View from the mountains of Longyearbyen and the Isfjord (Photo: Sebastian Zeppenfeld,TROPOS).

Research vessel Polarstern off the coast of Norway (Photo: Moritz Zeising, AWI Bremerhaven)

Transregional Collaborative Research Center on Arctic Amplification

(AC)³ Newsletter

EDITORIAL

Dear readers of the (AC)³ newsletter,

Believe it or not, by the end of this year we will look back on almost 10 years of exciting research on Arctic amplification. Phase 1 of (AC)³ started in January 2016 and focused on local processes using a cascade of models across various spatial and temporal scales, complemented by extensive observations from ground-based, ship-, aircraft-, balloon-, and satellite platforms. Our analyses concentrated on clouds, aerosols, and their interactions with the surface.

In Phase 2, we expanded to marine processes and addressed Arctic amplification at the regional scale, supported by overarching activities connecting different subprojects. Now, in the final Phase 3 of (AC)³, we aim to integrate all findings and answer the three key strategic questions of our proposal. This challenging task was intensively discussed at our last General Assembly in September 2025 in Potsdam, hosted by our AWI colleagues. The GA featured oral and poster presentations, as well as reports on outreach, sustainability, and equality, and included an evening screening of "Picture a Scientist" followed by a panel discussion. Overall, it was a very productive and enjoyable meeting.

This Newsletter presents reports on outreach and research activities, workshops, and conferences, introduces three new (AC)³ Fellows from Ghana, India, and Austria, and concludes with a summary of a new study by Marcus Klingebiel and co-workers.

The Potsdam GA highlighted the project's progress and our plans through 2027. Our next major milestone will be the 4th (AC)³ Science Conference in Cologne in February 2026, which will review our current status and remaining tasks.

We thank all contributors to this Newsletter and wish all (AC)³ colleagues a peaceful and relaxing Christmas season and a smooth transition into 2026. Stay healthy and optimistic — we are grateful for your commitment and collaboration within (AC)³.

Yours,
Manfred and Marlen.

DECEMBER 2025
20th Issue

TOPICS IN THIS ISSUE

GENERAL ASSEMBLY MEETING REPORT

(AC)³ GA POTSDAM HIGHLIGHTS - A GLIMPSE INTO THE FUTURE OF POLAR RESEARCH

by Marlen Brückner (Scientific coordinator)

The (AC)³ General Assembly, which took place in Potsdam from September 23 to 25, 2025, was a lively gathering of minds focused on groundbreaking ideas and collaborations. From exciting project updates to interesting scientific discussions, the event offered deep insight into the latest developments in polar research.

Manfred Wendisch gave a comprehensive overview of the current status and upcoming milestones, setting the tone for the meeting. This was followed by an insightful report on the recent COMPEX-EC and upcoming COMPEX campaigns, followed by project reports from the numerous (AC)³ CONTRASTS/VAMPIRE team and an outlook on the planned CONIDA: Contrasting Polar Night and Day campaign in 2028, which goes beyond (AC)³.

The sessions on cross-cutting activities (CCAs) ranged from mixed-phase clouds in the Arctic to air mass transport and transformation, to convection and surface parameterizations, offering rich discussions on the latest findings in polar science.

Fig. 1: CONTRASTS/VAMPIRE team presented their recent Polarstern campaign (Photo: Marlen Brückner).

Cross-cutting activity (CCAs) sessions ranged from Arctic mixed-phase clouds, to air mass transport & transformation, followed by convection, and surface parametrizations, offering rich discussions on cutting-edge polar science.

Fig. 2: Lively discussions before the film at the THALIA arthouse cinema (Photo: Marlen Brückner).

This General Assembly focused on outreach, sustainability, and equal opportunities. Our outreach teams working on Mia's Climate Diary and our fact sheets reported on their successes to date and presented new, inspiring ideas. Meanwhile, the Sustainability Committee emphasized the importance of sustainability in polar research. The screening of the film "Picture a Scientist" by the Equal Opportunities Board (EOB) in a Potsdam cinema sparked important conversations about equality in science. In the subsequent panel discussion moderated by Juliane Handschuh, scientists from our project critically examined aspects of the film, stimulating important discussions.

