Passing the rocky coast of Svalbard (Photo: Marlen Brückner, Uni Leipzig).

Ny-Ålesund seen from the BELUGA balloon (Photo: Manuela van Pinxteren, TROPOS).

Transregional Collaborative Research Center on Arctic Amplification

(AC)³ Newsletter

EDITORIAL

Dear readers of the (AC)³ newsletter,

At the end of the year we present again - as now usual and accustomed - our biannual (AC)³ newsletter. The summer and fall were very busy - that too as usual - with the preparations for the application to continue our project in a third phase being in the foreground. A first meeting of the PLs (Project Leads, since recently PIs, i.e. Principal Investigators, are officially called PLs) took place in September in Leipzig. Our general goals for the third (AC)³ phase were discussed and agreed upon. In addition, ideas and visions for the continuation of the individual projects were presented and collaborations were discussed. The meeting was very productive. The progress we have made so far with (AC)³ – became very clear, and the team spirit was clearly evident in all discussions. We want to continue to research together on the causes and effects of Arctic amplification, and we want to continue to be successful with that.

As a second highlight in this semester, we organized the General Assembly, which was held at the Klimahaus in Bremerhaven. We had planned a whole week for the meeting this time. It was about the results of the work of our PhD students so far, and the further planning of the (AC)³ application for the third phase. The first part of the meeting was completely planned and organized by the PhD students themselves. It was very impressive how cleverly and confidently the presentation blocks were led by our young colleagues - kudos!

Apart from that, we would like to wish all readers of this newsletter a relaxing Christmas season. All the best, especially good health and lots of energy for all (AC)³ fans and your families.

With kind regards from Leipzig,
Manfred, Marlen, and Simone.

December 2022
14th Issue

TOPICS IN THIS ISSUE

MEETING REPORT

$(AC)^3$ GENERAL ASSEMBLY AT KLIMAHAUS IN BREMERHAVEN - ONE PLACE, THREE DIFFERENT MEETINGS, ONE TEAM

by Marlen Brückner

Time is flying... While our Phds and Postdocs of the current 2nd phase are still in the middle of evaluating their numerous observational data, several model runs and results, another part of the team is already in the middle of the preparations for our joint application for the third, and thus also last, funding phase of $(AC)^3$. Two different focuses, but one common goal. We want to get a little closer to the bottom of Arctic amplification again with our work. Better understand correlations with our results and data. Contribute to better understand our too fast changing Arctic and share the results with the world.

Since we will be working intensively in the next six months to set ourselves up for another four years $(AC)^3$ project, we decided, even if in the middle of the semester, to take a whole week for the project. After a long search and a change of location, we finally found the best location for us in the Klimahaus in Bremerhaven (https://www.klimahaus-bremerhaven.de/). From November 21 to 25, we were able to hold our General Assembly (GA) in the conference rooms and also take the opportunity to visit the exciting and worth seeing exhibition of the Klimahaus. We felt very comfortable here and the support as well as the food of the Klimahaus was excellent.

We divided our meeting into two parts, which reflected the situation described at the beginning. In the first part of the GA we heard presentations and posters from our Phds and Postdocs from the current phase. In five different sessions ranging from Arctic aerosol particles, satellite observations, atmospheric radiation and turbulence to air mass properties and transports and Arctic sea ice, the contributions were very exciting and insightful. Likewise, our four Crosscutting Activities (CCAs) came back to action with breakout sessions discussing a joint paper or individual case studies. Here, our PhD candidates compiled and designed the scientific program themselves from submitted papers.

Fig. 1: Helene and Thomas Hofmann gave an interesting evening talk (Photo: Hanno Müller).

A special highlight of the first part was the evening talk by Helene and Thomas Hofmann. With their art project Cryosity (https://www.cryosity.com/) Art & Science they gave us an amusing insight into the world of snowflakes and their diversity. One could think that science and art are so different in their nature that they can't make a connection. Where art is very subjective, shaped by its own feelings, science is always concerned with rationality and objectivity. And yet there are numerous points of contact that go beyond the purely aesthetic presentation of scientific results. They have found a way to preserve snowflakes. We were delighted that they took us along on their stories from the Arctic and Antarctic. We wish them both continued success with their project.

