Tracks in the snow of Hyytiälä (Photo: Sandro Dahlke AWI Potsdam).

Northern lights over Ny-Ålesund (Photo: Christian Buhren, Uni Cologne).

Transregional Collaborative Research Center on Arctic Amplification

(AC)³ Newsletter

EDITORIAL

Dear readers of the (AC)³ newsletter,

Time flies, and a lot has happened in the first half of 2025. Most of the important events during that time are reported in this Newsletter: the General Assembly in Bremen in February, the exciting winter school in Hyytiälä, the ground-based IOP4H2O campaign in Ny-Ålesund, the COMPEX-EC aircraft campaign based in Kiruna, and the ongoing ship-based CONTRASTS expedition on the Polarstern. But it wasn't just the observation groups for the atmosphere, ocean, and sea ice that were very active. The satellite analysis and modeling groups also published numerous articles, most of them in close collaboration with partners within (AC)³. It is impossible to list all the project activities of the last six months. It is becoming increasingly clear that the cooperative aspect of our project continues to be increasingly effective. And this is particularly relevant now, as we approach the 10th anniversary of (AC)³.

Public outreach is an extremely important part of our research. Therefore, the public appearance of the enthusiastic team that presented Mia's climate diary during the Ökofete in Leipzig is very welcome (see the short report on page 3 of this Newsletter).

In addition to the content presented in this issue, it is worth mentioning that a subgroup of our (AC)³ project actively participated in the American Meteorological Society's Polar Meteorology Summit Conference in Denver, Colorado (USA). The contributions from (AC)³ were very well received. Our American colleagues greatly appreciated our attendance.

Another important point that became known at the beginning of this year was the news that the Polarstern 2 will finally be available in 2030. This is a great success that will make it possible to continue great polar research in the future. There are already plans to focus on Antarctica until the fifth polar year 2032/33.

Yours,
Manfred and Marlen.

JULY 2025
19th Issue

TOPICS IN THIS ISSUE

- Editorial
- GA report
- News from the observations (ship, Ny-Ålesund, aircraft)
- (AC)³ Winter school report
- (AC)³ News
- Publications

GENERAL ASSEMBLY MEETING REPORT

GUEST IN BREMEN

by Marlen Brückner (Scientific coordinator)

From February 3–5, 2025, we held our first General Assembly (GA) meeting in phase III in Bremen. We were hosted by the Institute of Environmental Physics at the University of Bremen. It was our second in-person meeting since the kick-off in spring 2024, and everyone was genuinely excited to see each other again.

A great deal of progress had been made within the individual projects, which set the stage for a dynamic and engaging scientific exchange. Across three thematic sessions — Atmospheric Aerosol Particles, Ocean/Sea Ice–Atmosphere Linkages, and Arctic–Mid-Latitude Linkages — we attentively followed 12 presentations delivered by our PhD students and postdocs.

The sessions were enriched by inspiring keynote talks from our Mercator Fellows, Matt Shupe and Harald Sodemann, whose input was especially valuable for our early-career researchers. The GA also welcomed two new associated members: Micha Gryschka (University of Hannover) and Dmitri Moisseev (University of Helsinki). We are very much looking forward to collaborating with them in the future.

Two intensive poster sessions provided space for in-depth discussions and further strengthened the collaboration and networking within the project and across clusters. It's always a good sign when conversations in front of the posters have to be wrapped up only because the schedule demands it!

On the final day, the four Crosscutting Activities (CCAs) had the opportunity to outline their interdisciplinary efforts and shape the next steps of their work.

All in all, it was a highly successful and stimulating meeting that sparked many new collaborations and ideas. We are already looking forward to our next GA in Potsdam this September.

Fig. 1: Group picture of participants (Photo: Marlen Brückner, Uni Leipzig).