Two dynamic poster sessions allowed participants to present their latest findings and exchange ideas with colleagues from various scientific fields. The assembly concluded with a forward-looking IPY 2032/33 Planning, marking the beginning of new initiatives that will shape the future of polar science.

Stay tuned as these exciting discussions and projects continue to unfold — (AC)³ is making sure the research frontier never stops moving forward!

Fig. 3: Group picture of GA participants (Photo: Christa Genz).

OUTREACH REPORT

ENGAGING YOUNG MINDS: MIA BRINGS CLIMATE FUN TO THE ÖKOFETE

by Patrizia Schoch (PhD student in C01 at Uni Leipzig)

This year, Mia went to a very special event: the Ökofete in Leipzig. On 15 June 2025, the Clara-Zetkin-Park was filled with organisations that deal with climate-related topics, sharing information and offering hands-on activities. At this exciting event, Mia had her own colourful stand next to Scientist for Future, to capture the attention of the smaller participants. We were offering different kinds of colouring pictures, a how-to-draw Mika instruction, a blog-related climate quiz with prizes and interactive climate stripes where visitors could fill in the climate anomaly of their year of birth. And of course, we had a lot of Mia-Merch like buttons, postcards and stickers. Plenty of curious children were coming and had a great time at our stand. Not only were the kids interested in our outreach project, but also the parents were pretty curious and grabbed some fact sheets and flyers. Everything went well until a thunderstorm was coming up, and we had to pack everything earlier than planned. But all in all, the event was successful, and we had a great day together with Mia, Mika and all the excited kids at the Ökofete.

Fig. 4: The Mia Climate Diary stand was a great success and constantly visited by curious children and adults. A big thank you to the whole team (Photos: Marlen Brückner).

MEET THE (AC)³ FELLOWS

Hello everyone!

I'm Ernest Agyemang-Oko, from Ghana, where I earned my bachelor's degree in physics. In 2018, I moved to Germany to pursue a master's degree in Environmental Physics at the University of Bremen. During my studies, I worked at AWI Bremerhaven as a student assistant and completed my master's thesis there. This exposure was pivotal in shaping my scientific curiosity about the role of polar processes in influencing large-scale climate variability, especially how rapid Arctic warming influences weather and extremes far beyond the polar region. As the Arctic continues to warm at an accelerated pace, understanding its remote impacts on global weather and climate has become more urgent than ever.

Currently, I'm a PhD researcher in Project D06 "Arctic and Midlatitude Linkages" at the Leipzig Institute of Meteorology, University of Leipzig. My research explores how Arctic sea ice loss, particularly over the Barents-Kara sector, influences large-scale atmospheric patterns such as Ural blocking and their downstream effects on Eurasian cold weather extremes. To quantify these linkages, I combine ERA5 reanalysis with CESM2 Large Ensemble simulations and apply a suite of statistical and dynamical diagnostics using causal networks and causal inference methods. A key focus of my work is to assess how the influence of Barents-Kara sea ice loss on Ural blocking varies under different tropical (ENSO) and Arctic (Deep vs. Shallow warming) background states. By uncovering these conditional pathways, I aim to improve our understanding of how Arctic change contributes to midlatitude climate variability and extreme events.

I'm excited to be part of the (AC)³ community and to contribute to advancing our knowledge of Arctic-midlatitude connections.

HOW WE USE THE ICON MODEL TO UNDERSTAND ARCTIC MOISTURE

by Hannah Marie Eichholz (PhD in E06 at Uni Leipzig)

The Arctic has undergone a marked moistening over the past four decades, influencing clouds, precipitation, and radiative processes and thereby contributing to Arctic amplification. Parts of this trend can be attributed to local warming and sea-ice decline, but the role of large-scale moisture transport into the Arctic remains insufficiently understood. So a key question is: Where does all this extra moisture come from, and how does it change on its way into the Arctic?

