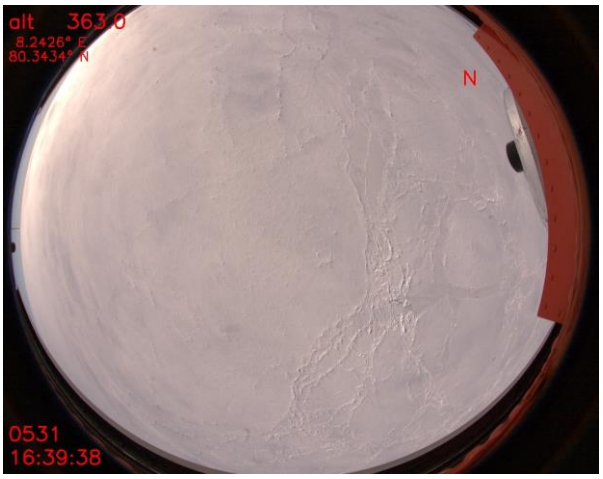
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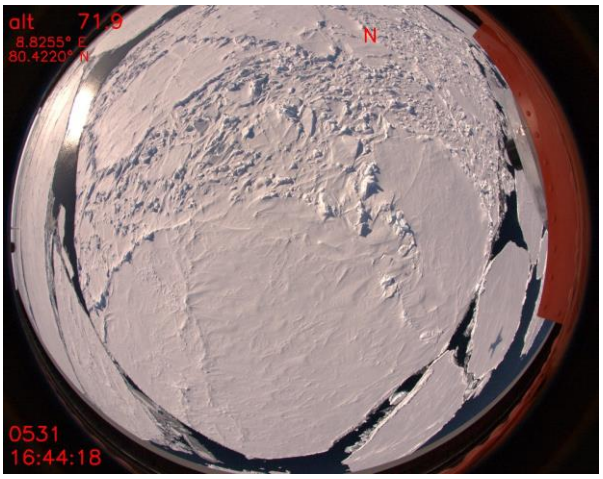
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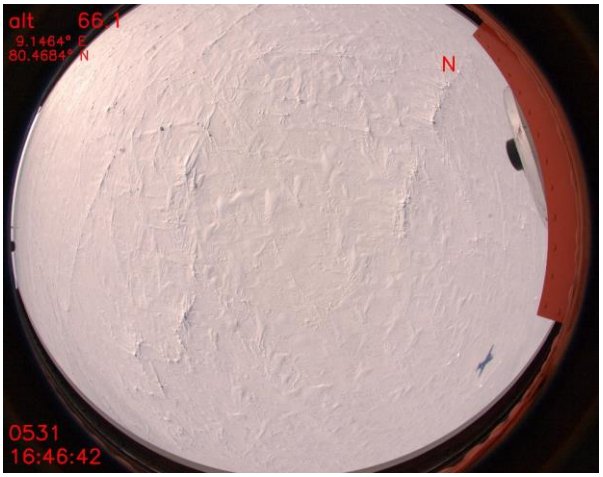
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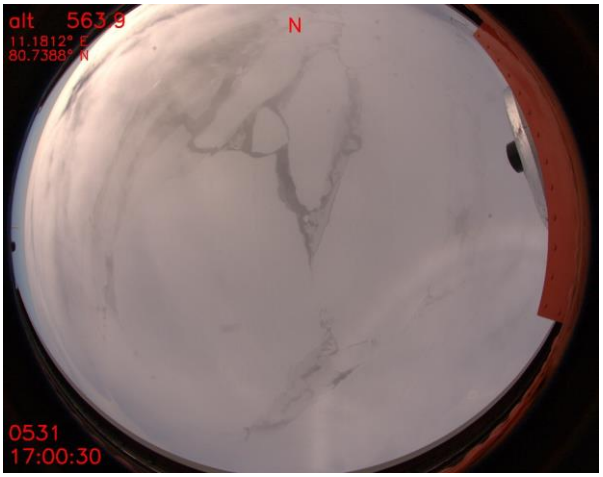
