Polar 5 at Longyearbyen airport ready to take off (Photo: M. Schäfer).

Transregional Collaborative Research Center on Arctic Amplification

(AC)³ Newsletter

August 2019
7th Issue

EDITORIAL

Dear Reader,

we actually made it! On 8 July 2019 we submitted our proposal for continuation of the (AC)³ project in a second funding period to the DFG in Bonn. We have put together a strong proposal with a clear plan for phase II and a vision for phase III of (AC)³ based on the achievements of the previous three and a half years. The proposal is the result of an intensive discussion in which the whole (AC)³ team was involved.

Besides the proposal, we had another busy half a year. In January, we performed the PI meeting and the regular biannual General Assembly in Bremen. Here we continued the discussion of the proposal for the second phase of (AC)³, and we presented the outcome and perspectives of the individual projects. In March and April we completed the AFLUX campaign; the third in a row of aircraft missions to study energy fluxes in the marginal sea ice zone close to Svalbard. First data analysis shows interesting contrasts to previous measurements during ACLOUD/PASCAL and PAMARCMiP. In April we convened a Special Session at the EGU in Vienna. 7 oral and12 poster presentations were contributed by members of the (AC)³ team. The PhD students performed an inspiring workshop on "What to do with a PhD – Professional Orientation for PhD students?" in Leipzig in May. Last but not least, in June a "Workshop on Airborne Activities in the Arctic: Science and Prospects" was conducted, again in Bremen. This meeting was attended by a wide international audience.

Besides these activities, several of our PIs and students were actively involved in the "Fridays for Future" or the "Scientists for Future" movements, be it as speakers on student conferences or as active participants of demonstrations. We from (AC)³ consider it a natural commitment to support these actions.
Now let's focus on the evaluation of our continuation proposal taking place in Leipzig on 11-12 September 2019. We will be well prepared to enthusiastically present our case and to convince the reviewers to support our plans for phase II of (AC)³. Let's keep fingers crossed …
By the way: As of 8 July 2019, we published 95 peer reviewed papers. Amazing, isn't it?

Manfred Wendisch, Speaker of (AC)³; Marlen Brückner, Christa Genz, Scientific Coordinator.

TOPICS IN THIS ISSUE

(AC)³ NEWS

- **(AC)³ Vice Speaker Professor Dr. Susanne Crewell was awarded with the Alfred-Wegener-Medal of the German Meteorological Society**

  For her outstanding performances in the research fields of remote sensing of the atmospheric boundary layer and cloud processes, Prof. Dr. Susanne Crewell, University of Cologne, was awarded with the Alfred-Wegener-Medal of the German Meteorological Society. Her scientific work provides, among others, the basis for their use in modern weather forecast. The laudatory speech was given by Prof. Dr. Andreas Macke from TROPOS Leipzig. The award ceremony was held during the annual conference of German, Austrian and Swiss meteorologists (DACH-Tagung) in March in Garmisch-Partenkirchen.

Foto: © DMG, Robert Sausen

CONFERENCE REPORT

(AC)³ @ EGU IN VIENNA 2019

by Marlen Brückner

The European Geosciences Union General Assembly (EGU) took place in Vienna (Austria) from 7 to 12 of April 2019. With about 16,000 participants from 113 countries, of which 53% were under the age of 35 years, this is the biggest geosciences conference in Europe. It consisted of about 5,500 oral presentations, 9,400 posters and 1,300 PICO presentations (Presenting Interactive COntent). Although at first this number of possibilities was overwhelming, we managed to find our way as the week progressed.

In April 2019, the major results of phase I of (AC)³ were presented in a Special Session on 'Clouds, moisture, and precipitation in the polar regions: Sources, processes and impacts'. The session was convened by 3 (AC)³ members. 7 oral (out of 14), and 12 poster presentations (out of 18) were contributed by (AC)³. This Special Session turned out to be a big success, which we plan to continue also in the following EGU conferences.

