More heat and moisture from the ocean is going into the atmosphere because the sea ice acts like a cap or a barrier between the relatively warm ocean surface and the cold and dry atmosphere above (Photo: Manuel Moser, DLR).

Group photo of (AC)³ Winter School in Hyytiälä, Finland, in March 2023 (Photo: Christa Genz, Uni Cologne).

Transregional Collaborative Research Center on Arctic Amplification

(AC)³ Newsletter

September 2023
15th Issue

TOPICS IN THIS ISSUE

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- Evaluation report
- News from the observation site
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- (AC)³ News
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EDITORIAL

Dear readers of the (AC)³ newsletter,

This time our biannual newsletter is a bit late, normally the summer issue would be distributed in June/July each year. However, we have a convincing excuse for the delay. At the end of June, we hosted a group of international reviewers and DFG representatives to evaluate our proposal for a possible third phase of (AC)³. So we were busy preparing this adventure and after the evaluation we felt so exhausted that we could not work on the newsletter.

Anyway, there is much to report from our activities in the first half of 2023! In fact, this period has been extremely busy for all of us, because before the evaluation could take place in June, we drafted, discussed, iterated, and finally submitted our 400-page proposal at the beginning of May. And that kept us incredibly busy! Thank you to all of us for putting so much time and ideas into this proposal. We are so hopeful that all the efforts will pay off. In some way our work on the proposal has already been worth it, because during the writing process, we've learned so much about what we've actually already accomplished and where there are still certain gaps. And that was very helpful for all of us. Of course, we are impatiently waiting for the final outcome of the evaluation of our application, which will be announced to us on the magic day of November 23. Keep your fingers crossed for us!!!

In addition to the proposal and its evaluation, we have done a lot of great scientific work, with numerous papers and conference presentations, some of which are highlighted in this issue. In addition, we co-organized a great Winter School with the University of Helsinki, which we report on in this issue as well.

Enjoy reading our newsletter!
With kind regards from Leipzig,
Manfred, Marlen, and Simone.

EVALUATION REPORT

REVIEW PANEL MEETING OF 3RD PROPOSED FUNDING PERIOD OF (AC)³ IN COLOGNE

by Marlen Brückner

On June 27-28 it was time again. The review of our project proposal for the 3rd and last phase of (AC)³ by the German Research Foundation DFG was due. After we had submitted our 400-page proposal in early May, we were allowed to present our project to 13 independent international reviewers as well as the DFG rapporteur and DFG representatives and to discuss our plans. This time the review took place at the University of Cologne, at the Institute of Geophysics and Meteorology. Together as a team we prepared the review for weeks, cleaned up the lecture hall and created project posters. In a three-hours poster session the individual projects presented themselves with their results achieved so far, but also the plans for the new phase were elaborated and discussed.

Fig. 1: The evaluation group was introduced to the topic and the project's plans for the new phase in the presentation by Manfred Wendisch.

A special highlight and an outstanding achievement were, besides the overview presentations of the speaker and the vice speakers, the presentations of some of our PhDs about their work in the current phase, but also their ideas of work for the proposed phase. The thematic framework of the presentations were our three major Strategic Questions (SQ): SQ1: What are the main causes of, and their relative contribution to, Arctic amplification? SQ2: How do changes in meridional transports impact Arctic and midlatitude weather and climate?, and SQ3: What trends caused by Arctic amplification can be identified and how they will evolve in a future, warmer climate?

Nina Maherndl from project B08 and Janna Rückert from project B05 gave in their presentations insights into how riming processes in clouds affect feedback processes and how they developed methods to detect water vapor feedbacks from satellite observations in the Arctic.

Andreas Walbröl from project B05 explained how the HALO-(AC)³ aircraft campaign will help to investigate the transformations of air masses, while Finn Heukamp from project D04 highlighted the drivers and influences of meridional ocean heat transport in the Arctic.

The mitigation and prediction of Arctic amplification and its controlling processes were explained by Olivia Linke from project E01. Finally, Anisbel Leon from project D02 gave perspectives on the modeling of marine organic aerosol and its impact on clouds in the Arctic.

It is not easy for a PhD to face a critical audience at such an important project review, on whose success the next four years of funding are based. However, all participants were engaged in the preparation to face this challenge. With self-confidence all PhDs mastered this challenge and were also explicitly praised for it by the reviewers. The entire (AC)³ project is proud of the young scientists which are the heart of (AC)³.

