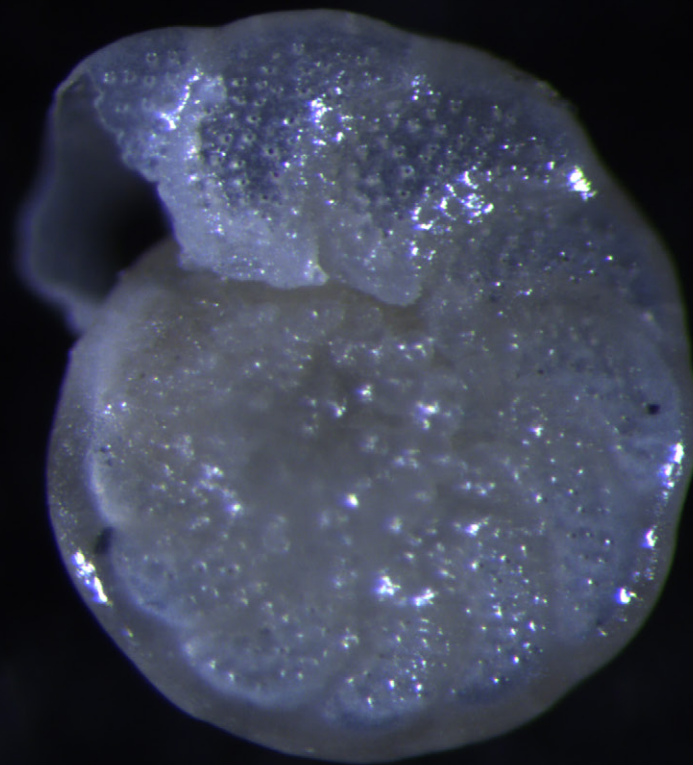


Bolin Centre for Climate Research

Report 2018



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Bolin Centre Vision

Our vision is the Bolin Centre as the nationally leading and an internationally recognised centre for interdisciplinary climate research and a primary Swedish contact point for scientists, media and the public on issues relating to the past, present and future climate.

Bolin Centre Mission

The mission of the Bolin Centre is to create and communicate fundamental knowledge about climate and the Earth system as part of an evolving global effort to understand and adapt to the Earth’s changing climate.

Front page: Foraminifera. Photo: Helen Coxall

Contents

The Bolin Centre for Climate Research	4
Bolin Centre organisation	6
Director’s corner	8
Ocean-atmosphere dynamics and climate	10
Clouds, aerosols, turbulence and climate	12
Hydrosphere, cryosphere and climate	14
Biogeochemical cycles and climate	16
Historical to millennial climate variability	18
Deep time climate variability	20
Landscape processes and climate	22
Biodiversity and climate	24
The Bolin Centre Climate Research School	26
The Bolin Centre Database	28
Bolin Centre modelling	30
The Bolin Centre mentoring programme	32
Bolin Centre coordination & communication	34
The Bert Bolin Climate Lecture	36
The Bolin Centre board	38
The External Science Advisory Group	40
Appendix 1: Facts & figures	42
Appendix 2: Publications	48
Appendix 3: Contact information	66



Photo: Niklas Björling

The Bolin Centre for Climate Research

The Bolin Centre is a multi-disciplinary consortium of more than 350 scientists in Sweden who conduct research, graduate education and outreach related to the Earth's climate. It was formed and comprise in 2006 of Stockholm University, the KTH Royal Institute of Technology and the Swedish Meteorological and Hydrological Institute (SMHI). The Bolin Centre is named in honour of Professor Bert Bolin of Stockholm University, a world leader in climate and carbon cycle research.

The Bolin Centre focuses on extending and disseminating knowledge about the Earth's natural climate system, climate impacting processes, climate modelling, human impact on the climate and climate impacts on ecosystems, biodiversity and humanity as well as how society can minimise the negative impacts of climate change. It contributes to the knowledge base for climate mitigation and adaption policies nationally and internationally.

The Bolin Centre is named after Professor Bert Bolin of Stockholm University, one of the founders of the Intergovernmental Panel on Climate Change (IPCC). Publication of the first IPCC report led to the recognition of the need for cross-disciplinary collaboration on climate science at Stockholm University. This resulted in a Climate Research School being established in 2005 and shortly thereafter the research program SUCLIM (Stockholm University Climate Research Centre) being awarded a 10 year Linneaus grant from the Swedish government in 2006.

In 2008, SUCLIM was renamed the Bert Bolin Centre for Climate Research, a name which was shortened to the Bolin Centre for Climate Research in 2013. From 2010, the Swedish Hydrological and Meteorological Institute (SMHI) and the KTH Royal Institute of Technology joined the Bolin Centre in a collaboration aimed at strengthening climate modelling within the centre. This initiative was funded as a strategic research area (SFO) by the Swedish government.

In June 2016, the Bolin Centre merged with another strategic research area at Stockholm University: EkoKlim – A multiscale, cross-disciplinary approach to the study of climate change on natural resources, ecosystem services and biodiversity. This merger widened the scope of the Bolin Centre to include the impacts of climate change on landscape processes and biodiversity.

Following this merger, the combined SFO funding of the Bolin Centre exceeds 30 MSEK annually.

Partners



www.bolin.su.se

Bert Bolin (1925–2007): A world leading scientist and science organiser

Bert Bolin joined the newly created Department of Meteorology at Stockholm University¹ in 1948 as an assistant to Professor Carl-Gustaf Rossby. With short intervening periods, Bert Bolin remained an active member of the department staff until his death in 2007.

During a productive period as Rossby's student he wrote several fundamental papers on atmospheric circulation and on the basic principles for numerical weather prediction. After he received his PhD in 1956, he broadened his interests to include studies of biogeochemical cycles of key life elements. This became the introduction to his world leading research on the carbon cycle in the atmosphere, oceans and biosphere.

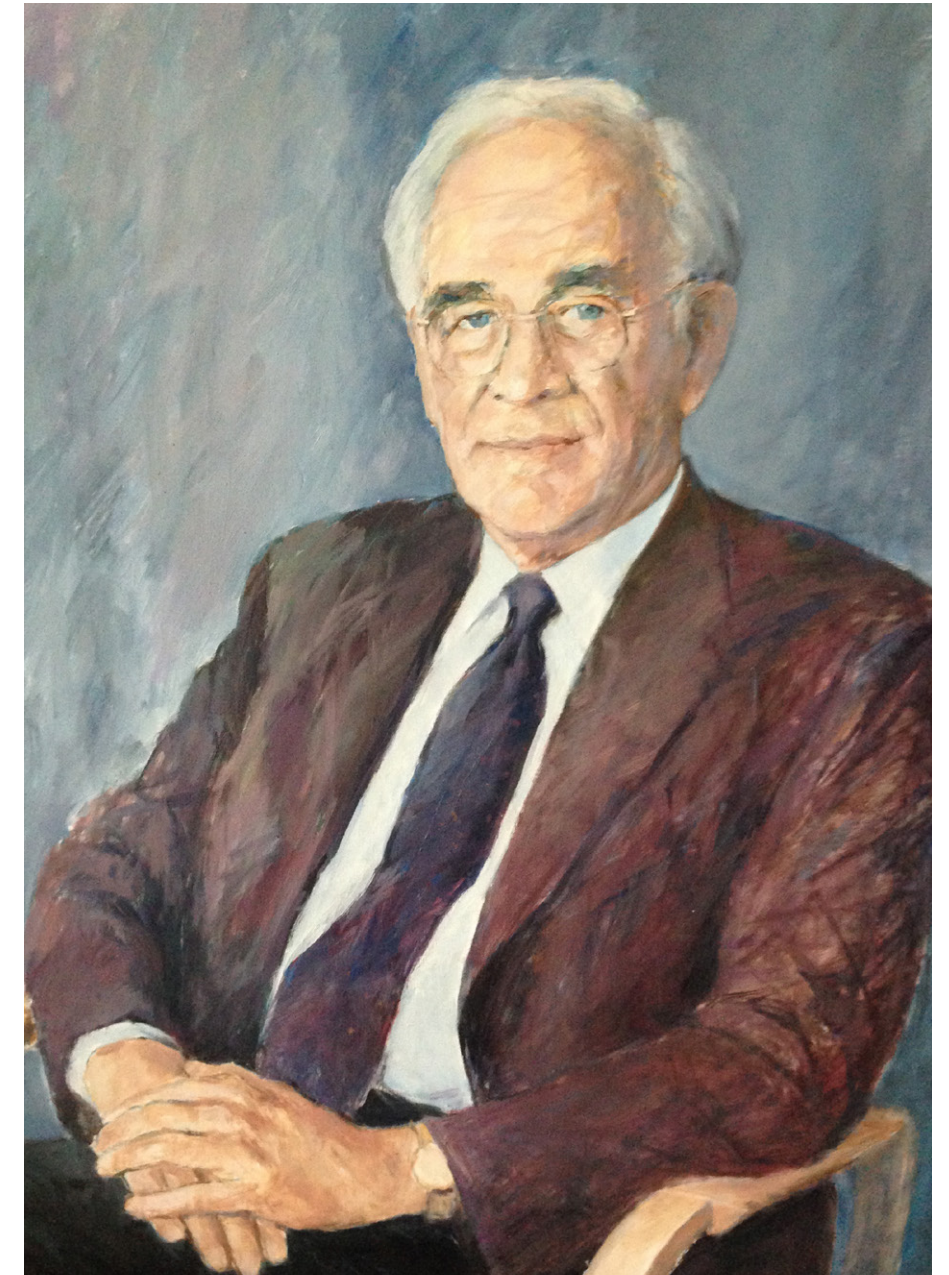
Bert Bolin was not only a prominent scientist. His role as an inspirer and organiser of international climate research has been of outstanding importance. Due to his broad and deep scientific knowledge, his unusual ability to see the big picture, his eminent ability to express himself orally and in writing, and his diplomatic talent, he became the natural leader. He initiated several research programmes focusing the global environment including the World Climate Research Programme (WCRP) and the International Geosphere-Biosphere Programme (IGBP).

Bert Bolin's most important achievement was his contribution to the formation and development of the Intergovernmental Panel on Climate Change (IPCC) under the UN. He chaired this panel during its first ten years (1988–1997). His extremely important role as the founder and initial leader of IPCC has been testified by many. IPCC received the Nobel Peace Prize in 2007.

The legacy of Bert Bolin remains alive among climate scientists at Stockholm University and at many other places through the inspiration that he brought about with lectures, supervision, his scientific approach and his engagement to make research results available to policy makers and the public.

*Henning Rodhe
Bert Bolin's student, colleague and friend*

¹Stockholm University was formed 1960 from Stockholms Högskola, which was founded 1878.



The Bolin Centre for Climate Research is named in honour of Professor Bert Bolin of Stockholm University, a leader in climate and carbon cycle research and one of the founders of the Intergovernmental Panel on Climate Change (IPCC) which received the Nobel Peace Prize in 2007. Painting and photo by Carin Adler.

Bolin Centre organisation

The Bolin Centre aims to bring climate scientists together. The centre comprises eight cross-disciplinary research areas, within which scientists from different disciplines join together to tackle key questions about climate. The Bolin Centre organises regular seminars, workshops, conferences, outreach projects, summer schools and mentoring.