In addition to the traditional sessions, the EGU is offering multiple other formats like workshops, short courses and Grand Debates. Some of them are especially relevant for early career scientist,

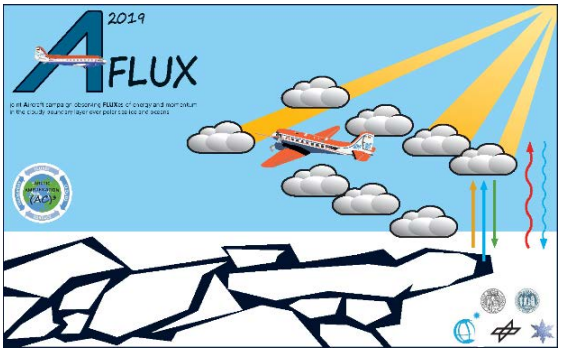
During the EGU there were a lot of possibilities to establish new connections by visiting one of the nice locations in Vienna. EGU gave us the chance to present and share our work with members of the community. The opportunity to discuss our results resulted in a lot of new ideas.

Fig. 1: Some impressions from the EGU 2019 in Vienna. Many (AC)³ members took the chance to present their work achieved within the last years. (Photos: Tilo Arnold).

News from the field

AFLUX CAMPAIGN 2019

by Christof Lüpkes (Cluster Speaker & PI in project A03, AWI Bremerhaven) & the AFLUX team



The 'Airborne measurements of radiative and turbulent FLUXes of energy and momentum in the Arctic boundary layer' (AFLUX) campaign took place in Longyearbyen (Svalbard) from 15 March to 15 April 2019.

AFLUX was a joint project of different German universities and research insititues embedded within (AC)³ and was, after ACLOUD in 2017 and PAMARCMiP in 2018, the third airborne campaign in phase I of (AC)³. 80 flight hours were planned for AFLUX, 62 of them were funded by DFG.

The overall goal of the campaign was to study the impact of clouds on Arctic amplification. We aimed to obtain comprehensive data sets especially of fluxes of energy through clouds as well as of a diversity of atmospheric parpameters including cloud and aerosol particles. These data will help us to quantify the role of clouds in the lower Arctic atmosphere over the Northern Fram Strait. Similar to ACLOUD, our strategy during AFLUX was to measure in, above, and below clouds with a large suite of sensors for in situ and remote sensing observations. With a successful campaign it was influenced to understand the seasonal varaiblity of fluxes, cloud parameters, and cloud related processes since ACLOUD was performed during late spring/early summer. The expected data will serve, e.g., as a basis for the validation of future numerical weather simulations with respect to their ability to represent clouds and their impact on fluxes in the Arctic environment. Furthermore, closure studies relating in situ cloud properties to measurements of cloud top albedo/reflectivity will be performed as well as process studies, e.g., of how aerosol properties may change cloud particles. Alltogether, we could successfully perform 13 scientific flights observing cold air outbreaks, warm air advection, clouds over the marginal sea ice zone and CloudSat/Calipso underfilghts. In the following we would like to briefly report on the highlights of the campaign.

During the first scientific flights it was important to become familiar with the sea ice situation (fraction of thin ice/leads, roughness etc.) and to relate the visual impression to the sea ice maps that are avaiable from different sources. Again, as during ACLOUD, the information made available by the University of Bremen turned out to be helpful for the planning.

The flight program during meteorological campaigns depends strongly on the weather conditions. Two aspects are important: the weather in the region of the main flight operation affecting the scientific flight program, and the weather at the airport. Both aspects imfluenced our flights a lot during the weeks.

MEET THE (AC)³ FELLOWS

Hi everyone, my name is Birte Solveig Kulla. After a Bachelor in Geography with a focus on remote sensing, geomorphology and hydrology, I went to Svalbard to work on the actual glacier instead of looking at satellite imagery only. This is where I fell in love with the Arctic.

During my Master in Climate and Environmetal Sciences my focus shifted towards Climate and a research semester at the Alfred-Wegener-Institute in Potsdam followed. Here, I calibrated a Lidar for water vapour measurements, supported the YOPP campaign with radiosondes from Ny-Ålesund, and wrote my Master thesis on influence factors on the radiative balance during clear state conditions in the polar night. (By the way: It's mostly wind, driving the turbulence, influencing the strength of ground-based inversion and therefor, surface temperature and outgoing longwave radiation.)

In January I started as a PhD-Student at University of Cologne in the project B03. Now, with an airborne lidar, I am characterizing the cloud top, and in combination with the airborne cloud radar, I will derive a cloud classification and look into the mixed phase clouds over the open Arctic Ocean and the marginal Sea Ice Zone.