Fig. 2: Above: The speakers Nina Maherndl (Uni Leipzig), Janna Rückert (Uni Bremen), and Andreas Walbröl (Uni Cologne). Bottom: Finn Heukamp (AWI Bremerhaven), Olivia Linke (Uni Leipzig), and Anisbel Leon (TROPOS) presented their work from the current phase and gave insights into future planned aspects in the 3rd phase of (AC)³ (Photos: Marlen Brückner).

Our project enjoys the continuous support of the participating universities in Leipzig, Bremen and Cologne as well as the research institutes AWI and TROPOS. Overarching structures and support in personnel and infrastructure help to implement the targeted goals and create sustainable structures for further Arctic research at the sites.

After a hard year of preparation, proposal writing and reviewing, all (AC)³-ers have now earned their well-deserved summer break before we start the future with new strength. Now we are curiously waiting until the final decision by the DFG is made by the end of November.

Fig. 3: All project members are eagerly awaiting the start of the plenary session and the opinions and assessments of the international review group, which is being assembled by the DFG. (Photo: Marlen Brückner).

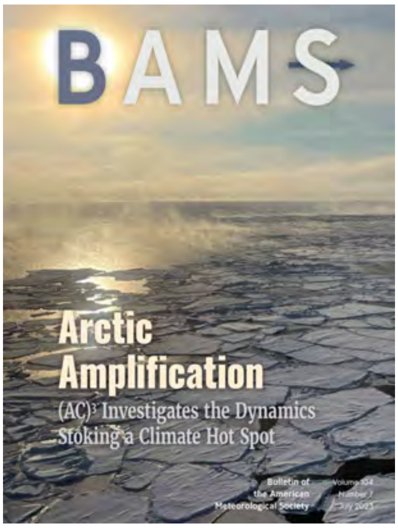
(AC)³ NEWS

Wie wirkt das Meereis auf das Klima in der Arktis?

Höhere Temperaturen führen dazu, dass das Meereis im Sommer dünner wird und sich mehr Risse und große Schmelzwassertümpel bilden. Diese manchmal riesigen Tümpel lassen das Meereis schneller schmelzen.

Check out our Fact Sheet #4 on interesting aspects on Arctic Amplification on http://www.ac3-tr.de/outreach/fact-sheets/.

(AC)³ scientists explain key facts in an easy and comprehensive language to intersted adults illustrated by drawings from Kerstin Heymach.



Our publication on early results from the Transregional Collaborative Research Centre (TRR 172) on Arctic amplification has made it onto the cover of the prestigious Bulletin of the American Meteorological Society (July issue).

"Being featured on the cover is a kind of international accolade for the work of our entire team," says Professor Wendisch. "The publication will help to make our results even more visible beyond the narrow circle of specialists, within the entire international community of meteorologists, oceanographers and climate scientists."

The bulletin, which has been published by the American Meteorological Society since 1920, first published the "Review of First Results and Prospects of the (AC)³ Project" in January (https://doi.org/10.1175/BAMS-D-21-0218.1).

WORKSHOP REPORT

4TH INTERNATIONAL SUMMER SNOWFALL WORKSHOP

by Max Maahn & Nina Maherndl

Fig. 4: Group picture of the snowfall workshop 2023 (Photo: Max Maahn).

Thanks to funding provided in part by (AC)³, the 4th International Summer Snowfall Workshop (ISSW4) was held in Leipzig, from September 11th to 13th, organized by Max Maahn and collaborators. The main goal of this workshop series is to bring together the snowfall community to exchange new developments in all related fields, including ground-based and spaceborne remote sensing, in-situ, laboratory, and modelling. This year, 42 scientists from 12 different countries came together for oral and poster presentations on ice-containing clouds and snowfall. This included excellent keynote presentations by Alexei Korolev, Alexis Berne (who gave a presentation by Anne-Claire Billault-Roux, who was unfortunately unable to attend), and Claire Pettersen. In between presentations, discussion sessions allowed the community to discuss ways to move the field forward. Of course, there was also time for fun activities. We went on a dragon boat ride through the famous canals of Leipzig. Afterwards, early career and young at heart researchers spent a nice evening at a local pub. The snowfall community will meet again at the next ISSW, where we hope to see many familiar and new faces.

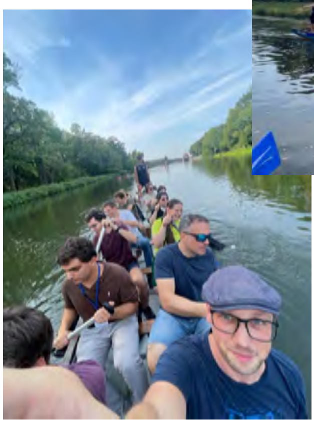


Fig. 5: Some impressions from the dragon boat ride (Photos: Max Maahn).