News from the observations

CONTRASTS EXPEDITION STUDIES ARCTIC SEA ICE MELT

by Marcel Nicolaus (PI in C01, AWI Bremerhaven)

The Polarstern expedition CONTRASTS (PS149) investigates causes and consequences of sea ice melt in the Arctic Ocean. Ten $(AC)^3$ scientists participate to study differences/contrasts between sea ice regimes and their link to atmospheric conditions. The atmospheric focus, particularly on water vapor and mixed-phase clouds, is supported by the $(AC)^3$ side project VAMPIRE-2 (Water Vapour, Mixed-Phase Clouds and Sea Ice Emissivity over the Central Arctic Ocean). From 2 July to 1 September 2025, the team will measure atmosphere, sea ice, and ocean properties across three key ice regimes (see Figure 2):

CONTRASTS EXPEDITION STUDIES ARCTIC SEA ICE MELT

(continued)

1. **Seasonal sea ice** from Russian shelves, drifting along the marginal ice zone - expected to represent future summer Arctic conditions.
2. **Mixed first- and second-year ice** within the transpolar drift - typical of the present Arctic and studied during MOSAiC 2019/20.
3. **Multi-year sea ice** in the "last ice area" north of Greenland – the characteristics of past decades, potentially the last to survive future summers.

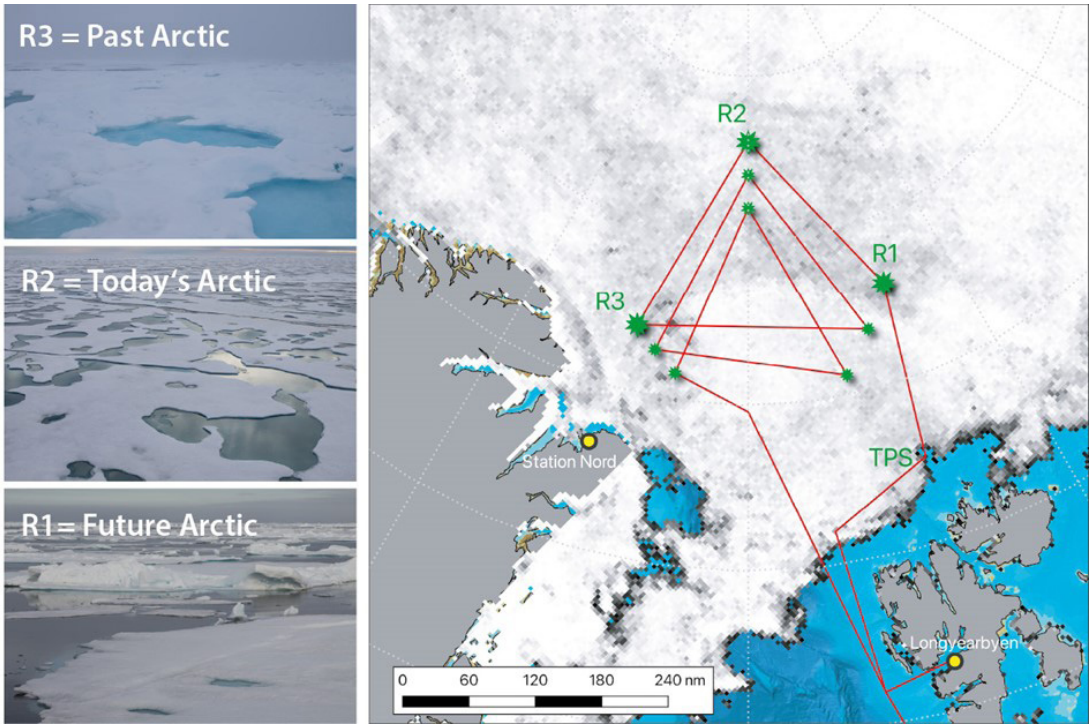


Fig. 2: Planned expedition track of the CONTRASTS (PS149) Polarstern expedition in summer 2025. The photos symbolize potential ice conditions in the three different sea ice regimes (R1 to R3). The track shows the concept of re-visits of the three sea ice regimes, considering a drift of the stations over six weeks. Sea ice concentration in the background is from July 2024 (www.meereisportal.de). Station Nord denotes the basis of the parallel aircraft campaign IceBird summer 2025. The expedition will start on 2 July in Tromsø, Norway (not on the map), and end on 1 September in Longyearbyen, Svalbard.

The core element of CONTRASTS are stops in all three sea ice regions. In each, a representative floe will be selected and visited three times: for initial measurements and autonomous instruments deployment, maintenance, and final recovery. Each visit lasts 2–3 days; observations span approx. Six weeks over the melt season. In parallel, the IceBird 2025 aircraft campaign operates from Station Nord, Greenland. Aircrafts overfly CONTRASTS sites to map sea ice and atmosphere at regional scales.