www.bolin.su.se/about-us



Research Area 1

Ocean-atmosphere dynamics and climate

Research Area 2

Clouds, aerosols, turbulence and climate

Research Area 3

Hydrosphere, cryosphere and climate

Research Area 4

Biogeochemical cycles and climate

Research Area 5

Historical to millennial climate variability

Research Area 6

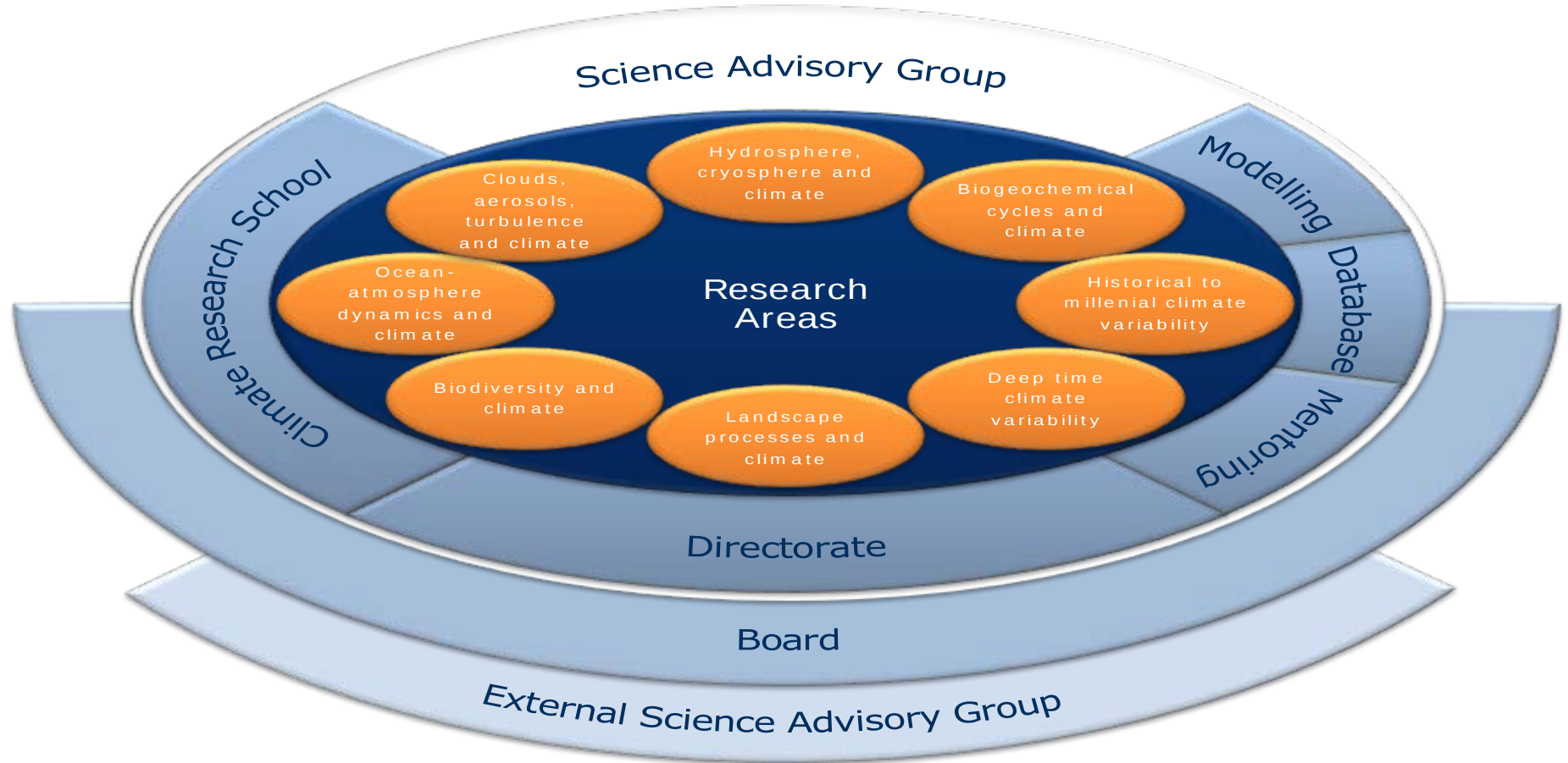
Deep time climate variability

Research Area 7

Landscape processes and climate

Research Area 8

Biodiversity and climate



The Bolin Centre is built around its eight multi-disciplinary research areas, each of which is led by two (or three) scientists. The centre hosts a research school and an open access database as well as it provides communication support and support for climate modelling activities. There is also a mentoring programme which is open to all of its members and a journal club for its postdoctoral community.

The directorate comprises two co-directors and two communicators and coordinators, who share the day-to-day tasks of centre operations. All research area co-leaders, coordinators and the directorate meet regularly in the Science Advisory Group (SAG), working to facilitate excellence in climate-related science conducted by the Bolin Centre members.

The Bolin Centre is led by its board, which includes heads of participating departments at Stockholm University, representatives from KTH Royal Institute of Technology and the Swedish Hydrological and Meteorological Institute (SMHI), and external members. The Bolin Centre receives guidance from its External Science Advisory Group (ESAG). These internationally recognised leaders in climate science visit the Bolin Centre annually at its internal conference: the Bolin Days.

The operational philosophy of the Bolin Centre is one of mutual respect and trust – a philosophy which is reflected in the form of paired leadership which is applied throughout the organisation.

Director's corner

The Bolin Centre has evolved from an idea among a few inspired individuals to a thriving node embracing more than 350 scientists focusing on science, education and outreach related to the Earth's climate. The Bolin Centre is a common effort, and its success is the success of its members.

We would like to express our continued gratitude to our members for making the Bolin Centre an internationally recognised environment for excellence in climate research, education and outreach.

With 2015–2018, each listed among the warmest four years since 1880, we seek inspiration in Bert Bolin's own words: "serious – but not hopeless". The science produced and communicated by the Bolin Centre and its members is a vital part of the fight against climate change. Our role in the global challenge, expressed in the words of the 2018 Bert Bolin Climate Lecturer Professor Veerabhadhan Ramanathan to "bend the curve" of climate change – is to ensure that actions aimed at bending this curve are grounded in fundamental scientific knowledge.

From 2018, we, above all, want to highlight the excellent scientific productivity of our members (see "Appendix 2: Publications" on page 48).

We also want to mention:

- Our mentoring program and journal club both of which continue to grow in popularity.

- The 10th Bolin Days with record attendance levels.
- The Climate Festival which continues to disseminate knowledge about climate change and attracted more than 1200 visitors and the educational public service broadcaster UR, recording 10 public lectures.
- Stockholm University's new Masters in Climate Science, which was created by the Climate Research School.
- Our friends on Öland who have created Bolinleden – a 10km coast-to-coast walking route near Bert Bolin's summer house.
- An extended collaboration with the Museum of Natural History (Naturhistoriska Riksmuseet, NRM), which we look forward to continue, both regarding science and education.

And starting in 2019:

- Climate Change Solutions, a cross-faculty undergraduate course.
- Arctic Avenue, a 3-year strategic collaboration with the University of Helsinki.

Co-directors



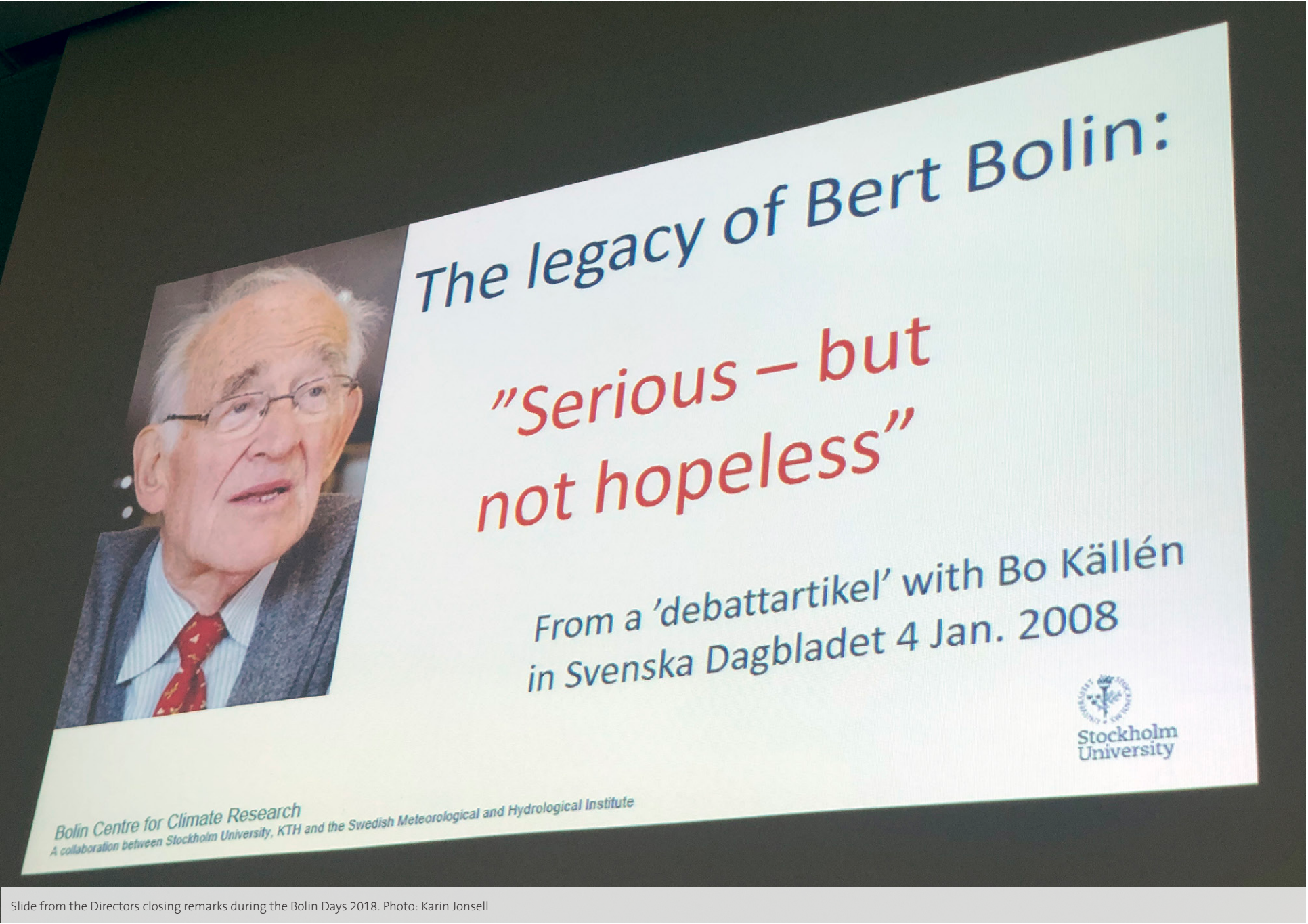
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***Alone I go faster, but
together we go further***

African wisdom



Slide from the Directors closing remarks during the Bolin Days 2018. Photo: Karin Jonsell

Ocean-atmosphere dynamics and climate

We do fundamental research on the dynamics of the atmosphere and oceans and their influence on climate. We apply and develop theory and conceptual models to gain insight into the underlying mechanisms that govern the oceanic and atmospheric circulation. This understanding is then used to interpret observations and simulations using complex global climate models aimed at understanding past and present climates as well as to predict future climate change.

Resources

Research Area 1 (RA1) received 400 kSEK in 2018. The resources were used to organize and co-fund three highly successful workshops. In addition, RA1 supported research activities, such as field work and conference attendance, through two openly announced calls.

Activities

RA1 organised three international workshops. The first workshop held in June 2018, was on the Miocene Climate and was organised together with RA6. About 12 international speakers were invited and a workshop paper on the Miocene is in progress. The second workshop focussed on the physics of Stormtracks and it brought together scientists representing various communities to explore how insights from their different perspectives may be integrated, and to identify opportunities for testing different mechanistic storylines quantitatively. The third workshop held in October 2018 was on Arctic climate and

brought together international experts who do basic research on the Arctic Ocean circulation.

RA1-scientists contributed to the 6th Coupled Model Intercomparison Project (CMIP6) organised by the World Climate Research Project (WCRP), by developing new versions of the EC-Earth and MPI-ESM models and performing the first CMIP6-designed simulations including historical simulations. These simulations will be an important contribution for the next IPCC 6th Assessment Report.

Awards and Grants:

One of our scientists, Gabrielle Messori, received the EUG Outstanding ECS Award of the Climate Division. RA1 leader, Agatha de Boer, gave an invited seminar at the prestigious Crafoord prize symposium where Susan Solomon and Syukuro Manabe received the prize. Scientists from RA1 were successful with several European H2020, European Research Council, Swedish Research Council, and Formas grants.

Co-leaders



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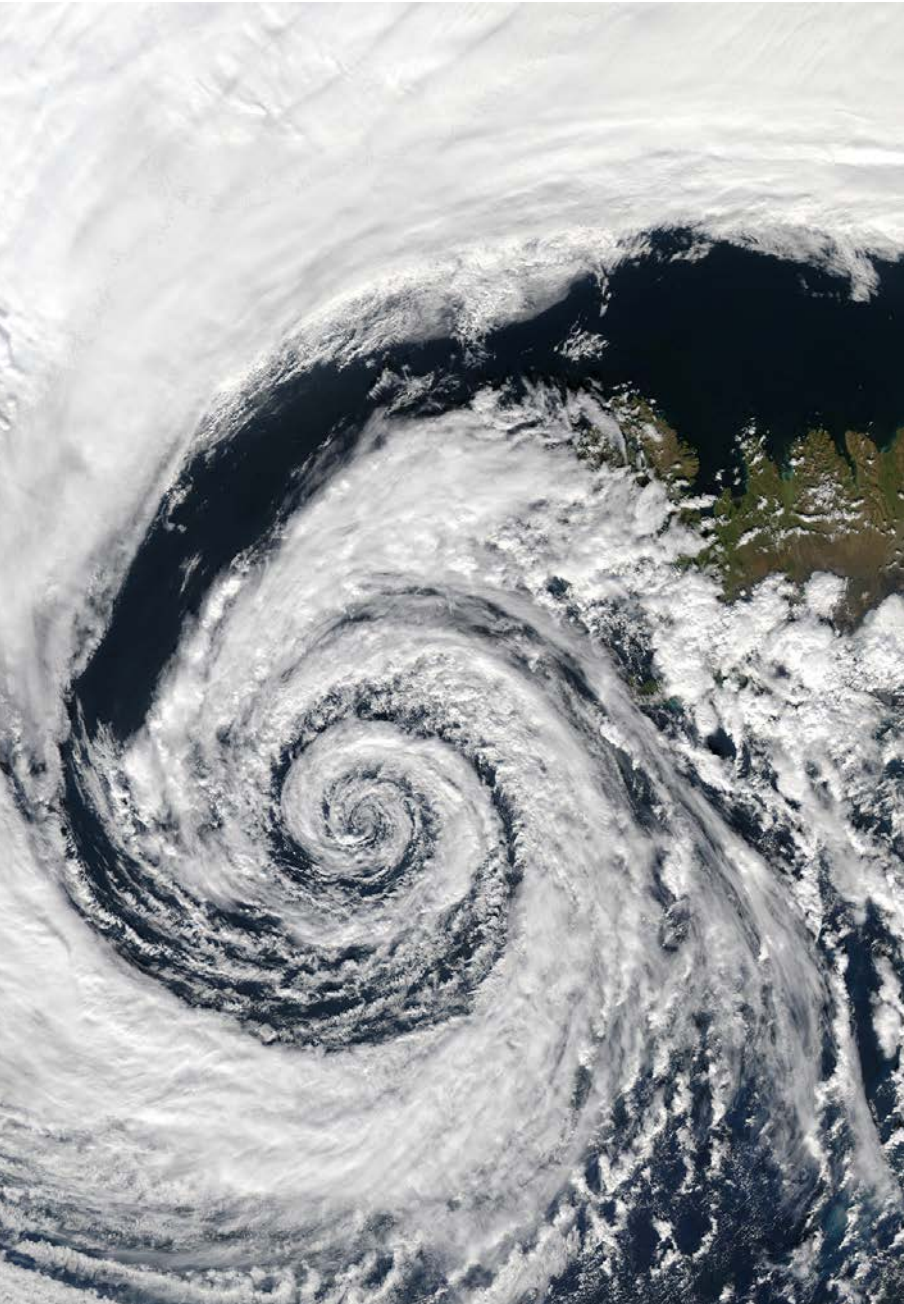
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A typical weather situation in the Southern Alps of New Zealand with a moist, westerly airflow pushing over the main Divide to create a typical foehn wind pattern (locally called Nor'Wester) in the region. It also shows how the glaciation of the central Southern Alps is influenced by the availability of moisture and the dynamic character of the regional climate. Photo: Stefan Winkler



Rapid sea ice formation along the Swedish east coast at Bråviken in the Baltic Sea. Photo: Torben König



Low pressure system over Iceland. Photo: Courtesy of NASA

Clouds, aerosols, turbulence and climate

We investigate the role of clouds, turbulence and aerosols in the climate system and develop approaches for representing them in large-scale models.
We use experimental data from detailed laboratory experiments, extensive field campaigns and long-term observations, in combination with models ranging from molecular-scale to fully coupled Earth system models.