To answer this, water vapour isotopes have become a powerful tool. They help reveal where moisture comes from and how air masses transform. This is because heavier isotopes (like Deuterium) behave differently than lighter ones during phase changes: they evaporate less easily and condense more readily. As air cools and moisture is removed, the remaining vapour becomes increasingly "depleted" in heavy isotopes. This isotopic composition is expressed as delta (δ) value, which describes how much the heavy isotope content differs from a defined standard (usually ocean water). A value of $\delta D = 0$ means the vapour has the same isotopic composition as the standard, whereas values approaching -1000 indicate extremely depleted vapour with very little Deuterium (D). Thus, δD simply tells us how enriched or depleted an air mass is in heavy isotope.

But despite their potential, current climate models are still not good at representing these isotope-related processes. They often miss important details in moisture transport and the evolution of air masses. Developing and improving isotope modelling is therefore essential, and exactly what my work focuses on.

In our project, we use the ICON (Icosahedral Nonhydrostatic) model. The ICON model is widely used in (AC)³ across projects and can run at kilometre-scale resolution. To simulate the isotopic composition, I work with the isotope-enhanced version of ICON-ART. To better evaluate and understand the model behaviour, we also use the limited-area model COSMOiso, which provides a well-established reference for isotope simulations. So far, we have managed to reproduce the overall atmospheric dynamics in ICON-ART-iso in a way that is consistent with COSMOiso (Figure 1). However, a closer look reveals that the water vapour in ICON-ART-iso is more depleted in HDO compared to COSMOiso. In other words, ICON transports less deuterium towards the Arctic.

Right now, we are trying to identify the cause of this discrepancy. In other words, to find the bug in the model and understand where in the code this error is introduced.

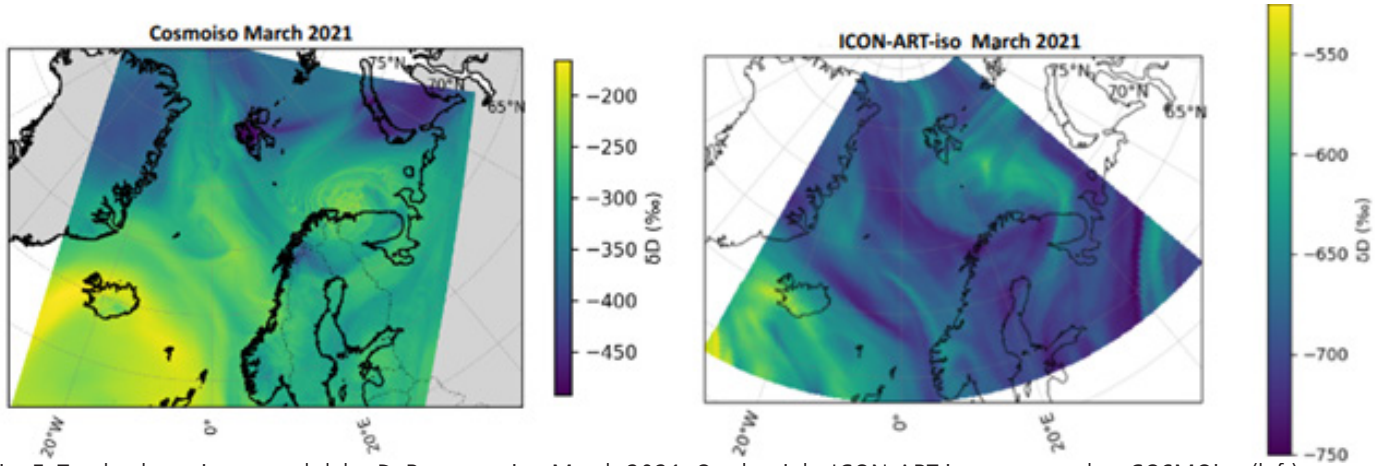

Fig. 5: Total column integrated delta D. Representing March 2021. On the right ICON-ART-iso, compared to COSMOiso (left).