The concept of contrasting regime studies with repeat sampling is unique. CONTRASTS builds on MOSAiC's methodology but extends it by comparing distinct regimes, including multi-year and marginal ice, under peak melt conditions. All groups follow a common goal: describing contrasts and transitions across sea ice regimes and their coupling with ocean and atmosphere. Standardized, process-based measurements across regimes will enable robust comparisons. Atmospheric properties, including water vapor and clouds, will be continuously monitored using radiometers, radars, and frequent radiosondes. Sea ice emissivity measurements will improve satellite retrievals.

CONTRASTS aims to better quantify ongoing changes, reveal their drivers, and assess future impacts of declining summer sea ice in the Central Arctic Ocean.

(AC)³ NEWS

- The team from Mias Klimatagebuch took part in the Ökofete in Clara-Zetkin-Park, Leipzig! The Ökofete is a festival for the whole family around the topics of sustainability, environment and climate. We offered great hands-on activities for children, including colouring pictures and a quiz.
  Read more about it in the next newsletter!

SAVE THE DATES:

- (AC)³ General Assembly in Potsdam, 23 - 25 September 2025
- 4th (AC)³ Science conference on Arctic Amplification in Cologne, 23 - 27 February 2026
- Final (AC)³ & MOSAiC Conference in Leipzig, 8 - 12 March 2027

MEET THE (AC)³ FELLOWS

Hi everyone, I'm Neha, and I recently started my PhD as part of the (AC)³ project in the CASPAR (Cloud Aerosol Surface PArameter Retrieval) group at the Physics and Chemistry of the Atmosphere department of the Institute for Environmental Physics, University of Bremen.

My path to Arctic research actually began much further south in Pune, India, where I did my Bachelor's in Physics. After that, I moved to Utrecht in the Netherlands for a Master's in Climate Physics, where I wrote my thesis about carbon cycle fluxes and stratosphere-troposphere exchange. My interest in the carbon cycle took me next to GEOMAR in Kiel, where I got to work on modeling how the marine carbon cycle might change in the future. I found my way back to atmospheric research, now with a focus on Arctic research, through (AC)³. My research is on quantifying changes in aerosol amounts and composition using satellite remote sensing during the Arctic amplification period in the high Arctic where observations are limited. Hopefully in the future I can be part of an expedition to help fill more of the gaps!

Outside of research, I love being outdoors - hiking, cycling, and traveling whenever I can. Right now, I am trying to complete all sections of the European long-distance path E1 in Germany, and maybe one day I'll make it to the northernmost trail :)

News from the observations

IOP4H2O - SEVEN WEEKS IN NY-ÅLESUND

by Christian Buhren (PhD in B05 at Uni Cologne) & Andreas Foth (Postdoc in E05 at Uni Leipzig)

From 20th January to 10th March 2025 the intensive observation period for water in all its phases (IOP4H2O) field experiment took place in the small but beautiful research town Ny-Ålesund, Svalbard (78° 55' N, 11° 56' O). IOP4H2O was a joint effort of the (AC)³ projects B03, B05, E02, E03, and E05 (Universities of Cologne and Leipzig) with support from Alfred-Wegener Institute (AWI). The term 'intensive' also fits well with the workload at the beginning of the campaign, which involved installing all the instruments on site, including two radars that had to be lifted onto the platform of the AWIPEV observatory with the help of a crane.

After arriving in Ny-Ålesund, we started our work by setting up the two radars working at different wavelengths. One of the two radars is the newly developed G-band radar for water vapor profiling and Arctic clouds (GRaWAC) operating at 167 and 175 GHz. This new radar closes a current observational gap of measuring water vapor profiles in cloudy and precipitating conditions. As cloud and water vapor properties are tightly coupled, the new measurements will also provide new insights to cloud and precipitation microphysics. Furthermore, the goals of the campaign are to better understand sublimation of snowfall and evaporation of rain, and to quantify blowing snow events, which have great impacts on precipitation observations. In a broader sense, a visit to NyÅlesund always involves observing and feeling the weather first-hand, which can change abruptly thus making the fieldwork very exciting. Future modeling studies will be based on the collected data.

