Delays, arctic summer and the first flight.

On July 7th and 8th our groups Ingmar Nitze (AWI) and Matthias Gessner (DLR) as well as Martin Gehrmann and Maximilian Stöhr (both AWI) took off to Alaska from Berlin and Bremen respectively. Polar-6 already departed from Bremen on July 5th to arrive in Barrow/Utkiagvik on the 9th.

The first group had a 2-day stopover in Fairbanks, where we had hot temperatures around 30°C in combination with thick smoke, which was the consequence of a heatwave in Alaska and widespread wildfires across large parts of the state. On July 9th we travelled from Fairbanks to Barrow with a short stop-over in Deadhorse, where we had the pleasure to breathe fresh air again.

The second group was supposed to arrive the same day, but they missed a connecting flight in Chicago. They finally arrived in Barrow on July 10th with a delay of one day. However, this did not cause any major logistical issues as Polar-6 was sitting idle in Iceland waiting for good weather over Greenland. Meanwhile we were forced to wait on the ground, but we used the time to optimize flight plans, get in touch with other research groups (U Texas El Paso, MPI for Ornithology, and others), and to prepare our presentation for the upcoming Science Fair. While waiting for the arrival of Polar-6 we had some more time to check out the town and its surroundings, local events and “measuring” the temperature of the Arctic Ocean. Meanwhile a Swedish TV team arrived in town, who made a short documentary/report on climate change in Alaska and interviewing Ingmar.

Finally, Polar-6, including pilots and mechanic, arrived in Barrow on the 13th of July around noon on a beautiful summer day with 16°C, with stopovers in Iqaluit, Rankin Inlet, Yellowknife and Fairbanks the previous days. After unpacking and preparing the plane, we managed to get airborne for about one hour to acquire Lidar (laser scanner) and MACS high-resolution optical data along stretches of the quickly eroding Drew Point coast. Due to fog rolling into Barrow, we had to cut-short our even limited flight and had to return as quick as possible.

After a brief stint of summer, weather has become typically cool and hazy and we are waiting for flight weather to get airborne until July 31st.

Greetings back home from Barrow. Ingmar, Matthias, Martin und Max + Flight Crew.



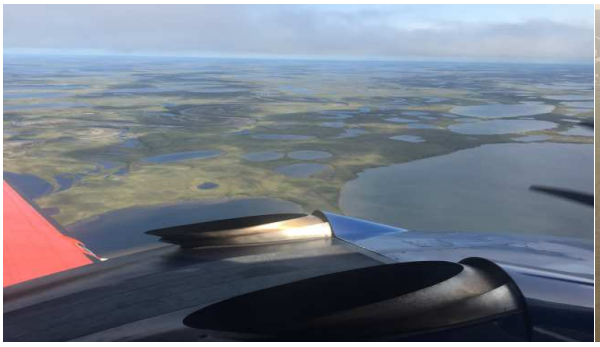
Left: Passing Brooks Range with dense smoke in interior Alaska. Center: Arrival of Polar-6 in Barrow. Right: First MACS acquisitions of quickly eroding coast.

Staff exchange, low clouds, and the aerial ultra-high resolution data acquisition of Alaska's northernmost permafrost region

Another week has passed in the ThawTrend-Air + Airmeth 2019 campaign. At the beginning low clouds and bad weather persisted, but new scientific and technical personnel arrived. Torsten Sachs of GFZ Potsdam took the theoretically short, but eventually much longer than anticipated route from Dawson in northwestern Canada to Barrow, Alaska. The same day our new Pilot Dean arrived as well on July 18th. One day later, Guido Grosse of AWI Potsdam completed the scientific crew with his arrival.

With the possibility of science flights at low altitudes now to do eddy covariance measurements, we became less dependent on very good weather conditions. Fortunately, the weather changed towards more favorable conditions, allowing us to conduct airborne surveys during five consecutive days. During these flight we managed to acquire rich measurements on greenhouse gas fluxes. Here we were able to fill a lot of so far blank spots in measurements for the southern Alaska North slope region, which will allow for much improved modelling of greenhouse gas fluxes in the wider region. However, for very detailed Lidar and MACS DLR camera systems we could only complete three survey target sites as these sensors are more dependent on good weather conditions without less cloud cover.