Fig. 2: Left: The object "Climate Change in Focus" is addresses the perishability and fragility of the polar regions and the associated global climate change. Right: "Below the surface", Image of the percolation process, Arriach/ Wöllaner Nock – Kärnten, Österreich, Jan. 2022 (Photos: from https://www.cryosity.com/projects-1).

For the second part of the meeting at the Klimahaus we split into two groups. While the PLs and Postdocs focused on the new project proposals for the third (AC)³ funding period, our PhD candidates had a completely different focus. With insights into the work of Science Communication and a Career development workshop they got useful information for their further life after the PhD.

So after an intensive but very nice week we all went home together with new ideas and motivation.

Fig. 3: Group photo of all participants at the Klimahaus in Bremerhaven (Photo: Marlen Brückner).

OUTREACH ACTIVITY FOR KIDS AND INTERESTED ADULTS

MIA AND THE CHOCOLATE

by Simone Lindemann (Admistrative coodinator, project outreach activities at Uni Leipzig)

Together we are tinkering, refining here and there and have achieved a great result: with our climate research contributions in Mia's climate diary we have reached 18,000 readers so far, every day about 40 readers browse the website for exciting content and read around 3-4 blog posts. Our Instagram channel is becoming increasingly popular, and various websites link to Mia's Climate Diary.

It's exciting, too: children can experience first-hand what we do on research campaigns, how to become a polar researcher, how high a weather balloon can fly, why farting cows are bad for the climate, and much more.

Now, Mia introduces the new Meet & Greet interview series: How did you find your way into science? Where would you rather live - in the Arctic or in Antarctica? The new series shows who we are, just fully human. Perhaps we encourage children to study STEM subjects.

Free chocolate! This was a little boost for your contribution during our GA in Bremerhaven. Please remember to add your name to the list of blog posts, making your work in (AC)³ visible to children and interested citizens. So if each of us invests one hour for a contribution soon, we will have enough content until the new funding phase starts.

And tatatataaaa: We are happy to announce that also Universitätsgesellschaft Leipzig thinks our Mia's climate diary is wonderful. So Simone Lindemann was awarded with the main prize in the category transfer during the Dies Academicus of the University of Leipzig on 2nd Dec 2022.

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Website: www.mias-klimatagebuch.de

MEET THE (AC)³ FELLOWS

Hello everyone,

I am Zerlina Hofmann. I am doing my PhD at AWI Bremerhaven as part of the (AC)³ project since May 2020. Before that I did my Bachelor's degree in "Physics of the Earth's System" and my Master's degree in "Climate Physics" at the University Kiel. A year-long stay abroad on Svalbard sparked my interest in polar oceanography (before I was actually planning to become a meteorologist, if I had stuck with that, maybe now I would understand all the talks about clouds). An internship at AWI and two subsequent Polarstern cruises had me completely hooked on the Arctic.

Naturally I was super excited to write my Master thesis and now my PhD thesis at AWI. I am one of the ocean people in the project, and I work on ocean fronts in the Marginal Ice Zone (which are not completely different to atmospheric fronts actually). For my PhD we conducted a process study in Fram Strait, where we tried to follow a front. Let me tell you, that is not an easy feat. But it's also a lot of hands on research and fun!

Hi everyone,

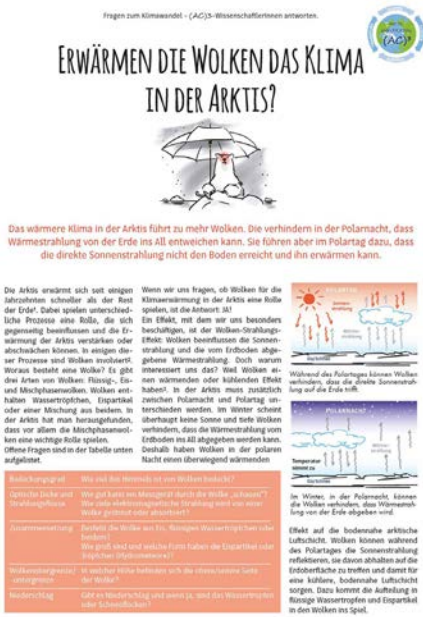
My name is Sofie Tiedeck and I am part of the E04 project since June 2021.

For as long as I can remember, I have always been interested in understanding nature. That's why I decided to study physics and did both my Bachelor and Masters at the University of Bayreuth, focusing on nonlinear Optics. And even though I really like this fascinating topic, I realized at the end of my Masters that I would like to switch to a more environmental topic. So when I saw the open PhD position at the AWI Potsdam I knew this was where I wanted to go and I'm so glad it worked out!