MEET THE (AC)³ FELLOWS

My name is Sina Mehrdad, and I am from Khorramabad, a city in western Iran. I embarked on my academic journey at the University of Isfahan, earning a bachelor's in Geomatic Engineering and later a master's degree in Remote Sensing Engineering.

I have always been deeply intrigued by our planet's climate and the intricate processes that govern it. This curiosity has guided my path, leading me to commence my PhD at Leipzig University in April 2021. I am excited to be working within subproject D01 of the (AC)³ project, where we dive into the complexities of Arctic climate change. Our goal in this subproject is to investigate and better understand the Arctic-midlatitudes linkages. Specifically, we are exploring how changes in the Arctic climate can influence, and be influenced by, changes in the mid-latitude climate. Our research toolkit includes sophisticated climate simulations and innovative machine-learning tools. Currently, we're deep into exploring the stratospheric pathway linking the Arctic and midlatitudes, and how regional climate forcings play into this dynamic.

Hello everyone,

My name is Jonas Hachmeister and I'm doing my PhD as part of the junior research group "Greenhouse gases in the Arctic" at the IUP Bremen, which is associated with the (AC)³ project. Before that I did both my Bachelor's and Master's degree in Physics at the University of Hanover, with a focus on computational and condensed matter physics. I have always had a great interest and passion for physics and my growing awareness and interest for climate change made this PhD topic a perfect match for me. Specifically my PhD focuses on methane in the Arctic, which is an important greenhouse gas and possibly emitted from thawing permafrost grounds. For my research I use satellite data from the latest generation of satellites which have a great coverage of the Arctic region and unprecedented spatial resolution. The difficult conditions in the Arctic and the huge amount of available data add some unique challenges to my PhD, which make it even more fun and interesting!

ROLE OF CLOUDS IN FEEDBACK PROCESSES: QUANTIFYING RIMING

by Nina Maherndl (PhD student in B08 at Uni Leipzig)

Mixed-phase clouds are an important part of the Arctic climate system. They consist of both ice crystals and liquid water droplets, which can occur in a supercooled state down to temperatures of about -38°C . Despite their thermodynamically unstable composition, they have surprisingly long life times in the order of days up to weeks. Many models, however, struggle with the representation of mixed-phase clouds. Simulated mixed-phase clouds often glaciate quickly to a purely ice state. The ice grows and eventually falls out in form of snowfall dissolving the clouds – much faster than what observations show. One reason for this discrepancy is the complexity of processes and feedback mechanisms governing mixed-phase clouds.

I am currently studying one of these processes called riming. Riming occurs when liquid droplets come into contact with ice crystals and freeze onto them. Because ice crystals typically have much larger sizes than liquid droplets, the droplets tend to attach to gaps in the complex ice crystal structure. That basically means that riming turns a pristine ice crystal into a more ugly blob-like shape (see Fig. 6).

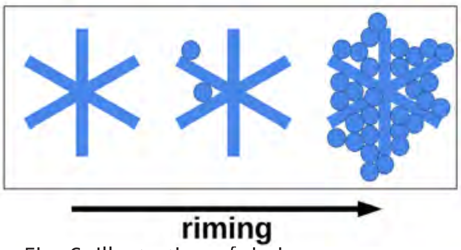


Fig. 6: Illustration of riming process.

Riming impacts ice particle properties, typically leading to denser, heavier, more spherical particles with increased fall velocity. It changes scattering properties of ice crystals, therefore changing cloud optical properties. By efficiently converting liquid water to ice, riming plays an important role in precipitation formation. However, many aspects of riming in the Arctic are still poorly understood. For example, many studies neglect riming when liquid water paths (meaning the total amount of liquid water in a column of air from the ground to the top of the atmosphere) are low. But there are observations of heavily rimed particles even at low liquid water paths. In addition, only very few studies derive quantitative estimates of riming.

Therefore, together with colleagues from the projects B03, B05 and B08 as well as from DLR, I have developed two methods to quantify riming from airborne data. We use data collected during the HALO-$(AC)^3$ aircraft campaign and take advantage of collocated flights with multiple aircraft.