(AC)³ GUESTS
DR. ALEK PETTY (NASA'S GODDARD SPACE FLIGHT CENTER AND UNIVERSITY OF MARYLAND) AT AWI-POTSDAM

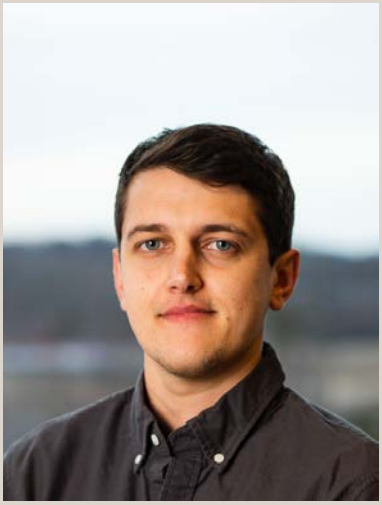
by Annette Rinke, AWI-Potsdam (Cluster Speaker D & PI)

Dr. Alek Petty visited the regional modeling group (A. Rinke & colleagues) at the Alfred Wegener Institute, Helmholtz Center for Polar and Marine Research (AWI) in Potsdam from 16-17 July 2019.

He is an Assistant Research Scientist at NASA's Goddard Space Flight Center and the University of Maryland. Dr. Petty researches Arctic and Antarctic sea ice variability and its interactions with the atmosphere and ocean using remote sensing data and climate models. He is a member of NASA's Operation IceBridge and ICESat-2 project science offices.

He gave a seminar on 'New estimates of Arctic sea ice thickness from NASA's ICESat-2 mission'.

We discussed overlapping interests and projects (ours are associated with (AC)³ projects D03 and E04) related to Arctic atmospheric-sea ice variability, including polar precipitation and Arctic cyclones/polar lows and their linkages with Arctic sea ice variability. Furthermore, we discussed plans for coordinated modelling efforts related to the Arctic-CORDEX model intercomparison project and the upcoming MOSAiC campaign in the Arctic.



News from the field
AFLUX CAMPAIGN 2019 (continued)

On the 25 March the flight conditions were ideal for observing a cold air outbreak. We went first to a position west of Svalbard over Fram Strait, and followed then roughly the direction of convective rolls to the North. Such rolls mostly form during of-ice flow in cold conditions and - as we learned during the former (AC)³ campaign ACLOUD - even when the difference between air and the surface temperature over open water is in the range of only 5-10 degrees. These rolls with their specific flow patterns exist already over the marginal sea ice zone and are shown in the photo. A study of their impact is important for different aspects such as the energy fluxes. We could clearly identify them during the flight, e.g. in the cloud radar and different camera systems so that we can analyse e.g., their characteristic increase of their width (apsect ratio) with increasing distance to the ice edge.

Fig. 2: Convection rolls observed during a cold air outbreak onboard of Polar 5.

In the third week we had much luck with the flight conditions and could carry out five flights to the west and north of Svalbard. While the first two weekss were influenced by the fast passage of lower pressure systems, the third week was characterized by a low that remained almost stationary in the east of Svalbard and causing a longer period of cold air outbreaks over Fram Strait.

One of our goals is to compare in situ measrements with satellite observations and we could manage one flight following excactly the track of CloudSat over Fram Strait.

As our flights strongly depend on the weather prediction, it was interesting to see how different models predict the passage of a strong warm front. This event was predicted by all forecast models, considered during our campaign, but details as the predicted time of the passage of the front, cloud cover and connected precipitation, as well as gustiness differed strongly among all available models, especially when more then one-day prediction time was considered. The uncertainty of the prediction documents the importance of model improvements and the relevance of data that we are sampling.

AFLUX CAMPAIGN 2019 (continued)

The passage of the front was finally accompanied by strong wind and snowfall so that we used the opportunity for a day-off. After a talk of Susanne Crewell on our (AC)³ project at UNIS we have been invited by UNIS to visit the Kjekk Henriksen Observatory located on a mountain near Adventdalen. This turned out to be an interesting excursion where we learned a lot about the instrumentation for Aurora observations and the related work by UNIS scientists.

Already now it is obvious that we have achieved many intersting results, although the schedule allowed only a very preliminary look into the data, whose analyses will need at least a full year. The data will form an important basis for the planned second phase of (AC)³ and the upcoming MOSAiC and HALO flight campaigns.