Clouds, aerosols and their interactions with each other and with the climate remain the main uncertainty in future climate projection. Within Research Area 2 (RA2), we work across scales to improve understanding, observation and model representation of these highly important processes.

The Arctic, with its rapidly changing climate is a focus area for many RA2 researchers, and during summer 2018 several RA2 members participated in the research expedition Arctic Ocean 2018. The icebreaker Oden, that was moored to a large ice floe for a month, hosted the Microbiology-Ocean-Cloud-Coupling in the High Arctic (MOCCHA) campaign, as well as representatives for the Arctic Climate Across Scales (ACAS) project. With a focus on the complex interactions between the life cycles of marine microbial particles and clouds, and their impact on sea ice and climate, measurements were made, and samples taken from air as well as water and ice. RA2 funds were used to support several projects related to the expedition.

During 2018, RA2 has additionally supported research and collaboration within the research area in several ways. Our continual call for proposals from RA members has resulted in funding for a wide range of activities: we have sent PhD students and young researchers to present their research at international conferences and to participate in summer schools and supported research visits at foreign institutions and provided funds for international guests and workshops arranged by RA members.

RA2 research has resulted in numerous articles in peer-review journals, and led to several successful funding applications during the year, including grants from the Swedish Research Council (VR), Swedish Research Council for Sustainable Development (Formas) and EU Horizon 2020.

Co-leaders



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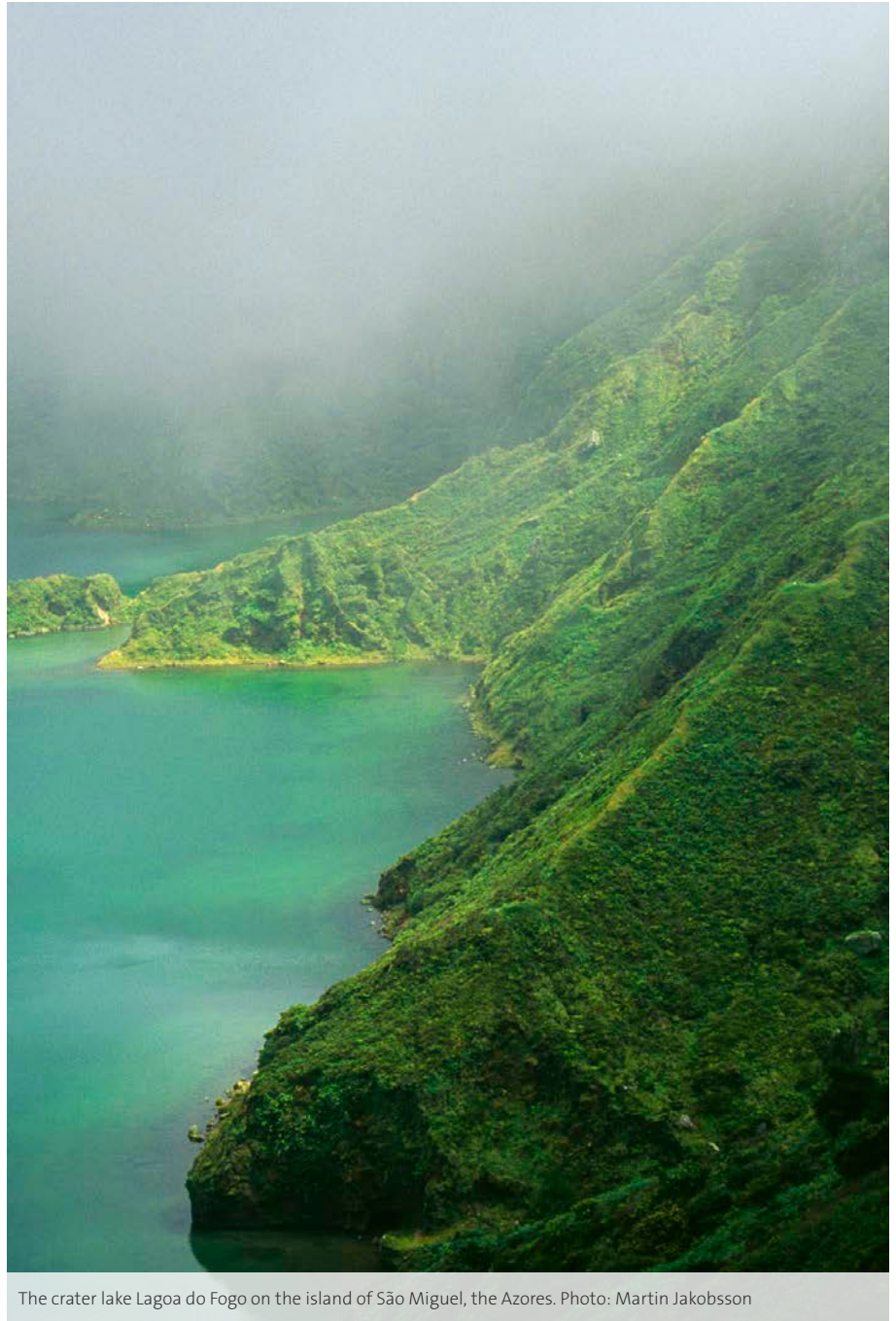
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Weather experiments in the Arctic. Photo: Michael Tjernström



Icebreaker *Oden* in the Arctic. Photo: Michael Tjernström



The crater lake Lagoa do Fogo on the island of São Miguel, the Azores. Photo: Martin Jakobsson

Hydrosphere, cryosphere and climate

Water circulation at or near Earth’s surface occurs by rainfall, evapotranspiration, surface water and groundwater flows. Frozen water forms snow cover, glaciers, ice sheets and permafrost. We study couplings between water in all physical states and climate systems. This includes effects of natural or man-made changes in land cover, vegetation and water flow paths. We also explore the effects of climate change on water-borne flows of substances including contaminants.

Fernando Jaramillo (Department of Physical Geography), an expert on hydroclimatology and hydrology, became part of the Research Area 3 (RA3) leadership, while Arvid Bring stepped down at the end of the year.

In RA3 we focused our funding scheme on helping a range of smaller initiatives to get started through an open call for seed money early in the year. We funded research projects focused on both field sampling and long-term analysis of the glazier impacted Tarfala catchment in northern Sweden and projects on the status of water resources in Iran and eutrophication in China. We also supported development of important instrumentation in the form of a low-cost drone platform that will help scientists monitor natural environments as high-resolution 3D point clouds. We furthermore supported research visits to the Oak Ridge National Laboratory that resulted in plans for future collaboration on biogeochemical transport and catchment-scale hydrology in permafrost settings.

Besides the support from the RA3 funding, our members also secured funding from other sources such as STINT (to starts a collaboration between The Unit and the Jet Propulsion Laboratory NASA, California) and Formas.

Outreach is an important part of the scientific work. Research on ikaite columns in the Ikka fjord in Greenland, a project supported by RA3, was shared through a popular science article in Geologiskt Forum. RA3 members also started outreach projects both in Stockholm and Italy “La Terra è Viva – Viva la Terra!” (The soil is alive – Hurrah for the soil) connecting to kindergarten and school children.

In March we hosted the RA3 Bolin Centre seminar where Terry D. Prowse from the University of Victoria gave a review on the Arctic Freshwater Synthesis and later this year Tom Gleeson, also from the University of Victoria talked about how groundwater is actually connected to other Earth systems.

Co-leaders



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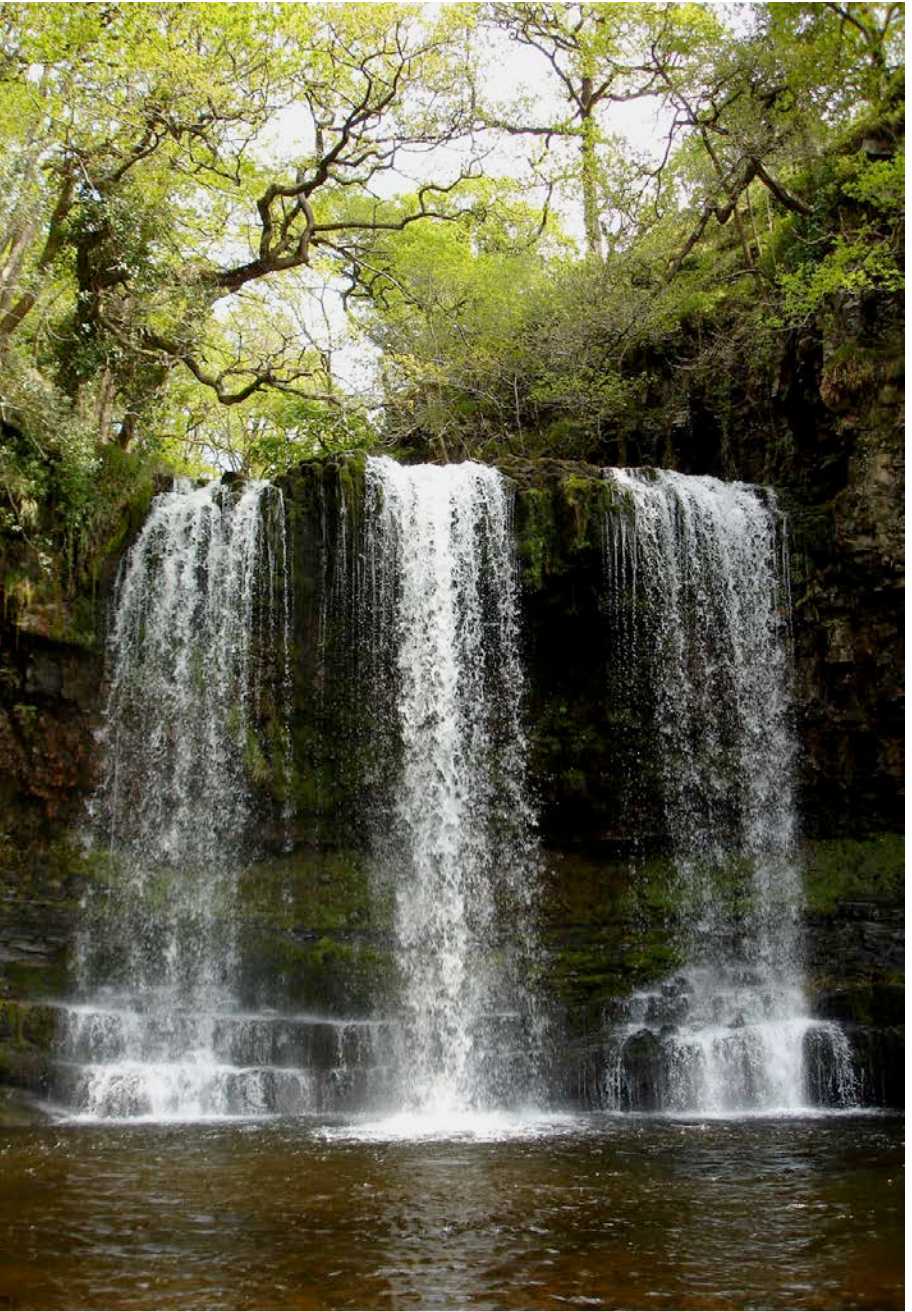
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Eemu Ranta and Paul Seaman at the Ikka fjord in Greenland. Photo:Erik Sturkell



Ikait Pillars in the Ikka fjord in Greenland. Photo: Eemu Ranta



Waterfall near Cwm Porth in the Brecon Beacons National Park, Wales. Photo: Karin Jonsell

Biogeochemical cycles and climate

We study interactions between climate and carbon-nutrient cycles through Earth system modelling, experimental and observational studies. Questions include: How much carbon dioxide and methane will be released from thawing permafrost on land and under the sea? How efficiently are carbon and nutrients used at the organism level to the global scale and across environmental and climatic gradients?

Our observational focus is on key climate impact components of the Earth's system in higher latitudes. These include studies on permafrost, wetlands, subarctic lakes, arctic rivers, marine-terminating glaciers, and the coastal zone.

Current efforts include continuous-ship-based monitoring of atmospheric and surface water concentrations of methane and carbon dioxide in the Arctic Ocean and land-coast interactions in the Baltic Sea, Siberia, and the northern Greenland coast. We construct new maps of wetlands to support the next global budget of methane fluxes. Global data on soil carbon, ecosystem productivity, and climate are combined to investigate broad-scale and long-term patterns of carbon turnover.