The two cloud radars which we installed (GRaWAC and NyRad-35, a Ka-band radar operating at 35 GHz) are accompanied by the already deployed JOYRAD-94 cloud radar (W-band radar, operating at 94 GHz), the humidity and temperature profiler (HATPRO, microwave radiometer) from AWI, which has been operating since 2012 at AWIPEV, and the Koldewey Aerosol Raman Lidar KARL operated by AWI. For the study of precipitation, we collected data from a micro rain radar (MRR, operating at 24 GHz) and a Parsivel, which is a laser-based optical system for measurement of all types of precipitation, both deployed since 2017. In addition to these instruments, we also installed a disdrometer on the west side of the balloon house platform, which based on a laser-based measuring principle to record different types of precipitation. More detailed information on precipitating particles provides the video in-situ snowfall sensor (VISSS), which has been operating since 2021 in Ny-Ålesund. We have also installed a snow particle counter (SPC) on the VISSS, whereby we had to ensure that the sensor was at least 10 centimeters away from the snow surface, which was very difficult in some cases due to heavy blowing snow. In addition to the suite of remote sensing instruments at the observatory and the operationally launched radiosondes by AWI at noon, we launched additional radiosondes (in total 78 out of 90 available radiosondes), especially in interesting cloud and precipitation cases.

IOP4H2O - SEVEN WEEKS IN NY-ÅLESUND

(continued)

After days of screwing and laying cables, we managed to successfully set up all the instruments that were added for the campaign. After that the instruments were ready, it was time to observe the weather conditions and wait for interesting situations. Overall, we had a broad range of interesting weather conditions, including an intense atmospheric river (narrow band of increased moisture, often associated with high temperatures and sometimes rain, even in the Arctic), strong snowfall events in connection with low pressure systems, and cold air outbreaks. However, it was much too warm for this time of year (see Figure 3). The temperature increased from -20°C up to 5°C and exceeded 0°C (dashed black line in the figure) for 26 days during our campaign. It was also raining for several days, especially in connection with the intense atmospheric river in the beginning of February, which can be identified from the rapid increase of the integrated water vapor (IWV) around the 2nd of February from values of 4 to 14 kg m^{-2}. During the entire campaign, the liquid water path reached maximum values of around 600 g m^{-2}.