In parallel to the low level flights we opportunistically switched on our AWI LIDAR and DLR MACS optical camera systems. During these flights along extended transects across the North Slope we acquired unique and huge datasets of ultra-high resolution elevation and multi-spectral data, which cover different permafrost landscape types. With several terabytes of data these datasets will push the limits of processing and create new challenges. Big Data and automated machine-learning methods approaches will be applied in recently funded projects to process such massive datasets and extract information on patterns in the micro-reflief and very detailed changes in the land surface related to permafrost thaw. However, the spatial resolution of the acquired is good enough to not only detect permafrost landforms, but also large mammals such as caribou and even smaller features such as lemmings or individual cotton grass flowers are within the resolution range. A detailed flight plan is provided at the end of the travel report.




In addition to the flight campaign, Ingmar presented our flight campaign during the yearly Science Fair in Barrow to interested people from Barrow and fellow scientists working here on other projects. Additionally, we enjoyed the local hospitality with fresh salmon and caribou meat in several occasions.

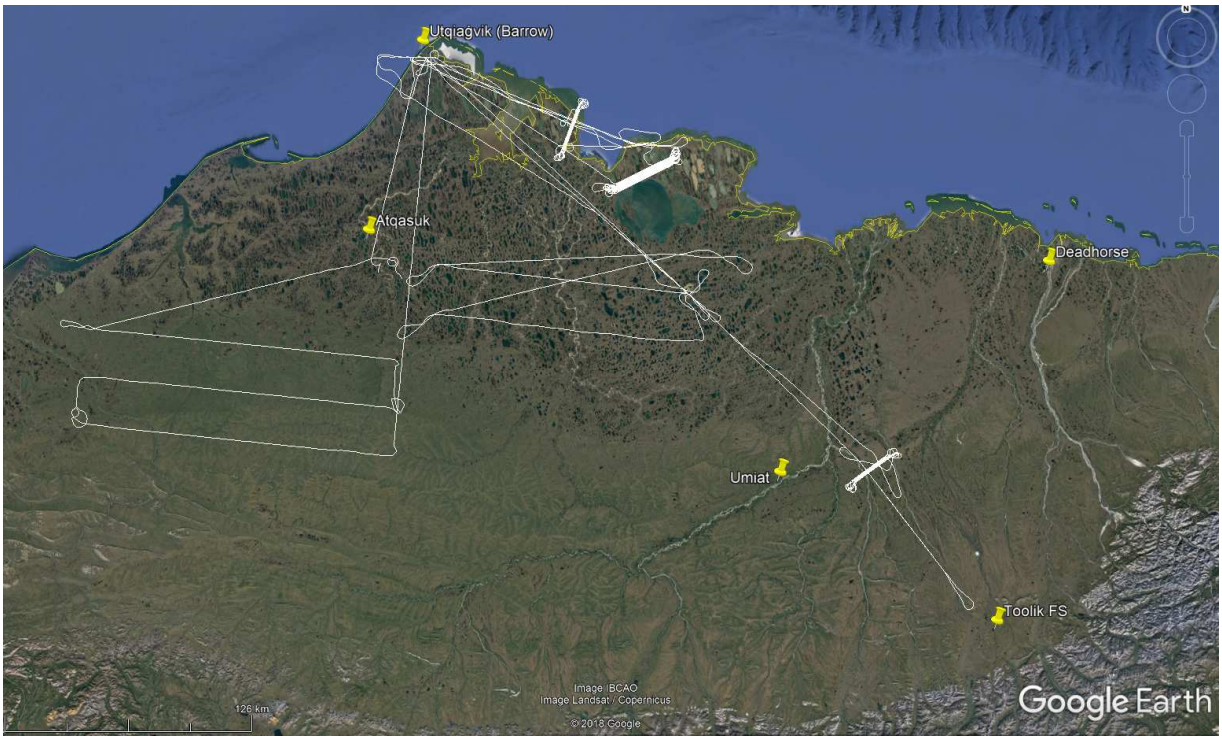
Best regards from Barrow/Utkiagvik, Alaska,

Ingmar, Guido, Torsten, Matthias, Martin, Max and the entire Flight Crew

Flight Time Alaska 2019

Day	Campaign Part	Target area	Flight time
2019-07-13	ThawTrend-Air	Barrow to Drew Point, high altitude transect	1h 17m
2019-07-19	ThawTrend-Air	Cape Simpson, high altitude grid	4h 14m
	Airmeth	Western North Slope, north-south low altitude transect	
2019-07-20	Airmeth	Western inner Arctic coastal plain, multiple low altitude transects	4h 46m
	ThawTrend-Air		
2019-07-21	Airmeth	Central inner Arctic coastal plain, multiple low altitude transects	4h 33m
	ThawTrend-Air		
2019-07-22	ThawTrend-Air	Northern portion Anaktuvuk River fire scar, high altitude grid	5h 18m
	Airmeth	Barrow – Anaktuvuk River fire scar, southeast-northwest low altitude transect	
2019-07-23	ThawTrend-Air	Teshekpuk Lake region, high altitude grid	5h 12m