We collaborate with several international groups to improve existing Earth system model structures to better describe soil carbon sensitivity to global warming. Current modelling efforts focus on the development, validation, and use of dynamic models to understand the global carbon cycle.

We have initiated a new research project with the goal to derive improved, empirically constrained methane and carbon dioxide balances for the marine inshore region. The proposed effort focuses on the inshore, shallow-water Baltic coast and will be of use not just for a model system in the Baltic Sea region, but also for other coastal regions, and for global assessments of coastal trace gas fluxes.

A continuing focus of several research groups is the potential CH₄ release from terrestrial, limnic and marine Arctic and subarctic environments, such as thawing terrestrial and submarine permafrost and destabilising gas hydrates.

A second major research topic is land-to-ocean carbon and nutrient fluxes in the Arctic. On a research expedition planned for the coming summer we will study the impact of subglacial runoff for the nutrient and carbon budget of a major marine terminating glacier in northern Greenland. These efforts address the fate of transported carbon and nutrients to the Arctic shelf seas and the potential for Arctic ocean acidification.

Co-leaders



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Base camp during a field campaign in the Arctic. Photo: Gustaf Hugelius



Julia Steinbach working on icebreaker *Oden* during the Swerus C3 expedition. Photo: Emma Karlsson



Swedish icebreaker *Oden* at the SWEDARP 2008/2009 Oden Southern Ocean expedition. Photo: Björn Eriksson

Historical to millennial climate variability

We reconstruct past climate evolution by investigating natural records such as marine, lake and terrestrial sediment cores, ice cores, cave deposits, tree rings, landforms and historical documents. By developing appropriate statistical methods and comparing with climate model simulations, we aim to better understand and interpret past climate variability on historical and millennial timescales.

Research Area 5 (RA5) invited Antonio Martínez Cortizas (University of Santiago de la Compostela, Spain) and Guido Vettoretti (University of Copenhagen, Denmark) to give a RA5 seminar lecture on “Climates hidden in Peat” and “The Role of Atmosphere-Ice Sheet Interaction on Glacial Millennial-Scale Climate Variability”.

Qiong Zhang was invited to give talks at the Fudan University, China; and Chinese Academy of Sciences, Xian, China during July 2018. Frederik Schenk was invited to give a presentation at the GFZ German Research Centre for Geosciences, Helmholtz Centre Potsdam, Germany during March 2018.

Malin Kylander served as a co-chair for the joint IPA-IAL Joint Meeting 2018 at Stockholm University with over 400 international researchers. RA5 funded 17 applications to support workshops and conferences (EGU in Vienna, SPARC in Kyoto) and conduct fieldwork in Norway, Sweden, Finland, SE-Asia (co-funded by RA4) and Punta Arenas, Chile.

Qiong Zhang organized the 2nd summer course on “Climate model simulations” (with six PhD students from the Bolin Centre) in Beijing, co-funded by STINT, Bolin Climate Research School and the Institution of Tibetan Plateau and Kathmandu-Center for Research and Education CAS-TU (KCRE).

Malin Kylander led a final year project for gymnasium students from the Per Brahegymnasiet from Jönköping and took students to Islay, Scotland, to work with Holocene peat records.

The editors of www.forskning.se selected the popular science article “Långsammare Golfström kan ha orsakat värmeböljan” (www.forskning.se/2018/07/19/langsammare-golfstrom-kan-ha-orsakat-varmeboljan) as the story of the year 2018. The article is an example for how paleoclimate research at the Bolin Centre may help to explain recent summer extremes like 2018.

Research Area 5 (RA5) congratulates Anna Plikk, Catherine Hirst, Natalia Barrientos Macho and Henrik Swärd for successfully defending their PhD thesis in 2018.

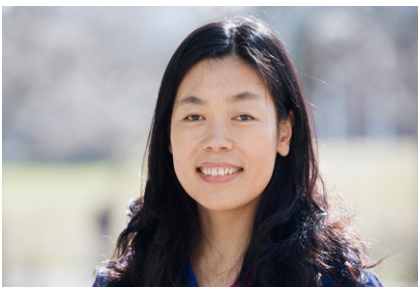
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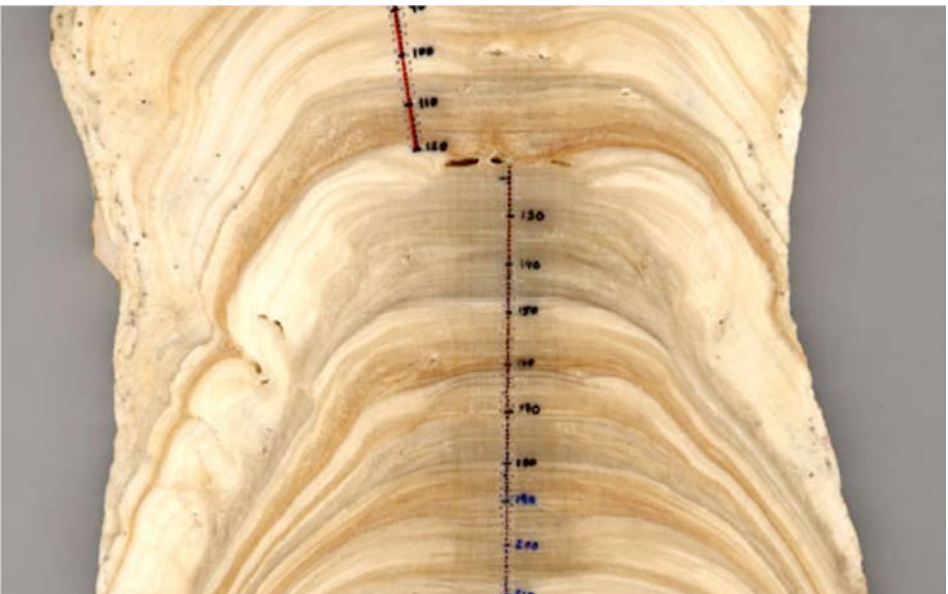
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Coreing on Islay, Scotland. Photo: Karin Jonsell



Speleothem proxy. Photo: Karin Holmgren



Akkaneewut (Nut) Chabangborn and Barbara Wohlfarth doing sediment coring in Lake Pa Kho, northern Thailand. The study of lake sediments from the Asian monsoon region allows researchers to reconstruct changes in Asian monsoon variability. Photo: Ludvig Löwemark

Deep time climate variability

To appreciate the full range of Earth’s climate variability it is necessary to look far back into geologic time where we find intervals when the world has been much warmer and colder than today. RA6’s mission is to reconstruct and interpret past climate variations on long timescales by comparing computer simulations and data from natural archives such as rocks, sediments and fossils. This helps us place limits on natural climate variability and better understand the Earth system.

During 2018, Research Area 6 (RA6) continued to fund a range of activities including spear-heading new data-model community networks, maintaining visibility in the national and international arena, and delivering research findings to wider audiences.

A considerable part of the RA6 budget was dedicated to organizing an international workshop on “Miocene climate” in June with 30 international experts. It resulted in delegates committing to writing a review paper on the Miocene, catalyzed interest in a new Miocene data-model inter comparison project (MioMIP) and initiated planning of another larger conference MioMeet 2019.

RA6 supported attendance for PhD students, postdocs and academic staff at five international conferences. Other grants were awarded to support laboratory analyses, as well as fieldwork including expeditions to the Arctic and Peru.

RA6 members published numerous peer-reviewed articles (some of which RA6 funded to be open access), contributed to several review papers and participated in outreach activities. A variety of these activities have led to successful external grant applications (EU Horizon 2020, VR).

Finally, RA6 hosted Prof. Brian Huber, Smithsonian Institute, USA, as the RA6 annual speaker who described the “super-greenhouse” climate of the mid Cretaceous.

A clear positive of these activities is the increasing cooperation between Stockholm University and The Natural History Museum, which RA6 bridges exceptionally well. The other continuing theme is the fusion of modelling and data perspective, something that the RA1 and RA6 continued to do, e.g. involving collaborations and manuscripts involving Hutchinson, DeBoer, Caballero, Nilsson and Coxall.

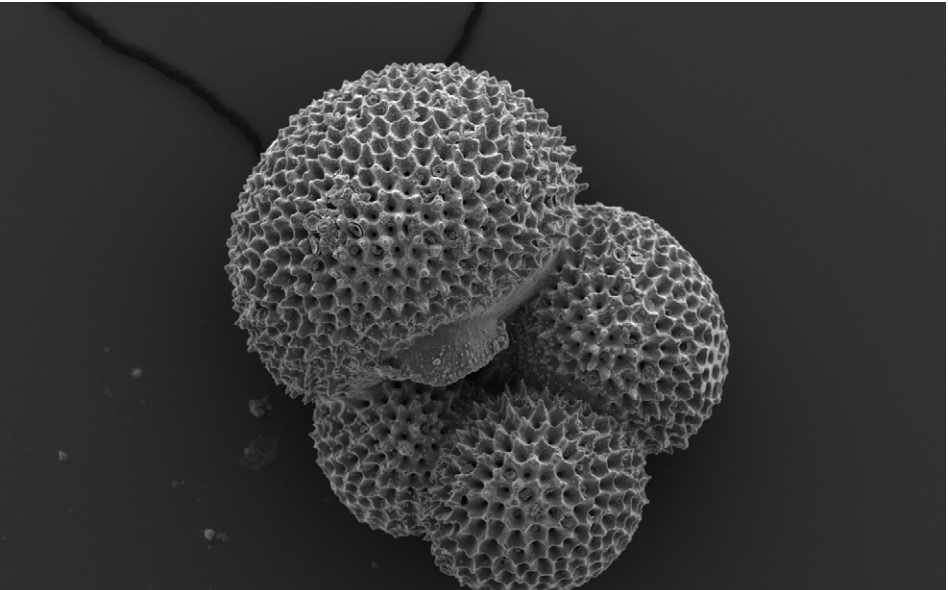
Co-leaders



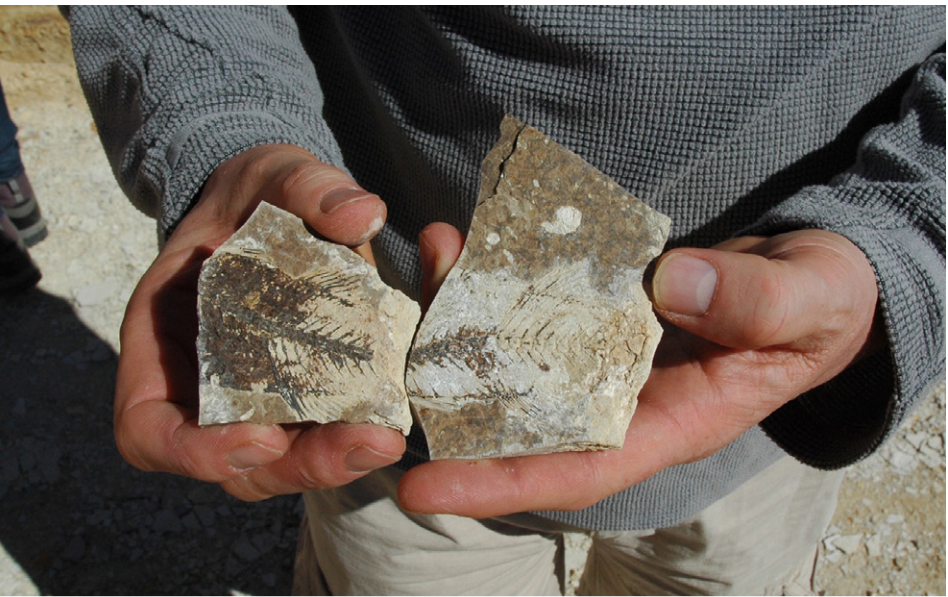
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Foraminifera. Photo: Helen Coxall



Fossil. Photo: Helen Coxall



Ancient marine sediment layers on Svalbard, now turned to rock and uplifted in mountain belts, contain geochemical and fossil evidence for a much warmer Arctic climate in the geological past. Photo: Love Dalén

Landscape processes and climate

The combined effects of changes in climate, land use and water use may heavily influence natural resources in terrestrial and marine environments in the coming decades. To meet these challenges we bring together natural and social scientists to do coordinated research on ecosystems. We focus on multi-scale processes of climate, biodiversity, ecosystem services and adaptive governance across landscape.

The seven larger projects that were funded the previous year are now all running. During the autumn of 2018 we financed three additional projects on land-use and climate effects on reindeer husbandry, carbon sequestration in sea grass beds and modelling of groundwater flows at different scales. Together with the seven previously funded projects the Research Area 7 (RA7) project portfolio covers a broad set of complementary questions. Many researchers from many departments are involved and new collaborations are beginning.

The RA7 seed money of 2018 were distributed among 11 smaller projects including equipment, analyses, visits to conferences and arrangements of workshops.

On May 31 we arranged a half day seminar with a list of presentations about the state of the art of the seven larger projects by the PIs or PhD-students as well as the results of a few of the 2017-years seed money projects. We also discussed how to build on the RA7 identity within the Bolin centre.

During the Bolin Days RA7 together with RA3 organized a session about extreme weather, which was a hot topic given the very dry summer in Sweden of 2018. Congratulations to Caroline Greiser who won the poster price!

RA7 had an active role at the Bolin centre summer school that were located to Abisko in end of August 2018. Kristoffer Hylander participated as a teacher and several of the RA7-financed PhD student attended the course.

During 2018 members from RA7 have been active in many ways in various outreach activities such as IPBES meetings, conferences arranged by The Swedish Environmental Protection Agency and our own Bolin Climate Festival.