Now I am trying to find out how moist air intrusions impact the surface energy budget in the Arctic, and which transformation processes take place during such events using reanalysis and model data.

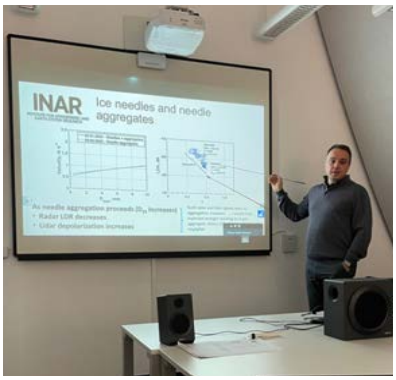
In my free time, you have a very high probability of finding me doing brain-relaxing handicraft work.

(AC)³ NEWS



Check out our Fact Sheet #3 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.



Dmitri Moisseev from the Helsinki University visteted LIM from 28 Nov - 2 Dec funded via (AC)³ travel grants. He gave an intersting colloquium presentation on "Radar and lidar depolarization ratios of snowflakes".

- Evaluation of proposal for third funding period if (AC)³ in Cologne: **27 - 28 June 2023**
- Stay informed: If you want to receive this newsletter regularly, you can subscribe online at http://ac3-tr.de

STORMS IN THE ARCTIC CAN HELP TO PRESERVE THE SEA ICE

by Lars Aue (PhD student in D03 at AWI Potsdam)

Cyclones (also referred to as low pressure systems) do not only shape the weather in our latitudes, but are also important for the weather and climate conditions in the Arctic – and particularly for the Arctic sea ice. In our study, conducted in the (AC)³ project D03 and recently published at Geophysical Research Letters, we systematically analyze how the passage of cyclones impacts the amount of sea ice at a certain location in the Arctic (in the following referred to as sea ice concentration, or short: SIC). Generally, these impacts on SIC consist of enhanced drift and deformation of ice floes due to the stormy wind conditions often associated with cyclones as well as of melting of ice (or stalling of ice growth) due to warm and moist air masses that are transported over the sea ice cover (Figure 4). Even though scientists are generally aware of these processes, they have mostly been studied for individual cyclone events so far, and rarely been quantified in a statistical way over lots of events. In our study, we use reanalysis data (a combination of observations and model forecasts) and satellite observations as well as a cyclone tracking algorithm to answer the question, how the overall impact of cyclones on SIC looks like for all winter cyclones in the period of 2000 to 2020.

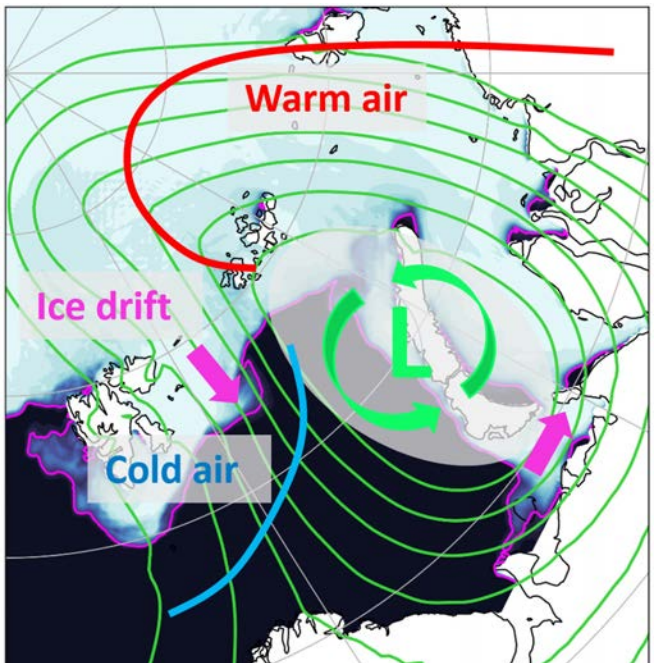


Fig. 4: Schematic overview on a cyclone crossing the Arctic sea ice cover.