To summarize, we had a successful campaign and reached many of our goals. We are looking forward to the detailed data analysis. We would like to thank the AWI logistic team and the pilots for the great support.

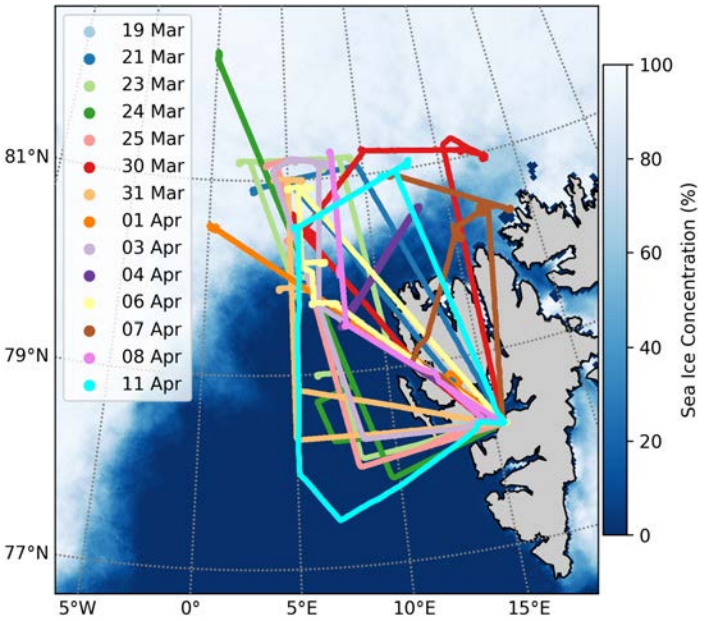
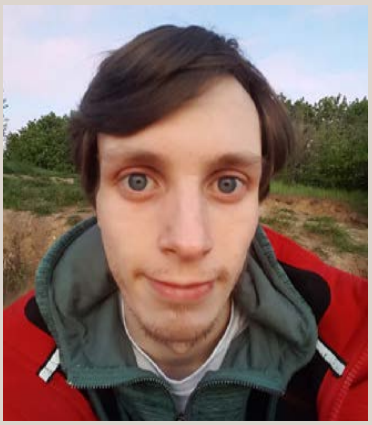


Fig. 3: Left: Our trip to the Kjell Henriksen Sation. The final road to the sation cloud not be used by normal cars. Right: Flight patterns of all research flights with Polar 5 with underlying sea ice concentration.

MEET THE (AC)³ FELLOWS



I'm Enrico and a new PhD of the (AC)³ project. My main topic is the stability of the Arctic Ocean stratification and how it's changes contribute to Arctic Warming.

This topic is quite far away from my meteorological studies at University of Leipzig where I obtained my bachelors and masters degree. Originally I'm from Radebeul/Dresden and I've been fascinated in things related to weather and astronomy all my life.

(AC)³ NEWS

- Announcement - **Evaluation of (AC)³** in Leipzig, 11 to 12 September 2019. Further details at http://www.ac3-tr.de/meeting/evaluation-of-ac³/
- Our Special Issue in ACP/AMT is now open for submission. Please check out https://www.atmos-chem-phys.net/special_issue971.html
- Stay informed: if you want to receive this newsletter regularly, you can subscribe online at http://ac3-tr.de

Workshop report

FOLLOW-UP WORKSHOP ON AIRBORNE ACTIVITIES IN THE ARCTIC: SCIENCE AND PROSPECTS IN BREMEN

After the first „Workshop on Airborne Activities in the Arctic: Science and Prospects" performed in Leipzig, 5-6 October 2017, we have invited project members, and several national and international collaborators to a follow-up meeting in Bremen from 3-5 June 2019. There were two objectives of this meeting: to generally review the research needs in the Arctic and the plans to address them with airborne campaigns for the years to come (including collaborations), and to more specifically plan airborne efforts related to MOSAiC and $(AC)^3$.

On the last day, our project member Andreas Herber took the participants on a sightseeing tour to the hangar of Bremen airport, where the two AWI aircraft Polar 5 and Polar 6 are stationed. Although the sight of the airplanes is well known to some of us, it is always impressive and fascinating to get in close contact with the working tool in the Arctic. Thanks to the Bremen AWI hangar crew for the insight into the technology and some interesting stories around the campaigns in the harsh conditions in the Arctic.