Stefano Manzoni was recognized as Highly Cited Researcher 2018 in the category: cross-field by Clarivate Analytics and Johanna Sörensen won the New Generation prize by The Swedish Association for Water. Congratulations!

Co-leaders



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John Livsey and Edmond Alavaisha are studying how changing irrigation practices and intensifying agriculture might change soil organic matter stocks, which could have implications for both greenhouse gas emissions and soil fertility.a. Photo: Stefano Manzoni



Sampling soils in the context of the project Quantifying the trade-offs between ecosystem service provision and water management in rice systems. Photo: Stefano Manzoni



Photo: Sara Cousins

Biodiversity and climate

We investigate how climate influences ecological and evolutionary processes in natural populations. Field observations and experiments are used to examine effects on abundance and distribution of single species, as well as how climate affects interactions between species, community structure and ecosystem functioning. We also use this information to develop methods to mitigate negative effects of climate change on biodiversity.

The Research Area 8 (RA8) second call resulted in 15 applications. Five PhD-positions and one post-doc position were funded: “Testing for the existence of common evolutionary routes for adapting to the Northern temperate winter” (Humphreys), “The effects of winter microclimate variability on diapause timing processes in butterflies” (Lehmann), “Temporal scale changes in species distributions in boreal peatlands” (Kylander), “Long-term effects of climate change on Swedish bird populations” (Kullberg), “Genomics of extreme climate change – exploring demographic change and adaptive evolution during the Pleistocene” (Dalén) and “Effects of biochar and compost amendments on belowground biodiversity and drought-spell resilience in grasslands” (Hugelius). We received 13 applications for seed money and funded eight.

Seven new PhD students and one new postdoc were recruited during 2018: Edana Lord, Loke von Schmalensee, Mats Ittonen, Marta Lomas Vega,

Álvaro Gaytán, Laura Schat, Nina Roth, Daniela Guasconi, and Eleonor Ryberg.

Professor Love Dalén, Swedish Museum of Natural History, gave a seminar titled “Paleogenomic history and extinction dynamics of the woolly mammoth” in the Bolin Centre seminar series.

In February we organized a workshop with 25 participants at Tovetorp field station to discuss current and future research activities. We invited two external guests, Vigdis Vandvik, University of Bergen, and Tomas Roslin, SLU. One outcome was to initiate a network consisting of PhD-students and post-docs RA8-members. Since April 2018 the network meets every month. We also launched a Facebook group to facilitate field work and field equipment for RA8 members.

We presented our research on several conferences, for example ESA (Ecological Society of America) and BES (British Ecological Society).

Co-leaders



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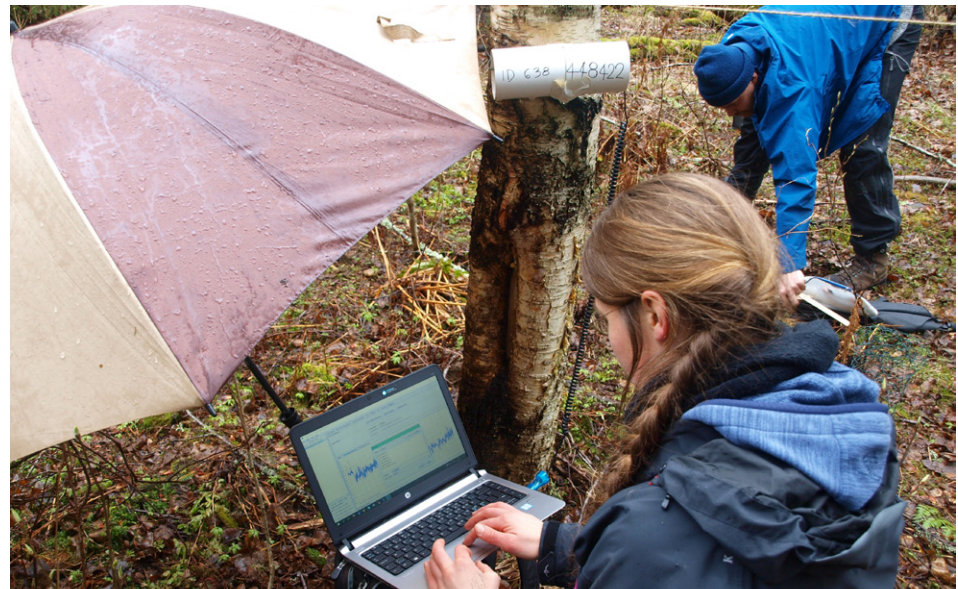
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Karl Gotthard
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Sonia Merinero taking canopy cover pictures. Photo: Caroline Greiser



Caroline Greiser doing temperature logging. Photo: Sonia Merinero



Within Research Area 8 we investigate how climate influences ecological and evolutionary processes in natural populations. One example is the seasonal emergence of insects and flowering of plants in early spring such as the emergence of the Small Tortoiseshell butterfly and the flowering of Goat Willow. We do research on how the timing of such events are affected by climate, and how climate-induced changes in different species influence patterns of biodiversity across time and space. Photo: Christer Wiklund

The Bolin Centre Climate Research School

The Climate Research School provides a platform for PhD students to interact with climate scientists from neighbouring disciplines and organises interdisciplinary climate related courses to masters and PhD students within the Bolin Centre. A summer school focusing at a specific research topic is given regularly. Financial support allows PhD students to participate in conferences, field courses and workshops.

The Climate Research School offered a range of courses to its PhD students in 2018.

Highlights of 2018 include the launch of a new Masters program in Climate Science. This program, which is offered jointly by the host Departments of the Bolin Centre, was initiated by the Climate Research School.

The 2018 Bolin Arctic Climate Summer School was held at the Abisko Research Station from August 27 to 31. This was the fifth summer school organized by the Bolin Centre. It was attended by 16 students.

The summer school focused on the dynamics of sub-arctic climate, linking atmospheric and terrestrial observations with the physical processes that affect these processes. The curriculum included lectures on past climate and future climate projections as well as exercises aimed at presenting different perspectives on current conditions.

The students could choose from three different topics: Arctic Hydrology, Climate Monitoring and Ecosystem Dynamics and Arctic Permafrost and Variations.

At the summer school, field and laboratory studies which were led by a subset of the instructors, while other instructors provide a theoretical framework for these studies. The mixture of theoretical and practical studies proved to be effective both at keeping the students interested and expanding their familiarity with the overall topic. Student evaluations were extremely positive highlighting the overall success of the summer school.

Chair



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Field excursion on Islay, Scotland. Photo: Karin Jonsell



Field excursion on Islay, Scotland. Photo: Malin Kylander



Learning how to do peat coring at the Bolin Centre Summer School *Isotopes in Climate and the Earth System* on Islay, Scotland. Photo: Karin Jonsell

The Bolin Centre Database

The Bolin Centre Database is a resource that scientists at the centre, and their collaborators, can use to provide open access to climate and Earth system data. The database staff can also help our scientists to visualise their data and give advice on data sharing.

Data contributions from Bolin Centre scientists come from many different research activities around the globe. This includes both longer-term large research projects and monitoring programmes that require a solid host and individual scientists who share a wide range of datasets from finished or ongoing projects.

During 2018, we published 57 datasets with metadata and made continuous efforts to improve the service to contributors and users. In particular, we signed an agreement with the National Supercomputer Centre for data storage. This gives us a flexible solution for storing and making available much larger data volumes than hitherto.

We launched a new visually attractive website layout at the Bolin Days 2018, where we also interacted with the participants at our help desk.

Our ongoing collaboration with the research data team at the Stockholm University Library was continued, in accordance with the SU policy to support the FAIR data principles and to advance new incentives and structures for open science.

The Bolin Centre Database currently hosts 158 datasets having metadata and 8 thematic data presentations with tailor-suited visualisations of many more individual datasets.

Examples of Bolin Centre Database data types:

- Chemical composition of atmospheric aerosols
- Palaeoclimatological indicators in tree rings, peat, rocks, and lake and ocean sediments
- Ocean chemistry data
- Bathymetric chart data and seismic profiles
- Ship track data from research expeditions
- Reconstructions of past ice sheet configurations and other landforms
- Glacier monitoring data
- Weather observation data
- Micrometeorological data
- Atmosphere and ocean turbulence data
- Hydrological data
- Land-cover data and soil carbon data.

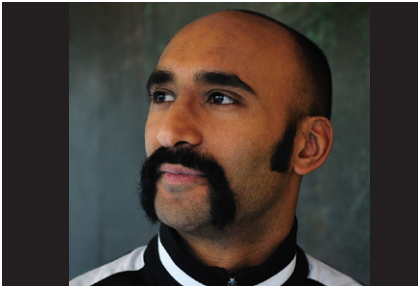
We have a goal of becoming internationally recognised as a trusted repository for research data.

Coordinator



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Technical database manager



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The Bolin Centre Database booth during the Bolin Days 2018. Photo: Karin Jonsell

Bolin Centre modelling

Numerical models of the global climate system are essential in research carried out at the Bolin Centre. Earth system models are used across the research areas to study topics covering deep ocean circulation, land surface processes, atmospheric composition and dynamics, and upper atmospheric physics. Bolin Centre researchers also participate in the development of the next generation of Earth system models.

The annual application for the continuation of the Bolin Centre's computational project provided by the Swedish National Infrastructure for Computing (SNIC) was approved. This secured the Bolin Centre's access to computational resources for the period July 2018 to June 2019.

The Bolin Centre's main computational resource since 2012, the supercomputer Triolith at the National Supercomputer Centre (NSC) was closed down in September. Shortly before that, in August NSC's new flagship computer Tetralith became available to users. We have in close collaboration with NSC assisted the supercomputer users from the Bolin Centre with the transfer to the new computer. This included help with basic usage as well as reinstalling codes, models and software on the new computer.

The Bolin Centre is participating in the development of the next version of EC-Earth towards the next phase of CMIP, CMIP6.

Representatives participated in the annual EC-Earth development meeting held in Lisbon in October 2018.

The modelling coordination continued their support activities during 2018:

- In December the Bolin Centre hosted a one day SNIC training course taught by NSC representatives.
- Introductory seminars for new users of the computing system at NSC and the Bolin Centre's computing projects was given twice in 2018.
- The Bolin Centre module system developed together with NSC on Triolith was reintroduced and expanded with more software on Tetralith.
- We welcomed several new Bolin Centre supercomputers users during the year as well as installed new models and codes.

Coordinator



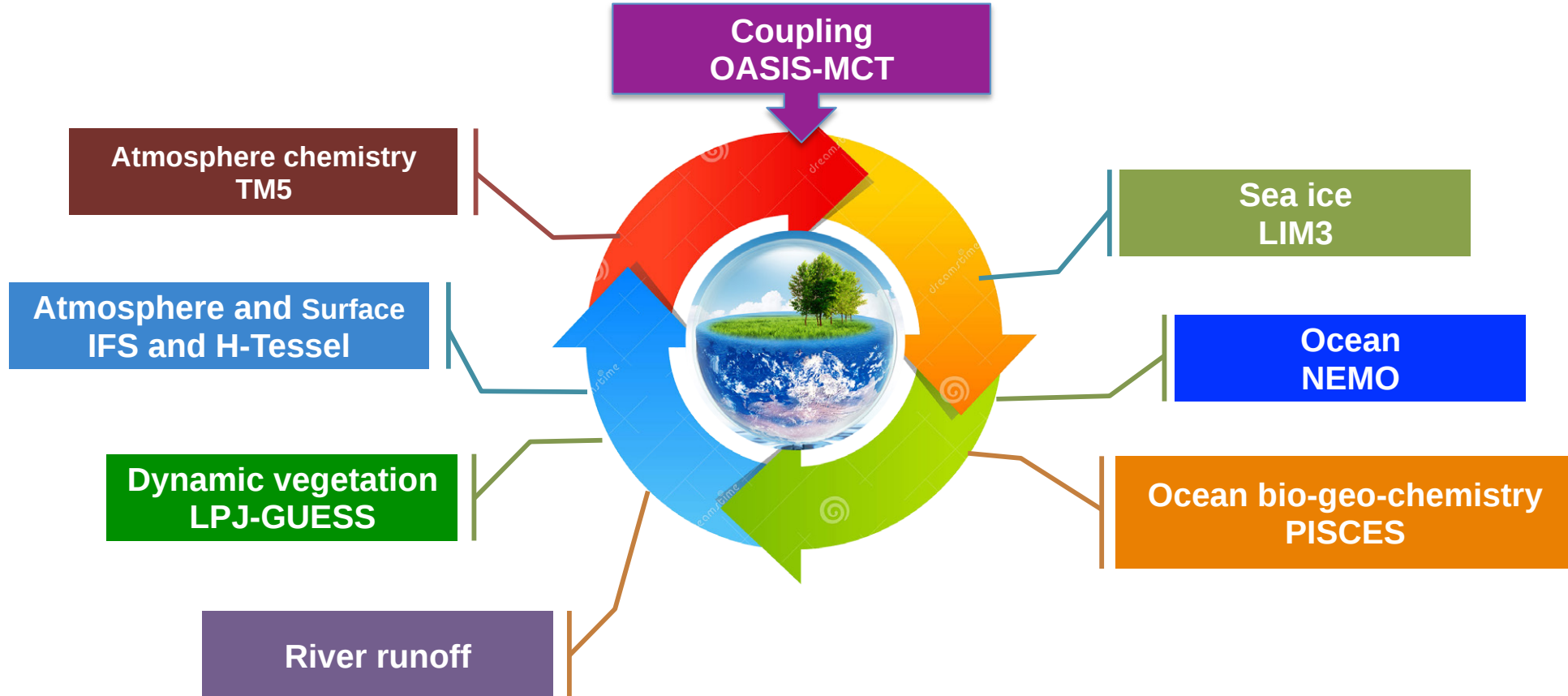
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Scientific programmer



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EC-Earth - Earth System Model



The Bolin Centre mentoring programme

The Bolin Center Mentoring Program is a voluntary initiative that links up interested junior and senior scientists in a mentor-mentee relationship. The programme runs from the Bolin Days in November each year for at least one year at a time. The programme started in 2012 and normally has 20–30 pairs of mentee and mentor.