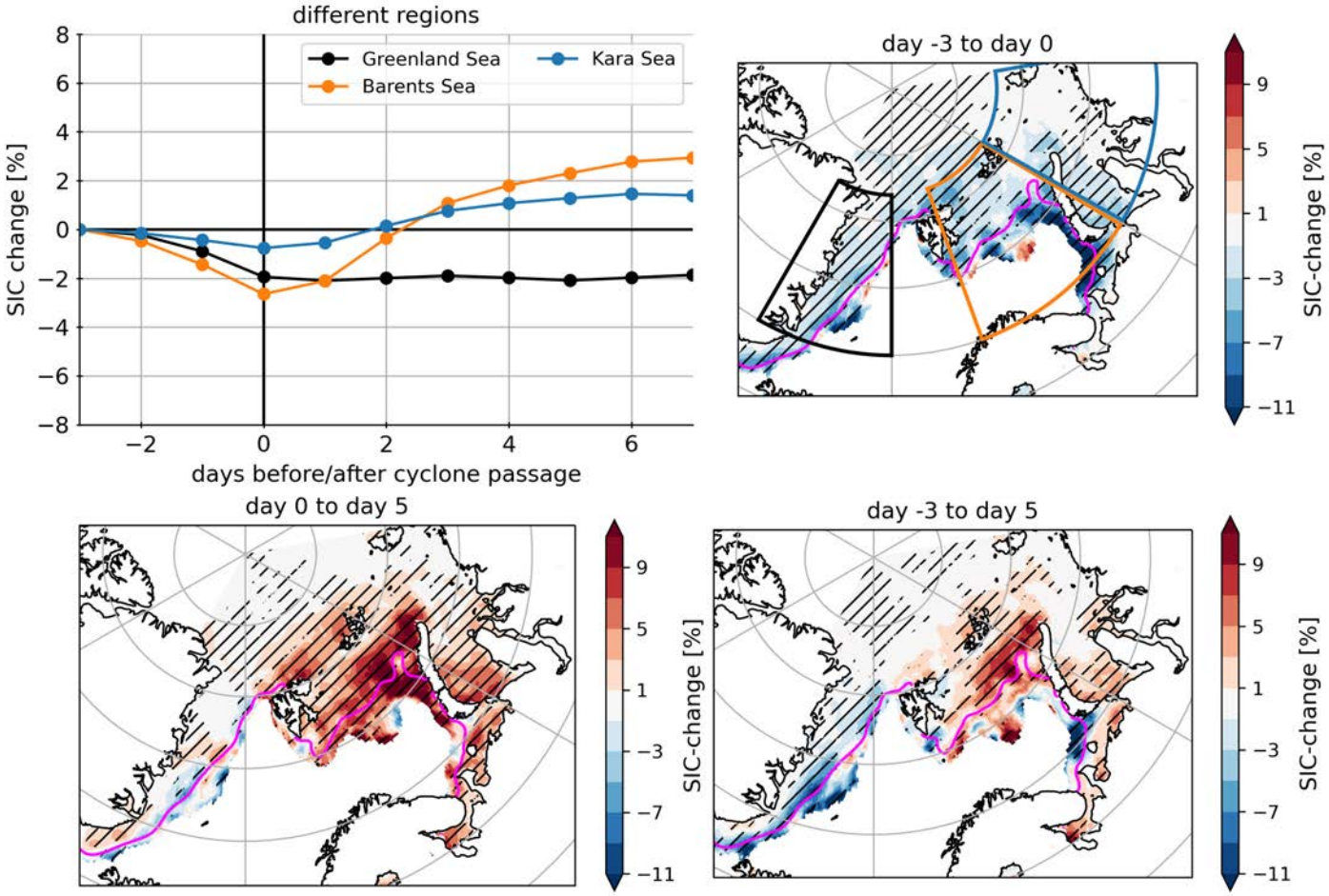


Fig. 5: SIC changes over different time periods (of up to 10 days) associated with cyclone passages in the Arctic.

MEET THE (AC)³ FELLOWS

Hello, my name is Alexander Mchedlishvili, and I am part of (AC)³ D03 dealing with atmosphere-ocean-sea ice interactions in the Arctic. I study how uneven a sea ice surface can be and what that means. It's easy to forget that though the Arctic ocean is frozen solid in some places, because only the surface is frozen, the ice layer moves quite a bit! Every current from below or storm from above has the ability to influence where the ice goes. I look at how the ridges and snow dunes on top of the ice are able to act as sails that propel the ice floes in a given direction. Same effect plays for the "keels", the bits sticking out at the bottom of the ice layer, but sadly the satellite I use (ICESat-2) only observes the sea ice atmosphere boundary. Because of this, the distribution of these ridges and dunes change constantly. Using an altimeter satellite that sends out light and measures how long it takes for it come back, I survey the Arctic as often as I can and try to map out where the ice is uneven and where it is smooth. The way I quantify all this is with drag coefficients, where drag denotes the friction between the atmosphere and sea ice layers of the Arctic climate system.