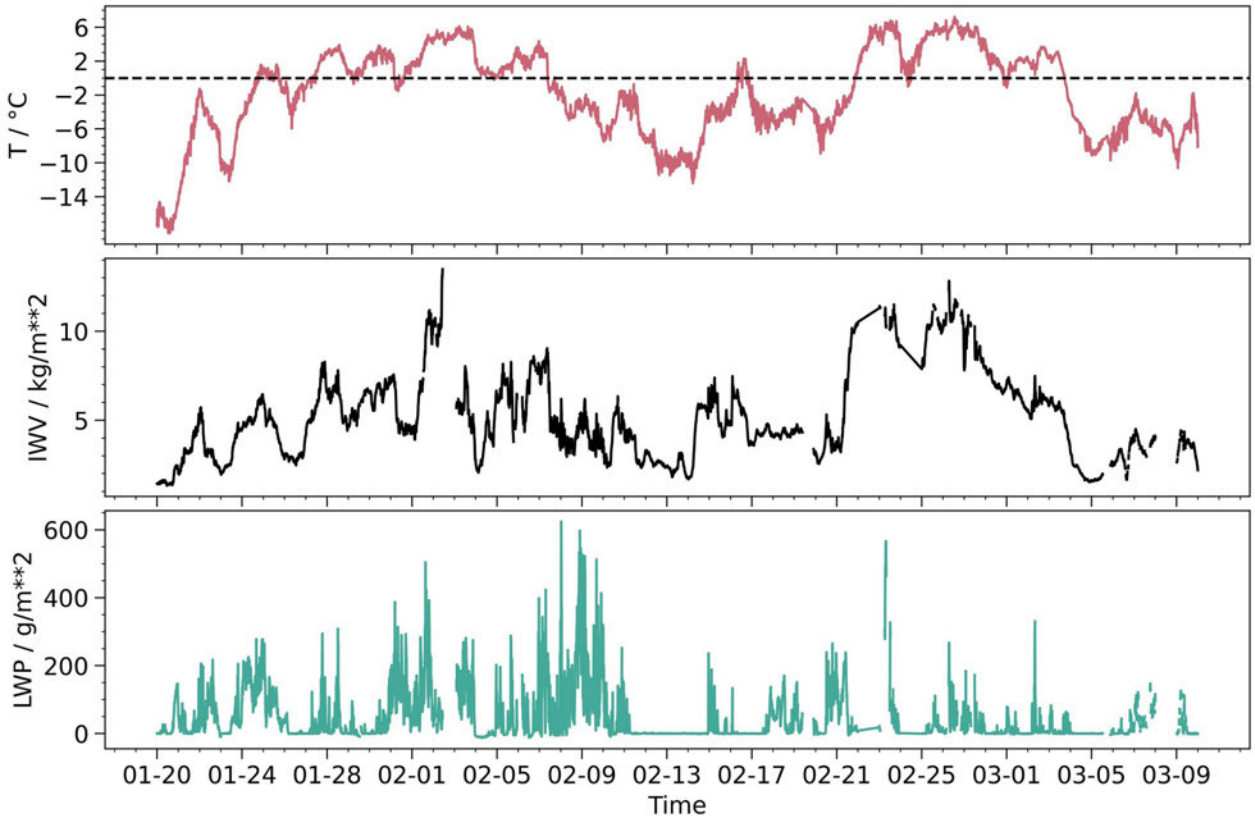


Fig. 3: Timeseries of the temperature, integrated water vapor (IWV) and liquid water path (LWP) from the microwave radiometer HATPRO at AWIPEV. Note the episodic warming during the end of January and the corresponding IWV profile, correlating with temperature. The 0°C mark was reached for the first time on 24th of January.

Thanks to the wonderful AWIPEV team, we were able to successfully carry out this campaign! We not only collected a lot of new multi-frequency radar data, but also really enjoyed our time there personally. Next to activities such as going out with the dog sledge or skiing, some of us were also lucky enough to visit the Zeppelin station on top of Mount Zeppelin, which offers a great view over the fjord and Ny-Ålesund. The discussions with other researchers and employees from all around the world and the legendary bar evenings on Saturday all together created a fantastic atmosphere, so we very much regretted the end of the field observations.

Once all the equipment not staying in Ny-Ålesund had been packed for return transportation, the end of the campaign had arrived. On the last morning before departure, the sun rose above the horizon again for the first time. A great moment for us, but especially for the many overwinterers who had not seen the sun for six months.

IOP4H2O - SEVEN WEEKS IN NY-ÅLESUND

(continued)

The IOP4H2O Team on site: Mario Mech, Christian Buhren, Lukas Monrad-Krohn, Andreas Walbröl, Andreas Foth

Home base: Heike Kalesse-Los, Maximilian Maahn, Kerstin Ebell, Sabrina Schnitt, Linnu Bühler, Beril Aydin, Vera Schemann, Lena Bruder, Christoph Ritter, Marion Maturilli

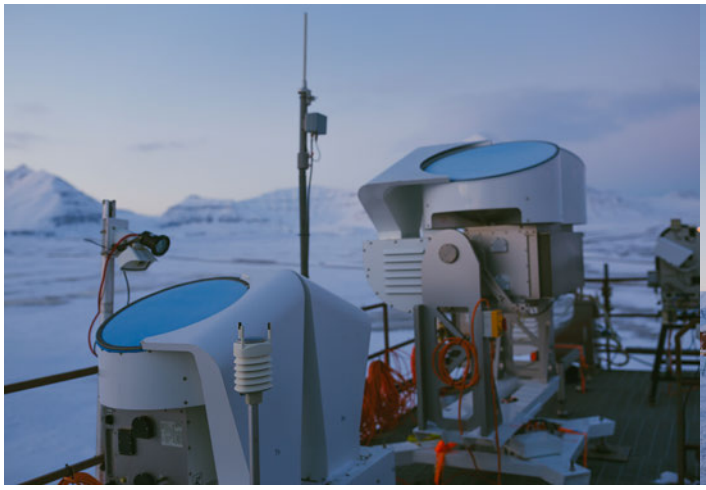


Fig. 4: The two cloud radars were installed (GRaWAC and NyRad-35, a Ka-band radar operating at 35 GHz) and are accompanied by the JOYRAD-94 cloud radar (W-band radar, operating at 94 GHz), the humidity and temperature profiler (HATPRO, microwave radiometer) (Photo: Christian Buhren).

Fig. 5: The Blue House in Ny-Ålesund at dusk (Photo: Christian Buhren).

MEET THE (AC)³ FELLOWS

Hey everyone,

I'm Christian, and I'm from the beautiful town of Aachen in Germany. In October 2024, I started my PhD in project B05 at the Institute for Geophysics and Meteorology in Cologne. It's my all-time favorite institute, as I already did both my BSc and MSc in Meteorology here, focusing on airborne and ground-based observations, as well as remote sensing techniques to explore precipitation and clouds in the Arctic. In early 2024, during my master's thesis, I was lucky enough to be selected as the supplier for new covers for the radars needed during a flight campaign in Kiruna. A transport by regular post would have taken too long, such that a person was needed to bring the important pieces to Kiruna. My experiences during the flight campaign and the overwhelming beauty of the Arctic ultimately fuelled my fascination for polar research. Besides research, I enjoy composing music or walking outside in nature.