The Bolin Mentoring Program continues to grow in popularity and is now in its 6th year.

In 2018 the program paired 23 mentees with mentors and there are 31 pairs signed up for 2019.

The program proves to add value to the careers of many of the Bolin Centre scientists as evident from selected feedback of the mentees:

“The program has been incredibly helpful. At the time I reached out I was in the middle of my PhD, I had not much supervisor time and had serious concerns about getting delayed. The mentorship has helped to keep focused and get back on track.”

“Personally the program was very helpful to me. One important point for me is that I have three male supervisors, so having a female as a mentor is extra important. What I like the most in the program is the freedom to choose the informal contact, since in the academic world everything is already so formal.”

“I have found it useful to openly discuss my research problems, interactions with other researchers, the nature of criticism and feedback in science, and other issues. It’s also great to get a perspective of someone who is not connected to my project, but is very experienced and knowledgeable about this kind of work. I wish I had sought out something like this program when I was a PhD student. I think that would have helped me back then.”

Coordinators



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Malin Kylander
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Characteristics of the programme

Voluntary

All mentees and mentors volunteer. This means the programme is always only as big as the need it fulfils.

Confidential

We never mention who signs up unless permission is given such as for marketing. Mentee-mentor interactions are also strictly confidential.

Cross-departmental

The mentees are signed up with mentors in other departments to provide more objectivity and avoid conflict of interest.

Mentee-driven

The mentees make the first contact and decide the frequency and format of the meetings. This is because the needs of every mentee are individual and a single format will not be optimal for all.

Annual

The programme runs annually from the Bolin Days. After that pairs may wish to continue formally, informally, sign up for new pairs, or leave the programme.



Nordenskioldbreen, Svalbard. Photo: Martin Jakobsson

Bolin Centre coordination & communication

The coordinators & communicators handles the coordination, communication and administration of the Bolin Centre. They organize big events such as the conference the Bolin Days, the outreach event the Climate Festival and profile seminars. They also handle smaller events such as the Bolin Centre Seminar Series, various internal meetings and focuses on both internal and external communication efforts.

Our communication efforts were focused on some bigger events this year: the symposium The Ocean in a +2°C world together with the Royal Swedish Academy of Sciences, the Bert Bolin Climate Lecture (hosted by the Faculty of Science, see page 36), Bolin Centre Climate Festival, ForskarFredag, co-sponsoring of a seminar about IPCC special report Global Warming of 1.5 degrees, celebrating the 10th Bolin Days conference and an exhibition booth at the American Geophysical Union (AGU) Fall Meeting.

The Climate Festival was arranged for the second time and was extremely successful with 1200 participants. A TV-team from UR Samtiden filmed all the popular science talks, and this was made into a TV-program which was aired at Kunskapskanalen and www.urplay.se. The Bert Bolin Climate Lecture was given on the first day of the Climate Festival and was well attended.

We also focused on strengthening our collaboration with actors outside the Academia. One of the effort was the start-up of the new

project, The Bolin Centre Climate Arena, together with the External Relations Department at Stockholm University. The Climate Arena aims to enable and facilitate co-production such as joint applications, research projects, etc. with parties outside academia.

We finished off the year with the 10th Bolin Days which had an attendance record with 270 participants, which meant a second room with live streaming had to be arranged. New for this year was topical session – this year on Arctic climate, Impacts of extreme weather events & climate change, Climate & environmental change and Climate & biota. The MERGE (Modelling the Regional and Global Earth system) initiative in Lund was invited and gave a seminar on climate modelling and the House of Science presented their outreach programme for children and students. All talks were live streamed and were followed by over 100 persons.

Coordinators & communicators



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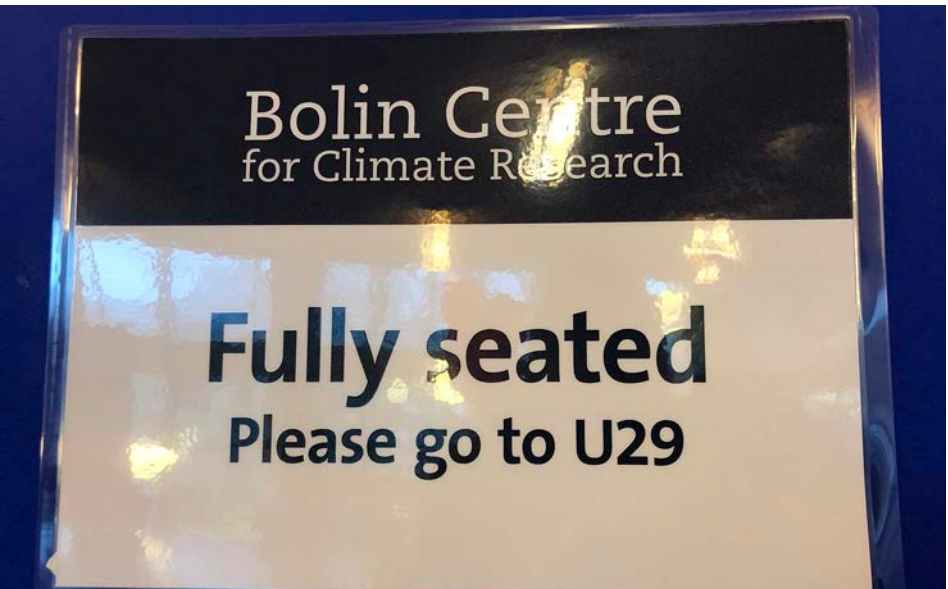


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The Bolin Centre Climate festival had 1200 participants. Photo: Niklas Björling



The 10th Bolin Days was well visited. Photo: Karin Jonsell



Iceberg at the Devil's Thumb, Greenland. Photo: Martin Jakobsson

The Bert Bolin Climate Lecture

Prof. Bert Bolin of Stockholm University was a leader in climate and carbon cycle research and one of the founders of IPCC which received the Nobel Peace Prize in 2007. To honour Prof. Bolin, the Faculty of Science at Stockholm University established the annual Bert Bolin Climate Lecture. The distinguished Bert Bolin Climate Lecturer is invited to Stockholm in May to hold a popular science lecture and a science seminar at the Bolin Centre for Climate Research.

The 11th Bert Bolin Climate Lecture was given on May 21st 2018 in Stockholm University's Aula Magna by Prof. Veerabhadran Ramanathan of the Scripps Institution of Oceanography, University of California, USA.

Addressed to a public audience, Ramanathan's Bert Bolin Climate Lecture was titled *Bending the Curve: Climate Change Solutions*.

Abstract: Svante Arrhenius, the Swedish Nobelist, laid the modern foundation for understanding the planetary warming effects of carbon dioxide, 122 years ago. The work was carried on by another famous Swede and a climate scientist, Bert Bolin, who in 1990 took the science of climate change and its implications to the whole world as the first chairman of the IPCC, Intergovernmental Panel on Climate Change.

Society has responded rather tepidly to the dangers of climate change, except for good examples like California and Sweden which have shown the world how to reduce emissions of

carbon dioxide and other climate pollutants and still enjoy prosperous economies.

Using data collected over the last three decades, I have concluded that unchecked climate change poses serious threats for our children and grandchildren. However, there is still time to avoid catastrophic changes. I will describe ten solutions (developed with a team of fifty faculty from the University of California system), which if implemented with urgency, can protect the people as well as the ecosystems.

Film: <https://bolin.su.se/index.php/bert-bolin-climate-lecture/736-2018-bending-the-curve-climate-change-solutions>

The Bolin Climate Lecturer is appointed by the Dean of the Faculty of Science of Stockholm University. Nominations can be made by all Bolin Centre members in response to a call issued during the autumn term by the Bolin Centre directorate.

Lecturers

2008

Prof. Susan Solomon

2009

Prof. Venkatachalam "Ram" Ramaswamy

2010

Prof. Robert J. Charlson

2011

Prof. Ralph Keeling

2012

Prof. Sherilyn Fritz

2013

Prof. Warren M. Washington

2014

Prof. Corinne Le Quéré

2015

Prof. Ulrike Lohmann

2016

Sir Brian Hoskins

2017

Dr. Thomas Cronin

2018

Prof. Veerabhadran Ramanathan



Bolin Centre Seminars
by the Bert Bolin Climate Lecture speaker

Climate Feedbacks Low Probability-High Impact Climate Changes



Our confidence in climate model projections derives from the fact that number of predictions made by studies to-date have mostly been verified with direct observations: These include the Arrhenius' (and later by Manabe and Wetherald) model of an amplifying feedback between surface warming and water vapor greenhouse effect; the surface warming-stratospheric cooling of CO₂; the Budyko-Sellers prediction of polar amplification due to ice-albedo feedback; warming penetrating to the deeper ocean layers; sea level rise and many others. In addition, Roland Madden, and I used a statistical model to test the greenhouse theory of CO₂ warming and predicted in 1980 that the CO₂ warming (undetected as of 1980) should rise above the background climate noise by 2000. This prediction was also verified by the 2001 IPCC-TAR report. We now have about three decades of observations of warming as well as the evolution of many physical/thermos-dynamical and carbon/methane feedbacks. Using these data, I will describe the low probability (5%)- high impact climate changes we can expect in the following decades.

Speaker: Professor V. (Ram) Ramanathan
Scripps Institution of Oceanography, University of California

Time: May 21, 10h00–11h00

Place: Ahlmansalen, Stockholm University

Bolin Centre for Climate Research
A collaboration between Stockholm University, KTH and the Swedish Meteorological and Hydrological Institute
www.bolin.su.se



Stockholm
University

21
MAJ

2018 års Bolinföreläsning om klimatforskning

Föreläsare: **Veerabhadran Ramanathan**, Scripps Institution of Oceanography, University of California at San Diego
Titel: Bending the Curve: Climate Change Solutions

Föreläsningen ges på engelska.
Fika serveras efteråt.

FRI ENTRÉ ► Tid och plats: 14.00–15.00,
Aula Magna, Stockholms universitet



The Bolin Centre Board

The Bolin Centre is led by the Bolin Centre Board which comprises representatives from all its collaborative partners: Six departments at Stockholm University, the Swedish Meteorological and Hydrological Institute (SMHI) and the Royal Institute of Technology. In addition, the board includes an external member and a student representative.

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Karin Jonsell, PhD

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Iceberg outside Greenland. Photo: Martin Jakobsson

The External Science Advisory Group

The Bolin Centre has appointed an External Scientific Advisory Group (ESAG) comprised of leading national and international scientists within climate research. The group's main tasks are to inform the Bolin Centre of its strengths, weaknesses and possibilities for development as well as increase the Bolin Centre's contacts to international networks and research groups within the climate research area.

Prof. Deliang Chen

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Academic Director Academia Europaea Bergen Knowledge Hub. Former director of the Bjerknes Centre for Climate Research; Department of Earth Science, University of Bergen, Norway
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Prof. Camille Parmesan

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Pay Pierrehubert of the External Science Advisory Group at the 2018 Bolin Days. Photo: Karin Jonsell



Malcolm Parsons calling to dinner and ceilidh at the Bolin Days 2018. Photo: Karin Jonsell

Appendix 1: Facts & figures

PhD thesis completed during 2018

- **Natalia Barrientos:** *Arctic Ocean benthic foraminifera preservation and Mg/Ca ratios: Implications for bottom water palaeothermometry.*
- **Henrik Carlson:** *Atmospheric dynamics and the hydrologic cycle in warm climates.*
- **Filippa Fransner:** *Organic carbon dynamics in the Baltic Sea: A modelling perspective.*
- **Kerstin Hartung:** *Paths to improving atmospheric models across scales: The importance of the unresolved scales.*
- **Koen Hendrickx:** *Solar Forcing of Nitric Oxide in the Upper Atmosphere.*
- **Catherine Hirst:** *Iron in the Lena River basin, NE Russia – Insights from microscopy, spectroscopy and isotope analysis.*
- **Simon Jakobsson:** *Wooded or Treeless Pastures? Linking policy, farmers’ decisions and biodiversity.*
- **Xiang-Yu Li:** *Droplet growth in atmospheric turbulence: A direct numerical simulation study.*
- **Andrew Mercer:** *Studies in Glacier Mass Balance – Measurement and its errors.*
- **Etienne Pauthenet:** *Unraveling the thermohaline structure of the Southern Ocean using functional data analysis.*
- **Anna Pliikk:** *The Eemian Interglacial at Sokli, Northern Finland – A multi-proxy environmental and climate reconstruction based on a 9m long lacustrine sediment sequence.*
- **Henrik Swärd:** *In the wake of deglaciation – sedimentary signatures of ice-sheet decay and sea-level change: Studies from south-central Sweden and the western Arctic Ocean.*
- **Johanna Sörensen:** *Urban, pluvial flooding: Blue-green infrastructure as a strategy for resilience.*

- **Emelie Waldén:** *Restoration of Semi-natural Grasslands – Impacts on biodiversity, ecosystem services and stakeholder perceptions.*

External grants awarded during 2018

- **Austrian Nuclear Science and Technology Organisation (ANSTO):** *“Fire-loving” plants of the mid-Cretaceous and the evolution and functions of plant resins.* Chris Mays, Peter Crane, Patrick Herendeen, Fabiany Herrera, Joseph BeviV, Ulf Garbe. €22,800.
- **Company of Biologists:** *Oxygen limitation and hypoxia tolerance during development in Cerambycid beetles.* Philipp Lehmann. GBP 1,700.
- **Deutsche Forschungsgemeinschaft:** *Molecular determinants of brain size and cognitive performance.* Partner for Stockholm University Collaborator/co-applicant: Philipp Lehmann. Main applicant: Katja Nowick (Freie Universität Berlin).
- **European Research Council (ERC):** *Reining in the upper bound on Earth’s climate sensitivities, “highECS”.* Thorsten Mauritsen. €2,000,000.
- **EU H2020:** *COASTAL Collaborative Land-Sea Integration Platform.* Georgia Destouni. €5,000,000.
- **EU H2020:** *CONSTRAIN.* Rodrigo Caballero, Thorsten Mauritsen. €8,000,000.
- **EU H2020:** *COMFORT (Our common future ocean – quantifying coupled cycles of carbon, oxygen, and nutrients for determining and achieving safe operating spaces with respect to tipping points..* Matthias Gröger, Ralf Döscher, Torben Koenigk.
- **EU H2020 – Research and Innovation Framework Programme, (FORCeS):** *Constrained aerosol forcing for improved climate projections.* Annica Ekman and Ilona Riipinen. €7,998,988.