Fig. 5: Some impressions from the hangar sightseeing tour after the workshop. Pictures from M. Schäfer.

MEET THE $(AC)^3$ FELLOWS

I am Michael Lonardi, "The new Matthias", and I come from Verona, Italy (Editor's note: Matthias Gottschalk is the former PhD student in project A02 in phase I). I did my bachelor in Physics at the University of Trento and then I began my master in meteorology at Uppsala University, in Sweden.

During my master I had the opportunity to go to Svalbard as a guest student for four months, that somehow became 14. During that time, I wrote my master thesis about wind channelling in the area of Longyearbyen, and I worked two months in a measurement campaign with a tethered balloon. I also participated in other smaller campaigns covering different topics (oceanography, geology, ecology, glaciology) and have been a nature guide, as I love the feeling of doing fieldwork in the Arctic. It shouldn't surprise then that I am part of the project A02 of $(AC)^3$. I began my PhD in Leipzig in January and since then I am improving the existing broadband radiation package with the aim of using it on the tethered balloon platform BELUGA during the 4th leg of MOSAiC, in spring 2020. I will use the campaign data to investigate the impact of cloud microphysics on radiative transfer.

PhD students workshop in Leipzig
WHAT TO DO WITH A PHD?

by Tobias Donth, University of Leipzig (project C02)

On 16 and 17 May 2019 a workshop dealing with future perspectives after finishing our PhDs was held at the Institute for Meteorology in Leipzig. The lecturer for this workshop was Dr. Gaby Schilling from the company KEPOS. 22 PhD students were attending this workshop.

Since phase I of (AC)³ is coming to an end, the main goal of this workshop was to think about the future perspectives and to gain knowledge about possible career pathways. To reach these goals, Gaby Schilling tackled various topics. In the beginning, the question was raised of what we learned during our time as PhD students – what skills and knowledge have we gained and how could these skills be translated and transferred to fulfill requirements possible future employers impose to us. We have analyzed various job advertisement to get a general idea in which areas we would like to work. Afterward, Gaby Schilling gave an overview of different jobs in the public and private sector and how jobs and personality relate to each other. In the evening, invited guests – former PhD students – were giving us an overview of their career pathways. On the second day, we learned more about values and motivators for a future job and we were tasked to think about, what we don't want to do in the future. In the end, everybody tried to make a plan for the next steps in terms of a future career. The closure of this workshop was held by the speaker of (AC)³ Manfred Wendisch.

Overall it was a very nice workshop where we had to think about what we can do and what we like to do in the future and we got a nice overview of possibilities. We would like to thank Gaby Schilling for teaching this nice workshop, all of our guest that they took their time to tell us about their careers as well as (AC)³ for funding this workshop.

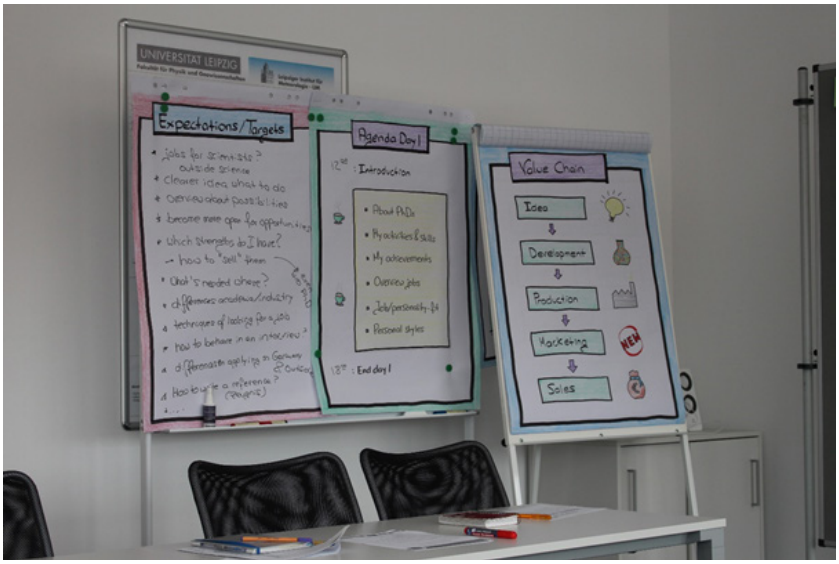


Fig. 6: A lot of flipcharts were used to illustrate and show possible further career opportunites (Photo: Tobias Donth).