By comparing simultaneous cloud radar and in situ ice crystal observations (see sketch in Fig. 7), we can derive quantitative measures of riming. We do so by finding the amount of riming that is needed to explain the cloud radar observation given the in situ measured number and size of ice crystals. Because we get pictures of ice crystals from the in situ observations, we can look at their shape and quantify riming independently.

Fig. 7: Schematic measurement strategy to obtain quantitative measures of riming by comparing simultaneous cloud radar and in situ ice crystal observations.

Now that we have laid important groundwork in developing methods to quantify riming, we can study the occurrence and variability of riming during HALO-$(AC)^3$ (and in the future also during other campaigns / using other data sets). We found that riming plays an important role in the variability of ice water in mixed-phase clouds. Also, we can confirm that rimed particles occurred even at low liquid water paths hinting at other important factors like updrafts or turbulence. However, that is ongoing research so I can't offer clear explanations just yet.

With my research, I hope to contribute to a better understanding of riming and mixed-phase clouds in general. In my opinion, we as scientists should find ways to communicate our research to the general public. Therefore, I have started making popular science videos and want to close with a shameless self-promotion: if you or anyone you know might be interested check out my channel youtube.com/@cloudyclimate, or scan the barcode.

NEW INSTITUTE BUILDING

PLUS-ENERGY BUILDING AT HISTORIC SITE

Fig. 8: The new research building of the Institute of Meteorology at the University of Leipzig (Photo: SIB/Cornelia Ködderitzsch).

On May 5, 2023, Saxony's Finance Minister Hartmut Vorjohann handed over a new research building of the leipzig Institute of Meteorology at the University of Leipzig to the university's rector, Prof. Dr. Eva Inés Obergfell. With seven professorships and around 150 students, the renowned Institute of Meteorology is one of the largest meteorological institutes in Germany.

The institute was previously housed at three locations. The new building with almost 900 square meters of usable space at the historic "Alte Sternwarte" site is a plus-energy building. This means that the building not only supplies itself, but also produces energy. This is done by photovoltaic panels or a brine-to-water heat pump with ground probes.

MEET THE (AC)³ FELLOWS

Hello,

My name is Nils Slättberg and I am a PhD candidate in the E02 project. I am working at AWI Potsdam since March 2021, but sometimes it feels like it was only yesterday I packed my bag, grabbed my guitar, and left my home town for Germany. In my project, I study the effects of oceanic and atmospheric changes on the surface-air heat fluxes and the vertical structure of the atmosphere in the Svalbard region. Coming from a broad Earth Science background, I am excited to work on a project, where I get to connect knowledge about the different components of the Earth system. It makes me especially happy that I get to focus on two of my favourite realms, namely the ocean and the atmosphere. I work with data from global and Arctic reanalyses, moorings in Fram Strait, and radiosondes launched from the Svalbard research village Ny-Ålesund. Last year, I had the chance to spend a few weeks in Ny-Ålesund collecting radiosonde data for the HALO-(AC)³ campaign. It was really interesting to learn how these data are collected, and absolutely amazing to spend time in the Arctic!

Greetings. I am a researcher in the field of atmospheric aerosol science, specializing in the space-borne retrieval of aerosols over the highly reflective bright snow and ice surfaces of the Arctic to study the effects of aerosols on Arctic amplification. My name is Basudev Swain, and I am deeply immersed in the fascinating field of atmospheric science, with a particular focus on how aerosols contribute to the complex phenomenon known as Arctic amplification. My research focuses on the intricate interactions between aerosols, Arctic climate, and the broader global climate system. My research not only contributes to our understanding of the Arctic, but also has far reaching implications for global climate patterns. I collaborate with other scientists to understand the impacts of Arctic amplification and its potential consequences for both Arctic amplification and global climate stability. As an Arctic aerosol researcher, this critical issue drives me and I am working to find sustainable approaches to address the role of aerosols in Arctic amplification.

(AC)^3 Winter School

IRTG & UNIVERSITY OF HELSINKI JOINT WINTER SCHOOL

by Nina Maherndl, PhD representative & student in B08 at Uni Leipzig

The joint winter school by (AC)^3 and the University of Helsinki in March 2023 provided a great opportunity to learn about Arctic amplification in the remote environment of the Forestry Field Station in Hyytiälä, Finland. Scientists from the University of Helsinki and (AC)^3, including Mercator fellows Matthew Shupe (University of Colorado Boulder, USA) and Irina Gorodetskaya (Interdisciplinary Centre of Marine and Environmental Research, Portugal), gave lectures and led projects in working groups of four to seven participants. There were about 40 doctorate candidates participating: about 30 from (AC)^3 and 10 additional PhDs from the University of Helsinki or other institutions. Although it's always fun to catch up with the (AC)^3 PhDs from the other locations in Germany, it was also nice to meet new people and network.