- **EU H2020 – Research and Innovation Framework Programme, (FORCeS):** *Forcing constraints for transient climate sensitivity.* Annica Ekman, Ilona Riipinen. €8,000,000.
- **Göran Gustafssons stiftelse för natur och miljö i Lappland:** *Glaciärrarkeologi i fjällen.* Per Holmlund. SEK 71,000.
- **Göran Gustafssons Stiftelse för natur och miljö i Lappland:** *Gruvindustrins påverkan på miljö och samhälle under hydroklimatförändring: Koppla samman fältobservationer med modelltolkningar.* Sandra Fischer. SEK 50,000.
- **Helge Axelsson Johnsons Stiftelse:** *Antipredator behaviour in the Caribbean reef squid (Sepioteuthis sepioidea).* Collaborator/co-applicant Philipp Lehmann. Main applicant: Eva Ehrnsten (Stockholm University).
- **Kone Foundation:** *Diapause behaviour polymorphism and interspecific interactions in a changing climate.* Collaborator/co-applicant: Philipp Lehmann. Main applicant: Aapo Kahilainen (University of Helsinki).
- **Swedish environmental protection agency:** *Landscape indicators for biodiversity.* Sara Cousins. SEK 5,000,000.
- **Swedish Foundation for International Cooperation in Research and Higher Education (STINT):** *Deltaic Hydrodynamics.* Jaramillo Fernando. SEK 146,000.
- **Swedish Foundation for International Cooperation in Research and Higher Education (STINT):** *Hydrogeodesy to study large deltaic hydrodynamics.* Fernando Jaramillo, Georgia Destouni, Ian Brown. SEK 150,000.
- **Swedish Innovation Agency (Vinnova):** *iWater – Water Monitoring Networks.* Georgia Destouni. SEK 6,022,000.
- **Swedish Innovation Agency (Vinnova):** *iWater – Övervakning av vattenkvalitet för framtidens smarta städer.* Georgia Destouni. SEK 472,000.
- **Swedish Ministry of Environment and Energy (FORMAS):** *Scoping for resilience and management of Arctic wetlands.* Zahra Kalantari, Samaneh Seifollahi, Georgia Destouni. SEK 263,800.
- **Swedish National Space Agency (SNSA):** *Fingerprints of North Atlantic – Nordic Seas Exchanges from Space across Scales (FiNNESS).* Léon Chafik. SEK ~4,700,000.



Weather experiment equipment at teh ASCOS expedition to the Arctic. Photo: Michael Tjernström

- **Swedish Research Council (VR):** *Biogenic particles and their role in the formation of Arctic clouds*. Paul Zieger. SEK 3,2000,000.
- **Swedish Research Council (VR):** *Characterising properties of Climate Relevant Organic and Inorganic Sea-Spray-aerosols, Sources and Air-sea-exchange causing their Net-emission* (CROISSANT). Douglas Nilsson. SEK 3,40,000.
- **Swedish Research Council (VR):** *Clouds, inter-hemispheric albedo symmetry, and climate stability*. Frida Bender. SEK 3,300,000.
- **Swedish Research Council (VR):** *Melting marine gas hydrates – Predictingseafloor methane gas release in a warming world*. Christian Stranne. SEK 4,000,000.
- **Swedish Research Council (VR):** *Nitrous oxide fluxes from the East Siberian Arctic Shelf*. Birgit Wild. SEK 3,400,000.
- **Swedish Research Council (VR):** *SEAgender*. Maricela de la Torre Castro. SEK 5,711,000.
- **Swedish Research Council (VR):** *The critical role of the benthic boundary layer in biogeochemical cycling of trace gases and nutrients*. Volker Brüchert. SEK 3,500,000.
- **Swedish Research Council (VR):** *Thawing permafrost and fluxes of environmental pollutants and organic matter to aquatic environments*. Gustaf Hugelius. SEK 3,800,000.
- **Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS):** *Ripples of Resilience: navigating cross-scale SDG interactions of water, land, and climate within planetary boundaries*. Co-applicant Fernando Jaramillo. SEK 2,000,000.
- **Swedish Research Council for Sustainable Development (FORMAS):** *BioDiv-Support: Scenariebaserat stöd för policyplanering och anpassning till framtida förändringar i biologisk mångfald och ekosystemtjänster*. Gunhild Rosqvist. SEK 306, 765.
- **Swedish Research Council for Sustainable Development (FORMAS):** *Choices, values and uncertainty in model projections of future climate*. Frida Bender. SEK 5,000,000.
- **Swedish Research Council for Sustainable Development (FORMAS):** *Climate Impacts of Paleogeography at the Eocene-Oligocene Transition*. David Hutchinson. SEK 3,260,925.
- **Swedish Research Council for Sustainable Development (FORMAS):** *Emissions of the strong greenhouse gas nitrous oxide from thawing coastal and subsea permafrost in the Siberian Arctic*. Birgit Wild. SEK 2,400,000.
- **Swedish Research Council for Sustainable Development (FORMAS):** *Genomics of extreme climate change*. Love Dalén. SEK 3,000,000.
- **Swedish Research Council for Sustainable Development (FORMAS):** *Large-Scale Atmospheric Variability driving changes in the Terrestrial Carbon Cycle and Storage*. Gabrielle Messori and co-applicant: Fernando Jaramillo. SEK 2,998,470.
- **Swedish Research Council for Sustainable Development (FORMAS):** *Policyplanering, biologisk mångfald*. Jan Plue. SEK 2,998,000.
- **Swedish Research Council for Sustainable Development (FORMAS):** *Productive agriculture for reachingthe sustainable development goals – PEGASUS*. Co-applicant: Stefano Manzoni. PI: Riccardo Bommarco, SEK 1,960,493.
- **Swedish Research Council for Sustainable Development (FORMAS):** *Ripples of Resilience: navigating cross-scale SDG interactions of water, land, and climate within planetary boundaries*. Line Gordon. SEK 1,999,537.
- **Swedish Research Council for Sustainable Development (FORMAS):** *Trends in aerosols and warming for northern Europe (TAWÉ)*. Paul Glantz. SEK 2,600,000.
- **Swedish Research Council for Sustainable Development (FORMAS):** *Uncertainties in theregulation of carbon mineralization by soil moisture: implications for modelling sustainable cropping systems under climate change*. Co-applicant: Stefano Manzoni. PI: Elsa Coucheney, SEK 2,998,470.
- **Swedish Research Council for Sustainable Development (FORMAS):** *Water quality impacts water scarcity – accounting for changing freshwater salinity on water scarcity in global drylands*. Josefin Thorslund. SEK 3,998,096.
- **Universidad del Rosario, Colombia, Big Grants:** *Change of hábitat in the post-conflict era: The National Park System and effects on national water resources*. Fernando Jaramillo, co-applicant. SEK 1,561,984 (Equivalent from Colombian pesos).

Prizes awarded during 2018

- **Arjun Chakrawal** was given the EGU Poster Award. Poster title: *How does soil spatial heterogeneity affect decomposition kinetics?*
- **Patrick Crill** was elected an AGU Fellow in 2018. <https://eos.org/agu-news/2018-class-of-agu-fellows-announced>.
- **Gustaf Hugelius** was one of 11 ”Nature Index 2018 Rising Stars”.
- **Fernando Jaramillo** was top reviewer at Publons.
- **Inga Koszalka** was awarded the AGU 2018 Editor’s Citation for Excellence in Refereeing (cited by a GRL editor). This prize is awarded every year to 0.1% reviewers of the AGU (ca. 170 of 17,000), see: <https://eos.org/agu-news/in-appreciation-of-agus-outstanding-reviewers-of-2018>.
- **Philipp Lehmann** was the top reviewer in “Animal Sciences” according to Publons.
- **Stefano Manzoni** was one of eight Stockholm University researchers listed as Highly Cited Researcher (category: cross-field, Clarivate Analytics).
- **Gabrielle Messori** received the EGU Outstanding ECS Award, Atmospheric Sciences Division.
- **Johanna Sörensen** was awarded The New Generation prize by The Swedish Association for Water.

Invited talks during 2018

- **Christian Beer** was invated to talk at KimaKampus Colloquium, Hamburg, Germany. Title: *Importance of temporal and spatial variability of environmental conditions for land-atmosphere interactions in permafrost landscapes*.
- **Christian Beer** was invated to talk at Deutsche Bodenkundliche Gesellschaft, Hamburg, Germany. Title: *Recent and future GHG emissions from permafrost soils*.
- **Agatha de Boer** was invated to talk at Crafoord Prize Symposium seminar at the Royal Academyof Science, Stockholm. Title: *The intricate link between the ocean’s deep water formation and climate through the ages*.

- **Agatha de Boer** was invated to talk at Miocence workshop, Stockholm. Title: *Periodically collapsing Antarctic ice-sheet becomes firmly established by the Mid Miocene Climate Transition*.
- **Agatha de Boer** was invated to talk at Seminar at British Antartic Survey, UK. Title: *Inter-connectivity between volume transports through Arctic straits*.
- **Agatha de Boer** was invated to talk at Seminar at Oxford University, UK. Title: *Inter-connectivity between volume transports through Arctic straits*.
- **Agatha de Boer** was invated to talk at Arctic workshop, Stockholm. Title: *Arctic Strait volume transports: Forcing and response*.
- **Volker Brüchert** was invated to talk at Århus University, Århus, Denmark. Title: *Methane in the Laptev and Eastern Siberian shelf sea and sediment – biogeochemical cycling, acoustic, and video observations*.
- **Rodrigo Caballero** gave an invited talk at Harvard Climate Seminar. Title: *Atmospheric superrotation at Earth’s surface*.
- **Patrick Crill** was invited to talk at Laboratoire des Sciences du Climat et de l’Environnement, Orme des Messiers, France. Title: *Commonalities in Global Wetland Methane Sources with a Focus on Arctic Emissions*.
- **Patrick Crill** was invited to talk at Laboratoire Géosciences Paris-Sud (GEOPS), Université Paris – Saclay, France. Title: *Permafrost Thaw and Biogeochemical Controls on Trace Gas Emissions*.
- **Patrick Crill** was invited to talk at Biosphere 2, University of Arizona, USA. Title: *Evolution of the Stordlen Mire Surface measurements Since 2004*.
- **Patrick Crill** was invited to present at NSF-Ocean Carbon Biogeochemistry, CH4 and N2O Workshop, Lake Arrowhead, CA, USA. Title: *Secular Increase in Summer and early AutumnAtmospheric Methane at the Arctic Ocean Surface, 2014–2018*.
- **Patrick Crill** was invited to give two talks at American Geophysical Union Fall Meeting, Washington, DC, USA. Title: *AGU and the Evolution of Biogeochemistry as a Discipline* and *(Crill and Thornton) Variability in Shipboard Ambient Methane Observations over the Arctic Ocean, 2014–2018*.