(AC)³ NEWS

SAVE THE DATES:

- 4th (AC)³ Science conference on Arctic Amplification in Cologne, 23 - 26 February 2026

Registration is open until February 1, 2026

- COMPEX aircraft campaign in Longyearbyen, Svalbard, March 14 to April 14 2026
- EGU General Assembly, Vienna, Austria, 3 - 8 May 2026
- (AC)³ General Assembly in Bremen, 15 - 17 September 2026 (likely)
- Final (AC)³ & MOSAiC Conference in Leipzig, 8 - 12 March 2027

MEET THE (AC)³ FELLOWS

Namaste & hello everyone,

I am Komal, and I come from Pune, India, where I completed my Bachelor's in Physics and my Master's in Atmospheric Sciences at Savitribai Phule Pune University. For my Master's thesis, I explored how surface and atmospheric boundary layer (ABL) processes influence the diurnal temperature range (DTR) variability over the Indian subcontinent. This work strengthened my interest in understanding ABL processes, shaping my research journey from the tropical boundary layer to the Arctic boundary layer.

My path into Arctic science began through the (AC)³ A02 project at TROPOS in January 2025. Here, I work with balloon-borne observations collected at Station Nord, Greenland, focusing on transition phases in the wintertime Arctic ABL. These transitions, particularly shifts between cloudy and cloud-free conditions, play a crucial role in modulating surface warming. I also use large-eddy simulation (LES)–based analyses to assess how well the models represent these transition processes and to identify their limitations. Through combining observations and modeling, my work will contribute to understanding and quantifying the lapse-rate feedback, one of the key drivers of Arctic amplification. Exploring these small-scale processes feels like tracing the delicate rhythms of the atmosphere–one profile at a time.

When I am not exploring Arctic inversions and boundary-layer processes, I work with Mia's Climate Diary, where I help manage the social media accounts and share updates on new blog posts — so do follow us here. And when I'm not doing science communication, you'll usually find me gardening or enjoying peaceful outdoor spots.

News from the observations

MEASURING WINDS INSIDE CLOUDS: WIVERN TAKES WEATHER SCIENCE TO THE NEXT LEVEL

A major milestone for climate science: The European Space Agency has chosen WIVERN as its next Earth Explorer mission. This groundbreaking satellite will measure winds inside clouds worldwide — something that has never been done before. The result? Better storm forecasting, improved climate models, and new insights into how our atmosphere works.

Leipzig University plays a key role. Meteorologist PD Dr Maximilian Maahn is helping design the algorithms that will translate WIVERN's radar signals into detailed maps of rain and snowfall. These measurements will be especially valuable in the polar regions, where data are sparse and climate change is accelerating rapidly.

The mission will also track sea ice, snow cover, and ocean currents, making WIVERN a powerful tool for understanding our changing planet. Launch is planned for the first half of the 2030s.

(AC)³ NEWS

Mia's Drawing Contest: Get Creative for Climate Action!

Mia's Klimatagebuch is hosting a fun and educational drawing contest for children, inviting them to get creative while raising awareness about climate change. The theme this year is "Our Climate Future," where young artists can share their vision of a sustainable world through their artwork. The best drawings will be featured on the website, and exciting prizes await the winners! Let's inspire the next generation to think about our planet's future — one drawing at a time.

Submit your entry here by 31 Dec 2025 and join the creative movement for climate action!

WORKSHOP REPORT

First 'ICON for observationalists' workshop in Cologne

by James Panton & José Vicencio (Postdocs in Z04 at Uni Cologne)

From the 1st to the 3rd of December, Cologne welcomed members of the (AC)³ community to a hybrid ICON training workshop, aimed at observationalists and others who would like to take their first steps into the world of modelling with ICON.

The course, presented by José Vicencio and James Panton, kicked off with an introductory presentation to modelling concepts, numerical experiment design, and high performance computing. This was followed by a session of installing ICON and other software into individual training accounts on Levante, the supercomputer managed by the DKRZ.

Across Tuesday and Wednesday, we set up and ran two example experiments. The first experiment showed how choices such as resolution affect model result, focusing on rainfall in the Arctic and Svalbard. The second experiment showed how external software can be run with ICON via the Community Interface (ComIn) plug-in. This included the PAMTRA plug-in, where cloud properties (such as radar reflectivity) are directly obtained from the model run for one of the flight campaigns of COMPEX-EC. To give the authentic modelling experience, some intentional errors (and some unintentional ones) were included, giving us all the opportunity to get our problem solving hats on.