(Airmeth: Trace gas measurements; ThawTrend-Air: DLR MACS + AWI LiDAR)



Tundra fires, drained lakes, coastal erosion, methane, and the Barrow weather

The last week of the ThawTrend-Air 2019 campaign continued with a mixed bag of weather conditions – low hanging clouds and changing fog over Barrow and offshore the coast stayed in the area and resulted in further days without flying. However, on July 27 we eventually used a chance to fly out of Barrow in order to use the much better weather a little farther south, taking the risk to not get back to Barrow because of fog but instead reroute to Kotzebue in Northwest Alaska. Luckily, everything worked out well and we were able to collect good data in the southwestern portion of the Alaska North Slope and successfully returned to Barrow in the evening. The survey grid covered on this day included two historic tundra fire areas, which caused top-down thaw of permafrost that we hope to quantify with our high-resolution image and laser scanner data based on the changes in land surface structure. On July 28 the Barrow fog grounded us again, and 6 jets inbound to Barrow had to cancel their landing after a first attempt or even without an attempt, including the big airliner from Anchorage, which fired up the engines after a first unsuccessful landing attempt and returned straight to Anchorage without landing on the ground at Barrow.

Finally, on the next day a blue sky appeared even over Barrow for the first time after 2 weeks and the new weather system offered excellent flying weather near the end of the campaign. We were able to cover two survey grids at 1000m altitude. These were some of the most important key areas for the DLR MACS and the AWI LiDAR instruments featuring another historic tundra fire and a region where several lakes drained only a few months ago, which also could be related to thawing permafrost. On July 30 and 31, adequate weather allowed detailed data acquisition over two more important study areas, the Drew Point coast and the Ikpikpuk River delta. Both regions are affected by strong permafrost coastal erosion, a changing sea ice regime, and sea level rise. The Drew Point coast erodes in some places with up to 80m per year, making it probably one of the most rapid retreating coastline of the world, and our data acquisitions over this site from the start, middle, and end of our campaign together with data from Alaska collaborators will allow the study of erosion rates at sub-seasonal resolution. This will help understanding, whether the ice break-up in spring, the high temperatures in summer, or the storms in fall are causing the most damage to this permafrost coast.

On the same flight days we continued trace gas and atmospheric measurements along multiple low altitude flight transects across large portions of the Alaska North Slope within the Airmeth program. During some of these flights clearly elevated methane emissions were measured which will be further investigated and are promising interesting insights into the different methane sources of this region.

The local hospitality is continuing and we were provided with some wonderfully prepared salmon for our dinner, participated in the fun mid-summer Christmas party of the local scientist crowd, and were interviewed by a documentary film crew from New York working on a movie about interactions between climate change, permafrost landscapes, and people living up here in the North.

The science team thanks the pilots and technicians from Ken Borek Air for the highly professional handling of the weather situation and the excellent completion of all survey targets doable under these weather conditions. We felt save throughout the campaign.