Just a few months into my PhD, I was already lucky enough to return to the Arctic. Highlighting one visit, from January to February, I participated in the intensive observation period for water in all its phases (IOP4H2O) campaign, which took part in Ny-Ålesund, Norway. Within project B05, I mainly work with data from the microwave radiometer (humidity and temperature profiler – HATPRO) which has been operating in Ny-Ålesund since 2012. My research focuses on investigating sudden changes in water vapor, their underlying causes, and how they impact the atmospheric column. Therefore, this campaign was not only a perfect match for my research but also gave me the opportunity to once again witness the Arctic in all its beauty – and reminded me of the importance of it for the entire globe. So, I'm super excited to continue my work within (AC)³ and contribute – like a puzzle piece – to the bigger picture of how water vapor affects Arctic amplification.

$(AC)^3$ winter school in Hyytiälä, Finland

by Florian Gebhardt (PhD student in A03 at AWI Potsdam)

The joint winter school by $(AC)^3$ and the University of Helsinki took place in Finland from March 23 - 29, 2025 - a highlight for all PhDs in this project phase! The program consisted of lecture blocks and project work in smaller groups all under the theme: "Causes, contributions, and trends to Arctic Amplification". On Sunday evening, we arrived in Hyytiälä, a remote place east of Tampere, which serves as a research station for long-term forest ecology and meteorological measurements in the wide forest and lake landscape of Finland. Now it offered us a beautiful environment for our winter school. The station and its surroundings were still covered in snow and the lake next to the station was frozen. Before moving into our cozy bed rooms, we were warmly welcomed by Dmitri Moisseev, our $(AC)^3$ Associate Member and co-organizer in Finland, in the historic old dining room of the Forest station.

Fig. 6: Everybody is listening to Claire Pettersons lecture (Photo: Marlen Brückner).

On day 1, Manfred Wendisch introduced us into the topic of airborne measurements, followed by Claire Pettersen (University of Michigan) reporting from the interesting work in her group. After lunch with potatos and sauce, a dish that accompanied us throughout the week from then on, we met in our working groups to start the projects. The projects ranged from long-term trend analysis, over applications of algorithms for cyclone and cloud research, to small field-work projects dealing with snow pits and aerosol measurements. In the evening, after the very early dinner and late work session in our groups, we were allowed to reward ourselves with some relaxation - of course, because we were in Finland - with a sauna evening. There were two sauna huts, each with its own access to the lake, where an ice hole provided ice-cold refreshment. In between, there was a cozy bonfire hut with cool drinks and a few snacks for those who were used to different dinner times.

The lecture blocks on day 2 focused on the topic of aerosols with talks by Manuela van Pinxteren and Silvia Calderón. After a short group work phase, we went on a tour to the SMEAR II measuring station that is the main part of the forest station. A scientist on site introduced us to the interesting measuring apparatuses that were set up in the forest and finished the tour by taking us up to the high measuring tower, from where we could enjoy the view on the seemingly endless forests around Hyytiälä. The following work phase in groups went on until 8 o'clock in the evening and all those who were not tired enough to fall into bed afterwards ended the evening with social games in the dining room and later that night, we saw beautiful northern lights!

Fig. 7: Mika is brave and climbs the measuring tower (Photo: Christa Genz).

Fig. 8: SMEAR II measuring station in the forest (Photo: Christa Genz).

WINTER SCHOOL REPORT

$(AC)^3$ winter school in Hyytiälä, Finland

(continued)

On day 3 and 4, we had lectures on atmospheric water cycle by Susanne Crewell, cloud particles and microphysics by Dmitri and Arctic cyclones and their role in the Arctic climate system by Annette Rinke and Sandro Dahlke, followed by afternoon work sessions in the project groups. In between there were coffee breaks with delicious cake, which was well deserved after working hard on the partly quite extensive projects. In the meantime, the sunny weather had triggered melting everywhere and the lake ice was covered with a fine layer of water. Nevertheless, the clear night was so cold that we were happy to warm up ourselves during our second sauna night and ended the day at the bonfire with drinks and "Stockbrot". As if this was not enough, there were again beautiful northern lights dancing in the sky over Hyytiälä!