Material produced for the course is available to download from Sciebo (https://uni-koeln.sciebo.de/apps/files/files/1184573128?dir=/icon-workshop/icon-workshop-notebooks) for all (AC)³ members to access if they would like a quick start guide to installing and running ICON. Thank you for the positive feedback about the workshop, and watch this space for more modelling workshops in the future!

Fig. 6: After completing their work on the computer, the workshop participants enjoy a meal together. (Photos: José Vicencio).

CONFERENCE REPORT

A CHANGING SVALBARD LANDSCAPE: INSIGHTS FROM THE SVALBARD SCIENCE CONFERENCE

by Kerstin Ebell (PI in E02 at Uni Cologne)

On 28–29 Oct 2025, the 4th Svalbard Science Conference (SSC) took place in Fornebu (Oslo, Norway). Established in 2017, the bi-annual SSC brings together scientists conducting research in Svalbard from various disciplines. Under this year's theme, "Svalbard as an Arctic hotspot for climate change and international cooperation," many contributions highlighted the rapid changes occurring in Svalbard, as well as the risks and social impacts these bring. However, society is not only under pressure due to climate change, but also due to the political developments. This tension can also be felt within the Svalbard community. On the one hand, science in Svalbard is a wonderful example of international cooperation; on the other hand, new regulations are increasingly complicating the scientists' work. This was made clear in several talks. Still, the scientific community is not discouraged and will continue to work jointly to better understand the Svalbard and Arctic climate system. New tools are being developed for monitoring, modeling, data analysis (buzzword AI), and risk management. Also, (AC)³ projects contribute to many of these topics. Some related to the Ny-Ålesund observations were represented with talk and poster contributions given by the E02 fellows Philip, Sandro, and Kerstin, who also participated in the Ny-Ålesund Atmosphere Flagship meeting, which took place prior to the SSC. What else did we learn during those days? The magnetic pole has moved 1500 km within the last 30 years (30 cm in a common lunch break!), and the Svalbard reindeer population is increasing. So, some good news after all.

LISTENING TO THE OCEAN'S FEEDBACK: A SMARTER WAY TO MODEL SEA ICE

by Rüdiger Gerdes (AWI Bremerhaven)

A better understanding of complex climate system processes can be achieved by numerical modelling experimentation of subsystems, i.e. the ocean-sea ice subsystem. Usually experiments involve the prescription of surface fluxes. Such an approach ignores feedbacks of the fully coupled system. This is especially relevant for feedbacks that affect the heat balance of the coupled system. We suggest a different approach where the momentum and vorticity-flux into the ocean and sea ice subsystem is prescribed. Otherwise, the full coupled model is employed. Some feedbacks are still suppressed but the energy balance of the system is hardly affected. In response to SST and sea ice anomalies (original SSTA) the atmospheric part generates anomalies (secondary anomalies). The latter contain wind-anomalies. Should these anomalies resemble the prescribed wind forcing, we conclude that a positive wind-related feedback exists.