MEET THE (AC)³ FELLOWS

Hello, my name is Sora Seo and I'm a new member of (AC)³-MOSAiC project. I got a bachelor and master degree in atmospheric science at Yonsei University in Seoul, South Korea and started my PhD study at University of Bremen in September 2016.

Before joining the (AC)³-MOSAiC project, my doctoral project is to develop an advanced algorithm for the detection and quantification of bromine monoxide (BrO) columns using Sentinel-5 Precursor satellite data. Since bromine compounds play an important role as a catalytic element in destroying ozone, monitoring temporal and spatial variations of BrO is important in understanding atmospheric chemical mechanisms. In particular, satellite BrO observations have shown huge areas of enhanced BrO covering several thousand km^2 over the Arctic and Antarctic sea ice region in polar spring.

Based on my previous working experiences, I will study atmospheric physical and chemical phenomena occurring over the Arctic using comprehensive atmospheric measurements obtained from the MOSAiC campaign combined with the Sentinel-5 Precursor products with high spatial resolution and excellent signal to noise.

ACKNOWLEDGEMENTS

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DFG Deutsche Forschungsgemeinschaft

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(AC)³ Publications

THE ARCTIC CLOUD PUZZLE: USING ACLOUD/PASCAL MULTI-PLATFORM OBSERVATIONS TO UNRAVEL THE ROLE OF CLOUDS AND AERSOSOL PARTICLES IN ARCTIC AMPLIFICATION

Abstract

Clouds play an important role in Arctic amplification. This term represents the recently observed enhanced warming of the Arctic relative to the global increase of near-surface air temperature. However, there are still important knowledge gaps regarding the interplay between Arctic clouds and aerosol particles, and surface properties, as well as turbulent and radiative fluxes that inhibit accurate model simulations of clouds in the Arctic climate system. In an attempt to resolve this so-called Arctic cloud puzzle, two comprehensive and closely coordinated field studies were conducted: the Arctic Cloud Observations Using Airborne Measurements during Polar Day (ACLOUD) aircraft campaign and the Physical Feedbacks of Arctic Boundary Layer, Sea Ice, Cloud and Aerosol (PASCAL) ice breaker expedition. Both observational studies were performed in the framework of the German Arctic Amplification: Climate Relevant Atmospheric and Surface Processes, and Feedback Mechanisms (AC)³ project. They took place in the vicinity of Svalbard, Norway, in May and June 2017. ACLOUD and PASCAL explored four pieces of the Arctic cloud puzzle: cloud properties, aerosol impact on clouds, atmospheric radiation, and turbulent dynamical processes. The two instrumented Polar 5 and Polar 6 aircraft; the icebreaker Research Vessel (R/V) Polarstern; an ice floe camp including an instrumented tethered balloon; and the permanent ground-based measurement station at Ny-Ålesund, Svalbard, were employed to observe Arctic low- and mid-level mixed-phase clouds and to investigate related atmospheric and surface processes. The Polar 5 aircraft served as a remote sensing observatory examining the clouds from above by downward-looking sensors; the Polar 6 aircraft operated as a flying in situ measurement laboratory sampling inside and below the clouds. Most of the collocated Polar 5/6 flights were conducted either above the R/V Polarstern or over the Ny-Ålesund station, both of which monitored the clouds from below using similar but upward-looking remote sensing techniques as the Polar 5 aircraft. Several of the flights were carried out underneath collocated satellite tracks. The paper motivates the scientific objectives of the ACLOUD/PASCAL observations and describes the measured quantities, retrieved parameters, and the applied complementary instrumentation. Furthermore, it discusses selected measurement results and poses critical research questions to be answered in future papers analyzing the data from the two field campaigns.

Wendisch, M. et al., 2019: The Arctic Cloud Puzzle: Using ACLOUD/PASCAL Multi-Platform Observations to Unravel the Role of Clouds and Aerosol Particles in Arctic Amplification**, Bull. Amer. Meteor. Soc., 100 (5),** 841–871, doi:10.1175/BAMS-D-18-0072.1

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