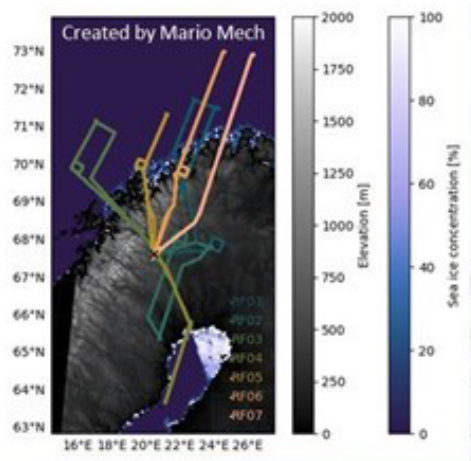
On the last day, after the talks by Heike Kalesse-Los and Gunnar Spreen on remote sensing of clouds and sea ice, we were finally able to present and discuss our exciting project results. It was surprising how much could be achieved in such a short time! After a wrap-up of the winter school by Manfred, we moved on to the last big highlight of the week, the final dinner with delicious food from a nearby caterer and the party including a pub quiz and karaoke singing. With lots of dancing and music in all kinds of languages, our wonderful time in Finland came to an end! Many thanks to Christa and Dmitri for organizing this winter school. The trip will be a wonderful memory for all of us and has brought us forward scientifically and socially!

News from the observations

COMPEX-EC: FLYING THROUGH ARCTIC SKIES TO VALIDATE SATELLITE OBSERVATIONS

by Lena Bruder (PhD in E03 at Uni Cologne) & Lars van Gelder (PhD in B03 at Uni Cologne)

The so-called COMPEX-EC ("Clouds over cOMPlEX environment – EarthCARE") aircraft campaign was beased in Kiruna, Sweden, from April 2 to 16, 2025. The goal was to validate the measurements from a new satellite called EarthCARE by underflying it with Polar 5. EarthCARE is a joint project of the European Space Agency (ESA) and the Japan Aerospace Exploration Agency (JAXA). The satellite was designed to study clouds, aerosols, and the radiative energy they emit, absorb or reflect, which is critical for understanding climate change. It was launched into the orbit in May 2024.



News from the observations

COMPEX-EC: FLYING THROUGH ARCTIC SKIES TO VALIDATE SATELLITE OBSERVATIONS

(continued)

To ensure the accuracy of the satellite data, it is essential to compare them to measurements taken in the atmosphere, either on the ground or from aircraft. During the COMPEX-EC campaign, the AWI aircraft Polar 5 was equipped with various sensors very similar to the ones operated on EarthCARE, such as cloud radar, lidar, spectral imagers, and radiometers, which provide information about cloud structure and particles in the air. The focus was on the "mixed-phase clouds" typical of the Arctic, i.e., clouds composed of ice crystals and supercooled liquid droplets. Their composition determines the cloud's radiation properties, i.e., how solar radiation is reflected back to space, and infrared radiation fthat is absorbed/emmited. They are also central to the Arctic's energy balance, so understanding how these clouds form and change helps to improve weather and climate models.

The best comparisons between satellite and aircraft measurements can be achieved if they are at the same place simultaneously. Therefore, having a good coordination of both tracks is very important. Due to appropriate weather conditions during the campaign, we could conduct seven research flights during which we observed Arctic cold air outbreaks. These events occur when cold air from the central Arctic flows south over the relatively warmer ocean, creating distinctive cloud patterns. A fascinating feature often appears during such outbreaks—"open-cell" cloud structures.

In summary, COMPEX-EC was a success and an essential step in combining satellite and airborne measurements over the Arctic and demonstrating EarthCARE's capabilities. At the same time, it sheds new light on processes in mixed-phase clouds and cold air outbreaks that can help solve the climate puzzle of the rapidly warming Arctic.

If you want more stories and insights from the campaign, please visit the COMPEX-EC blog, where we have regularly reported on our experiences and adventures during this exciting time with the great crew.

Fig. 9: Polar 5 flies over the winter landscape in Sweden (Photo: Marcus Klingebiel).