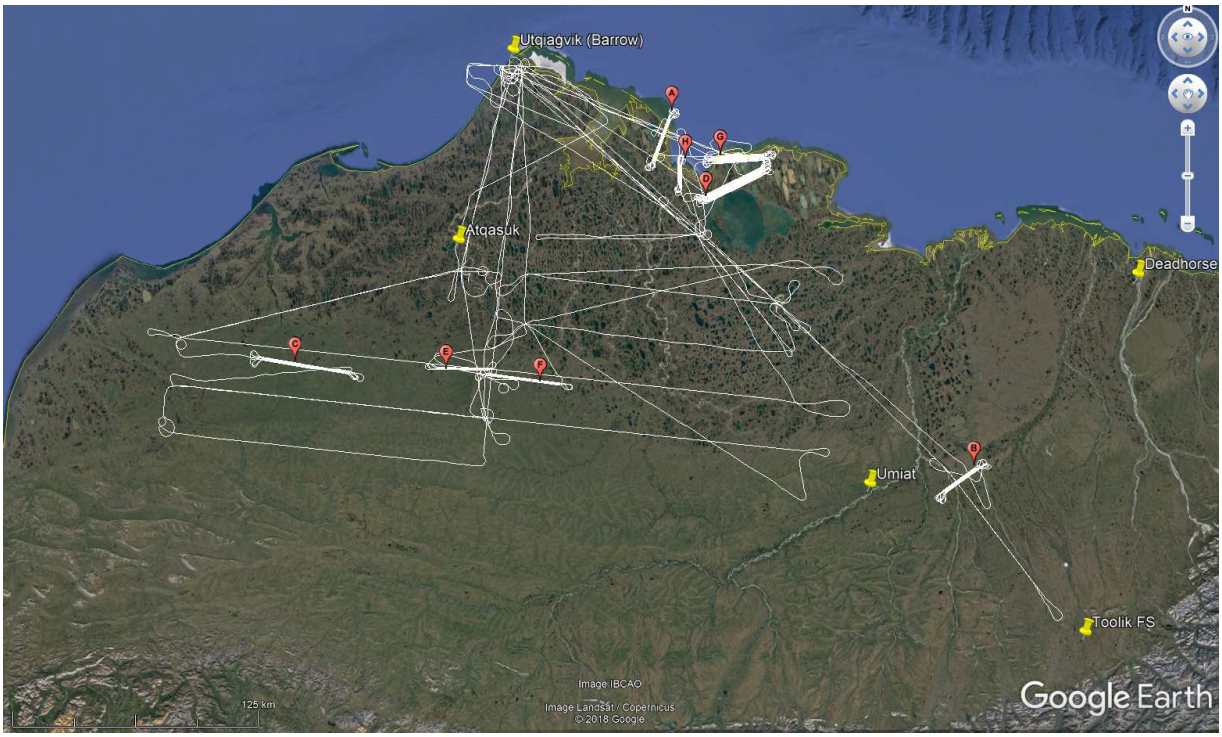
Best regards from Barrow/Utkiagvik, Alaska, or already from midway on the way back to Germany

Guido, Torsten, Martin, Max and the entire Flight Crew

Flight Time Alaska 2019

Day	Target area	Measurements	Flight time*
07/13	Drew Point, high altitude transect at 1000m	MACS, LiDAR	1h 17min
07/19	Cape Simpson, high altitude grid at 1000m	MACS, LiDAR	4h 14min
	Western North Slope, north-south low altitude transect	Los Gatos	
07/20	Western inner Arctic coastal plain, multiple low altitude transects	Los Gatos	4h 46min
07721	Central inner Arctic coastal plain, multiple low altitude transects	Los Gatos	4h 33min
07/22	Northern portion Anaktuvuk River fire scar, medium altitude grid at 500m	MACS, LiDAR	5h 18min
	Anaktuvuk River fire scar, southeast-northwest low altitude transect	Los Gatos	
07/23	Teshekpuk Lake region, medium altitude grid at 500m	MACS, LiDAR	5h 12min
	Drew Point coast, medium altitude transect at 500m	MACS, LiDAR	
07/27	Ketik+Kotlik River fire scars, medium altitude grid at 500m	MACS, LiDAR	5h 51 min
	Western inner Arctic coastal plain, multiple low altitude transects	Los Gatos	
07/29	Meade River fire scar, high altitude grid at 1000m	MACS, LiDAR	5h 29 min
	Southern inner Arctic coastal plain, multiple low altitude transects	Los Gatos	
	Drained Lakes east of Meade River fire scar, high altitude grid at 1000m	MACS, LiDAR	
07/30	Drew Point coast, high altitude grid at 1000m	MACS, LiDAR	5h 29 min
	Eastern inner Arctic coastal plain, multiple low altitude transects	Los Gatos	
07/31	Ikpikpuk River Delta, medium altitude grid at 485m	MACS, LiDAR	3h 50min
	Outer Arctic coastal plain, multiple low altitude transects	Los Gatos	
19 days		Total	45h 59min

*Always includes shuttling from and to Barrow.



ThawTrend-Air 2019 Flight tracks 13-30 July. A – Cape Simpson grid; B – Anaktuvuk River Fire grid; C – Ketik/Kotlik River Fire grid; D – Teshekpuk Lake grid; E – Meade River Fire grid; F – Drained Lakes grid; G – Drew Point Coast grid; H – Ikpikpuk River Delta grid.

Remaining ThawTrend-Air 2019 team at the end of the campaign on the only day with a blue sky over Barrow.