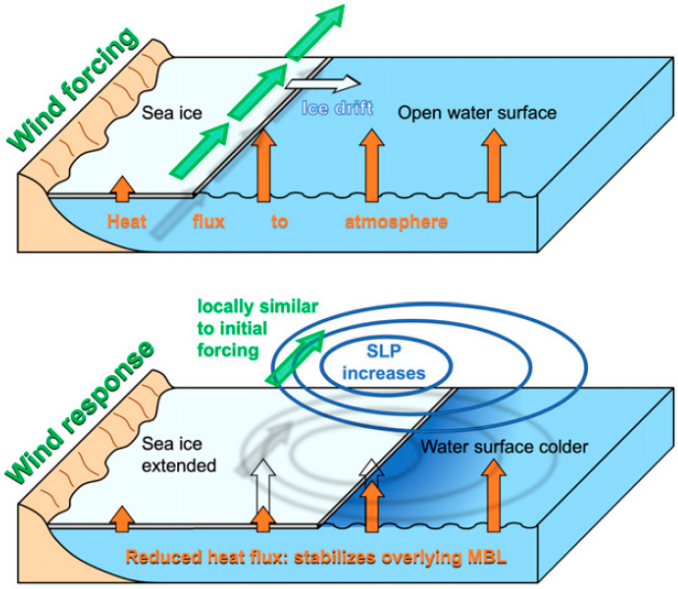

Fig. 7: Schematic of a wind feedback stemming from an anticyclonic forcing (Kovács et al., 2020, https://doi.org/10.1175/JCLI-D-19-0632.1). (top) Southerly winds along the ice edge push the ice eastward, increasing its extent. (bottom) In newly ice-covered areas and over a colder water surface the ocean–air heat fluxes reduce, leading to the stabilization of the overlying atmospheric marine boundary layer (MBL). The gradients of the corresponding increase of atmospheric sea level pressure (SLP) result in geostrophic winds that are locally comparable in terms of both velocity and direction to the forcing wind field. This suggests a positive feedback.

MEET THE (AC)³ FELLOWS

Hello everyone,

my name is Ilga and I started my PhD in the A04 project at the University of Cologne three months ago. Growing up in the mountains and close to nature in Innsbruck, Austria sparked my curiosity about the processes happening in the atmosphere. After school I was encouraged to study atmospheric and cryospheric sciences at the University of Innsbruck. Exploring many Norwegian glaciers during my Erasmus semester in Bergen, Norway, further fuelled my curiosity about glaciers and the cryosphere. I combined my strong interest in the atmosphere and cryosphere in master thesis on turbulence in glacier winds, which I finished last summer. It is my interest in the stable boundary layer over ice surfaces that has brought me to the (AC)³ community.

My PhD focuses on the boundary layer above sea ice in the Arctic, with the aim of identifying nondimensional heterogeneity parameters for use in climate models. The first step is to identify these parameters using observational data from various campaigns (MOSAiC, BACSAM, etc.). I am looking forward to visiting the Arctic for the first time and collecting data for my own research during the COMPEX campaign next spring.

Outside of research I love being outdoors - hiking, skiing and biking. My passion for teaching people how to treat nature and about the atmosphere led me to join the association Girls* on Ice Austria. As part of the association, we organise free glacier expeditions for girls aged 15–17.

I am very happy to be part of (AC)³ and excited to see what comes next!

ACKNOWLEDGEMENTS

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DFG Deutsche Forschungsgemeinschaft

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(AC)³ Publications

AIRBORNE OBSERVATIONS OF CLOUD PROPERTIES DURING THEIR EVOLUTION FROM ORGANIZED STREETS TO ISOTROPIC CLOUD STRUCTURES ALONG AN ARCTIC COLD-AIR OUTBREAK

Abstract

This case study explores the evolution of clouds during an Arctic cold-air outbreak in the Fram Strait region observed during the HALO–(AC)³ aircraft campaign. Our research provides information about the formation, structure, microphysical and macrophysical properties, and radiative effects and investigates the role of vertical wind shear and buoyancy forces in the transition from regular cloud streets to rather isotropic cloud patterns. Our findings show that lower horizontal boundary layer wind speeds (<12 m s−1) disrupt the formation of cloud streets, leading to more isotropic cloud patterns, characterized by increasing cloud fraction (from 0.73 to 0.84) and cloud top height (from 330 to 390 m), and quantify the increase in liquid water path as well. In addition, we observe an increase in the number concentration of ice crystals in a size range between 100–1000 µm and notable riming processes within organized cloud streets. Concurrent radiation measurements in our case study reveal that isotropic cloud patterns can exhibit either low or high albedo as well as low or high Fnet,TIR, suggesting that these patterns represent different developing stages.

Klingebiel, M., Ehrlich, A., Gryschka, M.**, Risse, N., Maherndl, N., Schirmacher, I., Rosenburg, S.,** Hörnig, S.**,** Moser, M.**, Jäkel, E., Schäfer, M., Deneke, H., Mech, M.,** Voigt, C.**, and Wendisch, M.:** Airborne observations of cloud properties during their evolution from organized streets to isotropic cloud structures along an Arctic cold-air outbreak**,** *Atmos. Chem. Phys.*, 25, 9787–9801, https://doi.org/10.5194/acp-25-9787-2025, 2025.

(AC)³ PROJECT PARTNERS

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