MEET THE (AC)³ FELLOWS

Moin,

My name is Linus and I'm one of the Phase III PhD students at the IUP in Bremen. I joined (AC)³ last November. I've had a fascination for space and technical things since early in life, and thought I'd end up as an engineer in the space industry. After finishing my bachelor's in computer science and working briefly in that sector while studying Space Science and Technology at the University of Bremen, I decided I'd rather spend my time in fewer meetings with worse pay—driven by science to understand underlying systems better and contribute to solving humanity's self-inflicted problems. Growing up near the Baltic Sea, I love being on or near the ocean and spend most summer weekends sailing. When not on the water, I enjoy gardening or tinkering with electronics.

In (AC)³, I work on Project B02 using satellite observations to retrieve aerosols over bright surfaces, addressing data gaps over sea ice zones and snow-covered areas. My focus is specifically on biomass burning events (forest/peat fires) in the subarctic and their atmospheric impacts in the Arctic. So far, (AC)³ has been great—both the work and social aspects, from GAs to the Hyytiälä winter school and everyday work at university and remotely with the colleagues from the other involved institutions.

ACKNOWLEDGEMENTS

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DFG Deutsche Forschungsgemeinschaft

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$(AC)^3$ Publications

A COMPREHENSIVE IN SITU AND REMOTE SENSING DATA SET COLLECTED DURING THE HALO–$(AC)^3$ AIRCRAFT CAMPAIGN

Abstract

The HALO–$(AC)^3$ aircraft campaign was carried out in March and April 2022 over the Norwegian and Greenland seas, the Fram Strait, and the central Arctic Ocean. Three research aircraft – the High Altitude and Long Range Research Aircraft (HALO), Polar 5, and Polar 6 – performed 54 partly coordinated research flights on 23 flight days over areas of open ocean, the marginal sea ice zone (MIZ), and the central Arctic sea ice. The general objective of the research flights was to quantify the evolution of air mass properties during moist and warm-air intrusions (WAIs) and cold-air outbreaks (CAOs). To obtain a comprehensive data set, the three aircraft operated following different strategies. HALO was equipped with active and passive remote sensing instruments and dropsondes to cover the regional evolution of cloud and thermodynamic processes. Polar 5 carried a similar remote sensing payload to HALO, and Polar 6 was instrumented with in situ cloud, aerosol, and trace gas instruments focusing on the initial air mass transformation close to the MIZ. The processed, calibrated, and validated data are published in the World Data Center PANGAEA as instrument-separated data subsets and listed in aircraft-separated collections for HALO (Ehrlich et al., 2024a, https://doi.org/10.1594/PANGAEA.968885), Polar 5 (Mech et al., 2024a, https://doi.org/10.1594/PANGAEA.968883), and Polar 6 (Herber et al., 2024, https://doi.org/10.1594/PANGAEA.968884). A detailed overview of the available data sets is provided here. Furthermore, the campaign-specific instrument set-up, the data processing, and quality are summarized. Based on measurements conducted during a specific CAO, it is shown that the scientific analysis of the HALO–$(AC)^3$ data benefits from the coordinated operation of the three aircraft.

Ehrlich, A., **Crewell, S.**, **Herber, A.**, **Klingebiel, M.**, **Lüpkes, C.**, **Mech, M.**, **Becker, S.**, Borrmann, S., Bozem, H., **Buschmann, M.**, Clemen, H.-C., De La Torre Castro, E., **Dorff, H.**, Dupuy, R., Eppers, O., Ewald, F., George, G., Giez, A., Grawe, S., Gourbeyre, C., Hartmann, J., **Jäkel, E.**, Joppe, P., Jourdan, O., **Jurányi, Z.**, **Kirbus, B.**, Lucke, J., Luebke, A. E., **Maahn, M.**, **Maherndl, N.**, Mallaun, C., Mayer, J., **Mertes, S.**, Mioche, G., Moser, M., Müller, H., Pörtge, V., **Risse, N.**, Roberts, G., **Rosenburg, S.**, Röttenbacher, J., **Schäfer, M.**, Schaefer, J., Schäfler, A., **Schirmacher, I.**, Schneider, J., **Schnitt, S.**, **Stratmann, F.**, Tatzelt, C., Voigt, C., **Walbröl, A.**, Weber, A., Wetzel, B., Wirth, M., and **Wendisch, M.:** A comprehensive in situ and remote sensing data set collected during the HALO–(AC)³ aircraft campaign, *Earth Syst. Sci. Data*, 17, 1295–1328, https://doi.org/10.5194/essd-17-1295-2025, 2025.

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