I am super happy to be working on what I do and have in the past tried communicating it (used to go by The Half Drawn Man on YouTube). Other than science, I am a huge fan of martial arts and swimming and am a proud dwarf hamster and crested gecko owner.

News from the modelers

STORMS IN THE ARCTIC CAN HELP TO PRESERVE THE SEA ICE

(continued)

The main outcome of our study is that the answer to the question, if cyclones increase or decrease the SIC, depends on the specific region of the Arctic. In detail, cyclones reduce the sea ice in the Greenland Sea (black box/line in Figure 5), while in the Barents Sea (orange box/line) and Kara Sea (blue box/line), a reduction in sea ice during the cyclone passage is outweighed by a strong increase in the week after the cyclone passage. In the end, this leads to a higher SIC in those regions compared to days, when no cyclone passes by.

This result comes partly as a surprise, since previous case studies have mostly reported on destructive effects of individual cyclones on the sea ice cover. Based on our study, it seems that cyclones – at least in some regions of the Arctic – rather contribute to preserving and restoring the Arctic sea ice in winter. Probably, this can be explained because during the stormy cyclone passages, cracks and openings form in the sea ice cover very frequently, and these provide room in which new sea ice can grow when the ocean is exposed to the cold air temperatures of the Arctic winter.

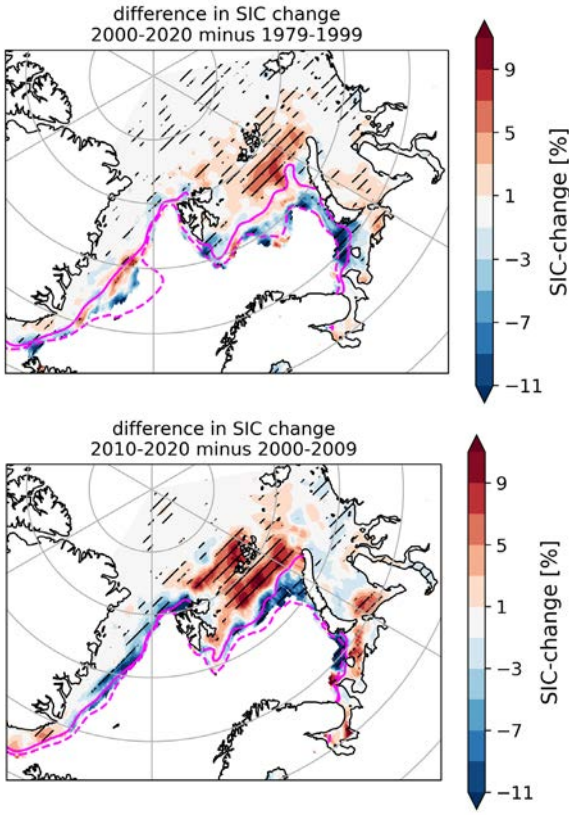


Fig. 6: Change in cyclone impacts on SIC between 1979-1999 and 2000-2020 (top) as well as between 2000-2009 and 2010-2020 (bottom).

As part of the (AC)³ project that focusses on Arctic amplification, we are interested in the fate of the Arctic in the context of ongoing global warming. Therefore, we additionally analyzed, if the impacts of cyclones on the Artic sea ice have changed recently. To address this question, we compared the impacts of cyclones on SIC between 2000 and 2020 with those during the period 1979 to 1999 (Figure 6, top). Based on this method, we find that cyclone impacts have generally amplified in the last decades in the Barents Sea. That means, both destructive and preserving effects of cyclones on the sea ice have gotten more intense. The reason for

News from the modelers

STORMS IN THE ARCTIC CAN HELP TO PRESERVE THE SEA ICE

(continued)

this is presumably that the sea ice cover has gotten thinner and therefore weaker in the last years, so that it can be impacted more easily by the cyclonic winds. Particularly in the last decade - 2010 to 2020 - we see a strong further intensification of the cyclone impacts on sea ice compared to the years 2000 to 2009 (Fig. 6, bottom). This highlights the importance of further research on this topic to understand in detail, how future cyclone impacts on Arctic sea ice will look like.