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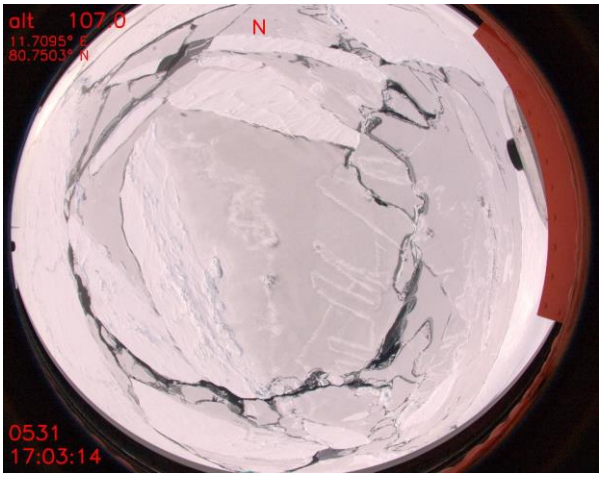
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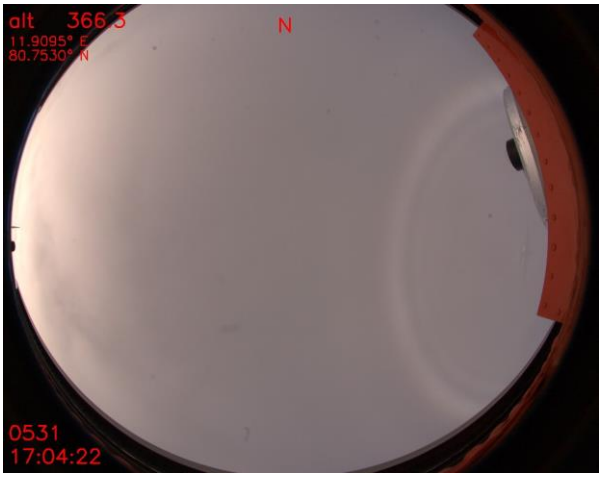
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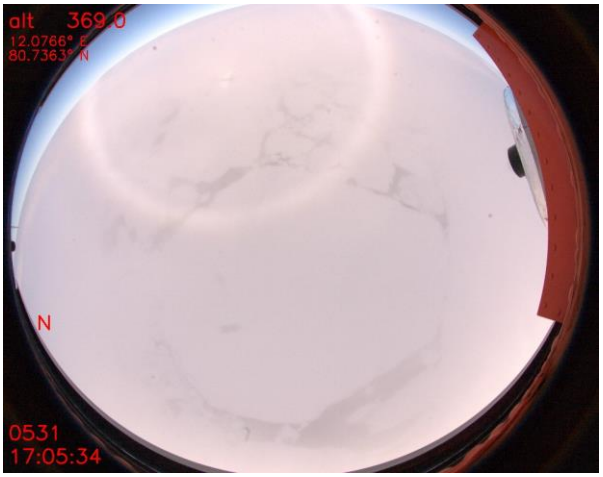
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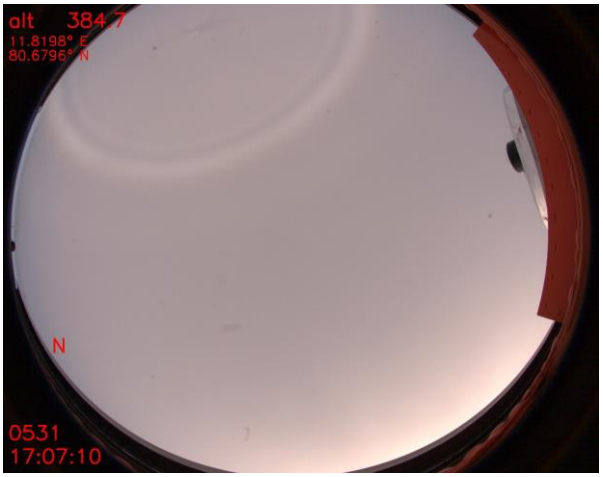