The main topic of the winter school was the role of clouds (in feedback mechanisms). However, we heard interesting talks from a wide range of (AC)^3 topics including but not limited to surface energy budget, snow, aerosol, remote sensing of atmosphere, sea ice and ocean and atmospheric rivers. Each morning we heard two lectures followed by group project work in the afternoon.

Hyytiälä was covered with snow when we stayed there and we were blessed with sunny weather and temperatures of about -5 to 0 °C during the day. So we tried to make the most of our one and a half hour of scheduled free time each afternoon and spent a lot of time outside. We hiked through the surrounding forest (with or without snowshoes), walked on the frozen lake, dug in the snow – both scientifically (to get snow pit measurements) and for fun (to make an impressive tunnel) – and tried unsuccessfully to build snowmen (the snow was just too dry). We also went on a guided tour through the measurement station where aerosol, trace gas, soil, radiation, water and other measurements are taken directly in the forest.

On Monday and Wednesday many of us tried out and fell in love with the Finnish sauna culture. Especially dipping in the ice holes in the lake in between sauna rounds was an amazing experience. We also hung out in the Kota, which is a small cottage with a fireplace located between the two saunas.

On Friday, we presented the results of our project group work and (with few exceptions) we were quite pleased with what we had accomplished in only a few days. My group, for example, applied the Bremen Sea Ice Algorithm to the SSM/I satellite data set, which is available for a longer time period than the currently used AMSR-E data with the goal of generating a continuous time series that could eventually be implemented in the Sea Ice Portal.

Of course, we had to celebrate our successes, and so the winter school ended on Friday evening with a nice dinner in the Old Dining Hall followed by a party. All in all, the winter school was a great success. Dmitri Moisseev (University of Helsinki) did a great job as host and Christa Genz from the IRTG (and the rest of the planning committee) did a great job organizing. Many thanks to Dmitri, to all the lecturers and the IRTG for the amazing week.

Fig. 9: Right: Group project work in the field, and left: at the computer (Photos: Christa Genz).

Fig. 10: Right: Intersting lectures from a wide range of (AC)^3 topics. Left: Mika, the small friend from Mias Klimatagebuch, was curious and followed the exciting field work in the snow (Photos: Christa Genz).

ACKNOWLEDGEMENTS

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DFG Deutsche Forschungsgemeinschaft

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(AC)³ Publications

MOSAIC-ACA AND AFLUX-ARCTIC AIRBORNE CAMPAIGNS CHARACTERIZING THE EXIT AREA OF MOSAIC

Abstract

Two airborne field campaigns focusing on observations of Arctic mixed-phase clouds and boundary layer processes and their role with respect to Arctic amplification have been carried out in spring 2019 and late summer 2020 over the Fram Strait northwest of Svalbard. The latter campaign was closely connected to the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) expedition. Comprehensive datasets of the cloudy Arctic atmosphere have been collected by operating remote sensing instruments, in-situ probes, instruments for the measurement of turbulent fluxes of energy and momentum, and dropsondes on board the AWI research aircraft Polar 5. In total, 24 flights with 111 flight hours have been performed over open ocean, the marginal sea ice zone, and sea ice. The datasets follow documented methods and quality assurance and are suited for studies on Arctic mixed-phase clouds and their transformation processes, for studies with a focus on Arctic boundary layer processes, and for satellite validation applications. All datasets are freely available via the world data center PANGAEA.

Mario Mech, André Ehrlich, Andreas Herber, Christof Lüpkes, Manfred Wendisch, Sebastian Becker, Yvonne Boose, Dmitry Chechin, Susanne Crewell, Régis Dupuy, Christophe Gourbeyre, Jörg Hartmann, Evelyn Jäkel, Olivier Jourdan, Leif-Leonard Kliesch, Marcus Klingebiel, Bitte Solveig Kulla, Guillaume Mioche, Manuel Moser, Nils Risse, Elena Ruiz-Donoso, Michael Schäfer, Johannes Stapf and Christiane Voigt, 2022: MOSAiC-ACA and AFLUX - Arctic airborne campaigns characterizing the exit area of MOSAiC. Sci Data 9, 790 (2022). https://doi.org/10.1038/s41597-022-01900-7

(AC)³ PROJECT PARTNERS