MEET THE (AC)³ FELLOWS

Hello everyone, my name is Hanno Müller. I received my bachelor's and master's degree in physics at Leibniz University Hannover. During my master studies, my interest shifted from quantum optics in the lab to spectroradiometers measuring solar radiation in the atmosphere. The next two years, I spent my time at AWI, joining the Neumayer III overwintering team as a meteorologist and sea ice physicist. This experience strengthened my fascination for the polar regions and therefore it was a good choice to join the (AC)³ community as a PhD candidate in January 2021. Since then, I am happy to be part of the working group of Manfred Wendisch at Leipzig University.

Within B03 I am working on the evaluation of the representation of Arctic mixed-phase clouds in numerical weather prediction models. For that, I compare the operational output from the ECMWF's Integrated Forecasting System with observations from the ACLOUD campaign to identify major representation issues and investigate the impact of different ice optical parametrizations. In 2022, I joined the HALO-(AC)³ campaign to collect valuable observations for the extension of our analysis to the operational output from the ICON model.

PhD News

PHD RETREAT IN BREMERHAVEN

by Zerlina Hofmann, PhD representative & student in C04 at AWI Bremerhaven

During the most recent (AC)³ General Assembly in November 2022, us PhD students gathered once more for the second part of the week to work on some soft skills. Our first workshop was on the topic of "Science Communication", led by Adam Polczyk from the Press and Communications department of the University of Cologne. We learned about how such a department works (in this case a lot through the medium of film) and we got to make our own little movie and practice camera perspectives.

Our second workshop was on the topic of "Career Development", led by Dr. Juliane Handschuh, a Soft Skill Trainer for Scientists. We considered our own strengths and desires, and thought of any potential future career (ranging from the "classic" route of postdoc, over data scientist to train driver or marrying rich – anything is possible). Lastly Juliane showed us, how to follow our career paths and how we can start to develop our future careers right now.

On the last day of the GA we were saturated with listening and talking and went to see the Klimahaus exhibition and had lunch together. We'll see you next time!

ACKNOWLEDGEMENTS

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DFG Deutsche Forschungsgemeinschaft

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(AC)³ Publications

ATMOSPHERIC AND SURFACE PROCESSES, AND FEEDBACK MECHANISMS DETERMINING ARCTIC AMPLIFICATION: A REVIEW OF FIRST RESULTS AND PROSPECTS OF THE (AC)³ PROJECT

Abstract

Mechanisms behind the phenomenon of Arctic amplification are widely discussed. To contribute to this debate, the (AC)³ project has been established in 2016 (http://www.ac3-tr.de/). It comprises modeling and data analysis efforts as well as observational elements. The project has assembled a wealth of ground-based, airborne, ship-borne, and satellite data of physical, chemical, and meteorological properties of the Arctic atmosphere, cryosphere, and upper ocean that are available for the Arctic climate research community. Short-term changes and indications of long-term trends in Arctic climate parameters have been detected using existing and new data. For example, a distinct atmospheric moistening, an increase of regional storm activities, an amplified winter warming in the Svalbard and North Pole regions, and a decrease of sea ice thickness in the Fram Strait and of snow depth on sea ice have been identified. A positive trend of tropospheric bromine monoxide (BrO) column densities during polar spring was verified. Local marine/biogenic sources for cloud condensation nuclei and ice nucleating particles were found. Atmospheric/ocean and radiative transfer models were advanced by applying new parameterizations of surface albedo, cloud droplet activation, convective plumes and related processes over leads, and turbulent transfer coefficients for stable surface layers. Four modes of the surface radiative energy budget were explored and reproduced by simulations. To advance the future synthesis of the results, cross cutting activities are being developed aiming to answer key questions in four focus areas: lapse rate feedback, surface processes, Arctic mixed-phase clouds, and air mass transport and transformation.

Wendisch, M. et al. (including 112 (AC)³ co-authors), 2022: Atmospheric and Surface Processes, and Feedback Mechanisms Determining Arctic Amplification: A Review of First Results and Prospects of the (AC)3 Project, Bull. Amer. Meteorol. Soc. (published online ahead of print 2022), https://doi.org/10.1175/BAMS-D-21-0218.1.

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