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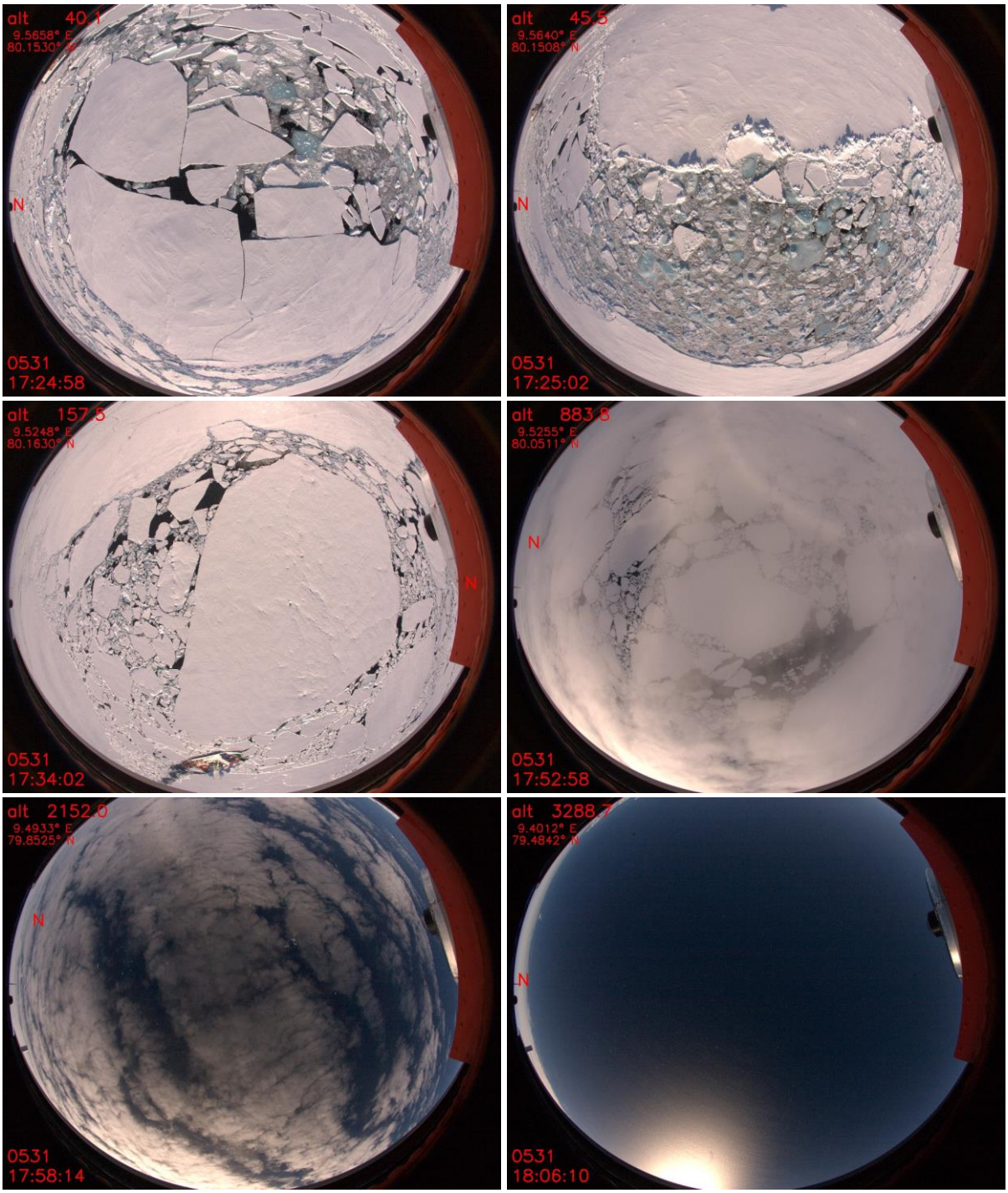
alt 40.1
9.5658° E
80.1530° N
N
0531
17:24:58
alt 45.5
9.5640° E
80.1508° N
N
0531
17:25:02
alt 157.5
9.5248° E
80.1630° N
N
0531
17:34:02
alt 883.8
9.5255° E
80.0511° N
N
0531
17:52:58
alt 2152.0
9.4933° E
79.8525° N
N
0531
17:58:14
alt 3288.7
9.4012° E
79.4842° N
N
0531
18:06:10