- **Love Dalén** gave a seminar in the Bolin Centre seminar series. Title: *Paleogenomic history and extinction dynamics of the woolly mammoth*.
- **Kristofer Döös** was invated to talk at EGU. Title: *Lagrangian tracking of the inter-ocean exchange of water through the atmosphere*.
- **Kristofer Döös** was invated to talk at a seminar at Peking University. Title: *Lagrangian tracking of the inter-ocean exchange of water through the atmosphere*.
- **Kristofer Döös** was invated to talk at a seminar at University of New South Wales. Title: *Inter-ocean exchange of water through the atmosphere*.
- **Annica Ekman** was invited speaker at BACCHUS Final meeting, Zurich, Switzerland. Title: *Formation and persistence of mixed-phase clouds in the winter- and summertime Arctic*.
- **Richard Gyllencreutz** gave a lecture at Lundellska Skolan, Uppsala. Gymnasiets 14:e Naturvetarveckan. Title: *Marine geology – how to measure climate change*.
- **Abdelwaheb Hannachi** was invated to talk at Atmospheric Physics, AOPP, Clarendon, Oxford. Title: *Circulation regimes, unstable periodic orbits and link to atmospheric large scale variability*.
- **Abdelwaheb Hannachi** was invated to talk at Meteorology, University of Reading. Title: *On an old problem: nonlinearity in hemispheric large scale atmosphere*.
- **Abdelwaheb Hannachi** was invated to talk at a Workshop: Statistical inference for stochastic process models in weather and climate science, Lorentz Center, Leiden. Title: *On the nonlinearity of winter northern hemisphere atmospheric variability*.
- **Luisa Ickes** gave a presentation at INUIT Final Conference and 2nd Ice Nucleation Conference, Grasellenbach, Germany. Title: *Ice nucleation in mixed-phase Arctic clouds: large-eddy simulation of an observed case study*.
- **Gustaf Hugelius** was a plenary keynote speaker for the 5th European Conference on Permafrost, Chamonix, France. Title: *Permafrost and the global carbon cycle*.
- **Torben Koenigk** gave a keynote talk at Arctic Frontiers Conference, Tromsø. Title: *Evaluating impacts of Arctic sea ice loss and variation on the northern hemisphere*.
- **Philipp Lehmann** was invited to talk at the EUROPEAN CONGRESS OF ENTOMOLOGY Naples, Italy. Title: *Responses of 31 global insect pests to ongoing climate change reveals both surprises and knowledge gaps*.
- **Philipp Lehmann** was a keynote speaker and panel discussion member in session ”Climate Change Impacts and Pest management” during a workshop at STIAS, Stellenbosch, South Africa. Title: *Legumes for Life*.
- **John Livsey** was invited to give a presentation at Göteborg Univesitet. Title: *Water efficient rice production – Trade-offs and sustainability*.
- **Stefano Manzoni** was invited speaker at EGU General Assembly. Title: *Microbial carbon use efficiency in soils: methods and environmental controls*.
- **Stefano Manzoni** was invited speaker at EGU General Assembly. Title: *Optimality of plant water use strategies – an eco-hydrological perspective*.
- **Stefano Manzoni** was invited to give a presentation at Göteborg Univesitet. Title: *Soil microbe-water interactions – Concepts and modelling*.
- **Gabriele Messori** was invited to talk at EGU General assembly, Vienna. Title: *The sporadic nature of atmospheric heat transport in a hierarchy of models*.
- **Gabriele Messori** was invited to talk at Storm Tracks Workshop, Utö. Title: *Destructive European windstorms modulated by the low-frequency variability of wintertime planetary wave-breaking*.
- **Gariele Messori** was invated to talk at the Meteorological Institute, Hamburg University and Max-Planck Institute for Meteorology. Title: *The Atmosphere as a Dynamical System: a Happy Tale of Theory Matching Reality*.
- **Gariele Messori** was invated to talk at Department of Civil and Environmental Engineering, Politecnico di Milano. Title: *The Atmosphere as a Dynamical System: a Happy Tale of Theory Matching Reality*.
- **Gariele Messori** was invated to talk at Department of Earth Sciences, Uppsala universitet. Title: *Different approaches to studying Euro-Atlantic climate variability and extremes*.
- **Gariele Messori** was invated to talk at CMCC, Bologna. Title: *The Low-Frequency Variability of Planetary Wave-Breaking driving European Windstorm Anomalies*.
- **Frederik Schenk** was invited to give a presentation at the GFZ German Research Centre for Geosciences, Helmholtz Centre Potsdam, Germany. Title: *The role of the Fennoscandian Ice Sheet in shaping the European summer climate during the Younger Dryas*.
- **Qiong Zhang** was invited to give talks at the Fudan University, China; and Chinese Academy of Sciences, Xian, China. Title: *Arctic warming during Pliocene in EC-Earth simulation*.
- **Qiong Zhang** was invited to give talks at Xi’an Institute of Earth Environment, Chinese Academy of Sciences. Title: *Climate response to green Sahara during mid-Holocene*.
- **Chris Mays** founded, authored and presented of the palaeontology-themed public seminar/workshopseries *Fossil Fridays* at Naturhistoriska riksmuseet.
- **Torben Koenigk** participated in a panel discussion on *Arctic climate research and the Year of Polar Prediction (YOPP)* in EGU General Assembly, Vienna.
- **Torben Koenigk** gave lectures for schools, Kunskapsgymnasiet Norrköping and Luleå Gymnasietskola on Arctic climate change: *Varför värms Arktis upp snabbare än resten av jorden?*
- **Gabriele Messori** participated in a debate with the public, in panel discussions at conferences, in school lecture on climate, etc. <https://www.climalteranti.it/2018/07/24/lincertezza-non-e-nostra-amica>
- **Helen Czerski** was feature on the radio BBC4 about the eight-week expedition on Oden to the Arctic, <https://www.bbc.co.uk/sounds/play/m0000nhx>, and had an article in the Guardian on the same subject, https://www.theguardian.com/environment/2018/sep/01/whats-happening-weather-answers-arctic-air-oden-helen-czerski?CMP=share_btn_tw.
- Matt Salter was interviewed on Swedish radio, <https://sverigesradio.se/sida/artikel.aspx?programid=2054&artikel=6998510>
- **Gorgia Destouni and Zahra Kalantari** are members of the Board and Steering Committee of European COST Action for: *CA18135 – Fire in the Earth System: Science & Society, 2019–2023* and *CA17109 – Understanding and modeling compound climate and weather events, 2018–2022*.
- **Gustaf Hugelius** founded the International Permafrost Association standing interest group *Permafrost and Carbon budgets* (IPaC)
- **Fernando Jaramillo** was one of the jurors in Svenska Juniorvattenpriset.
- **Philipp Lehmann** organized together with John Terblanche a workshop: *Metabolic Flexibility in Insect Invasions*. CIB, Stellenbosch, South Africa.
- **John Livsey, Ylva Sjöberg and Josefin Torslund** gave presentations and did small experiments with a school group at Jensen Gymnasium Internationella during the World Water Day.

Appendix 2: Publications

At least 215 climate-related publications were published by Bolin Centre scientists in 2018.

- Aggemyr, E., Auffret, A.G., Jädergård, L. & Cousins, S.A.O. 2018. Species richness and composition differ in response to landscape and biogeography. *Landscape Ecology*: 33, 2273–2284. <https://doi.org/10.1007/s10980-018-0742-9>
- Ahmed, E., Parducci, L., Unneberg P., Ågren, R., Schenk, F., Rattray, J.E., Han, L., Muschitiello, F., Pedersen, M.W., Smittenberg, R.H., Yamoah, K.A., Slotte, T., Wohlfarth, B., 2018. Archaeal community changes in Lateglacial lake sediments: Evidence from ancient DNA. *Quaternary Science Reviews* 181: 19–29. <https://doi.org/10.1016/j.quascirev.2017.11.037>
- Akperov, M., Rinke, A., Mokhov, I. I., Matthes, H., Semenov, V. A., Adakudlu, M., Cassano, J., Christensen, J. H., Dembitskaya, M. A., Dethloff, K., Fettweiss, X., Glisan, J., Gutjahr, O., Heinemann, G., Koenigk, T., Koldunov, N. V., Laprise, R., Mottram, R., Nikiéma, O., Scinocca, J. F., Sein, D., Sobolowski, S., Winger, K., and Zhang, W., 2018. Cyclone activity in the Arctic from an ensemble of regional climate models (Arctic CORDEX). *JGR-Atmos* 123. <https://doi.org/10.1002/2017JD027703>
- Andersen JL, Egholm DL, Knudsen MF, Linge H, Jansen JD, Pedersen VK, Nielsen SB, Tikhomirov D, Olsen J, Fabel D, Xu S (2018) Widespread erosion on high plateaus during recent glaciations in Scandinavia. *Nature Communications* 9, 830. <https://doi.org/10.1038/s41467-018-03280-2>
- Andersson, A., Brugel, S., Paczkowska, J., Rowe, O.F., Figueroa, D., Kratzer, S. and Legrand, C., 2018. Influence of allochthonous dissolved organic matter on pelagic basal production in a northerly estuary. *Estuarine, Coastal and Shelf. Science*: 204, pp.225–235. <https://doi.org/10.1016/j.ecss.2018.02.032>
- Angela V. Gallego-Sala, A.V., Charman, D.J., Brewer, S., Page, S.E., Prentice, I.C., Friedlingstein, P., Moreton, S., Amesbury, M.J., Beilman, D.W., Björck, S., Blyakharchuk, T., Bochicchio, C., Booth, R.K., Bunbury, J., Camill, P., Carless, D., Chimner, R.A., Clifford, M., Cresse, E., Courtney-Mustaphi, E., De Vleeschouwer, F., de Jong, R., Fialkiewicz-Koziel, B., Finkelstein, S.A., Garneau, M., Githumbi, E., Hribljan, J., Holmquist, J., Hughes, P.D.M., Jones, C., Jones, M.C., Karofeld, E., Klein, E.S., Kokfelt, U., Korhola, A., Lacourse, T., Le Roux, G., Lamentowicz, M., Large, D., Lavoie, M., Loisel, J., Mackay, H., MacDonald, G.M., Mäkilä, M., Magnan, G., Marchant, R., Marcisz, K., Martínez Cortizas, A., Massa, C., Mathijssen, P., Mauquoy, D., Mighall, T., Mitchell, F.J.G., Moss, P., Nichols, J., Oksanen, P.O., Orme, L., Packalen, M.S., Robinson, S., Roland, T.P., Sanderson, N.K., Sannel, A.B.K., Silva-Sánchez, N., Steinberg, N., Swindles, G.T., Turner, T.E., Uglow, J., Väliranta, M., van Bellen, S., van der Linden, M., van Geel, B., Wang, G., Yu, Z., Zaragoza-Castells, J., Zhao, Y., 2018: Latitudinal limits to the predicted increase of the peatland carbon sink with warming. *Nature Climate Change*: 8, 907–913. <https://doi.org/10.1038/s41558-018-0271-1>
- Arzhannikov SG, Ivanov AV, Arzhannikova AV, Demonterova EI, Jansen JD, Preusser F, Kamenetsky VS, Kamenetsky MB (2018) Catastrophic events in Quaternary history of Lake Baikal. *Earth-Science Reviews* 177, 76–113. <https://doi.org/10.1016/j.earscirev.2017.11.011>
- Auffret, A.G. & Cousins, S.A.O. 2018. Land uplift creates important meadow habitat and a potential original niche for grassland species. *Proceedings of the Royal Society B: Biological Sciences*: 285, 20172349. <https://doi.org/10.1098/rspb.2017.2349>
- Auffret, A.G., Cousins, S.A.O., 2018. Land uplift creates important meadow habitat and a potential original niche for grassland species. *Proceedings of the Royal Society B*: 20172349. <https://doi.org/10.1098/rspb.2017.2349>



Blue iceberg in the Arctic. Photo: Gabrielle Stockman

- Barcikowska, M., Weaver, S.J., Feser, F., Russo, S., Schenk, F., Stone, D.A., Zahn, M., 2018. Euro-Atlantic winter storminess and precipitation extremes under 1.5 °C versus 2 °C warming scenarios. *Earth System Dynamics*: 9, 679–699. <https://doi.org/10.5194/esd-9-679-2018>
- Barlow, A., Cahill, J.A., Hartmann, S., Theunert, C., Xenikoudakis, G., Fortes, G.G., Paijmans, J.L.A., Rabeder, G., Frischauf, C., Grandal-d’Anglade, A., García-Vázquez, A., Murtskhvaladze, M., Saarma, U., Anijalg, P., Skrbinšek, T., Bertorelle, G., Gasparian, B., Bar-Oz, G., Pinhasi, R., Slatkin, M., Dalén, L., Shapiro, B., and Hofreiter, M., 2018. Partial genomic survival of cave bears in living brown bears. *Nature Ecology & Evolution*: 2, 1563–1570. <https://doi.org/10.1038/s41559-018-0654-8>
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- Bartlett, R.E., Bollasina, M.A., Booth, B.B.B., Dunstone, N.J., Marengo, F., Messori, G., and Bernie, D.J., 2018. Do differences in future sulphate emission pathways matter for near term climate? A case study for the Asian Monsoon. *Clim. Dyn.* <https://doi.org/10.1007/s00382-017-3726-6>
- Beer, C., Porada, P., Ekici, A., Brakebusch, M., 2018. Effects of short-term variability of meteorological variables on soil temperature in permafrost regions. *The Cryosphere*: 12, 741-757. <https://doi.org/10.5194/tc-12-741-2018>
- Bender, F. A.-M., Frey, L., McCoy, D. T., Grosvenor, D. P., Mohrmann, J. K., 2018. Assessment of aerosol-cloud-radiation correlations in satellite observations, climate models and reanalysis. *Climate Dynamics*, 52 (7-8). pp. 4371-4392. <https://doi.org/10.1007/s00382-018-4384-z>
- Berg, C., Dupont, C.L., Asplund-Samuelsson, J., Celepli, N.A., Eiler, A., Allen, A.E., Ekman, M., Bergman, B., and Ininbergs, K., 2018. Dissection of Microbial Community Functions during a Cyanobacterial Bloom in the Baltic Sea via Metatranscriptomics. *Frontiers in Marine Science*: 5, 55. <https://doi.org/10.3389/fmars.2018.00055>
- Bergqvist, G., Paulson, S., and Elmhagen, B., 2018. Effects of female body mass and climate on reproduction in northern wild boar. *Wildlife Biology*: wlb.00421. <https://doi.org/10.2981/wlb.00421>
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- Björk, G., Jakobsson, M., Assmann, K., Andersson, L. G., Nilsson, J., Stranne, C., and Mayer, L., 2018. Bathymetry and oceanic flow structure at two deep passages crossing the Lomonosov Ridge. *Ocean Sci.*: 14, 1, 1–13. <https://doi.org/10.5194/os-14-1-2018>
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Bolin Centre Co-Director Alasdair Skelton and Caroline Greiser, the winner of the Bolin Days PhD student poster competition for the second year running. Photo: Karin Jonsell.

Appendix 3: Contact information

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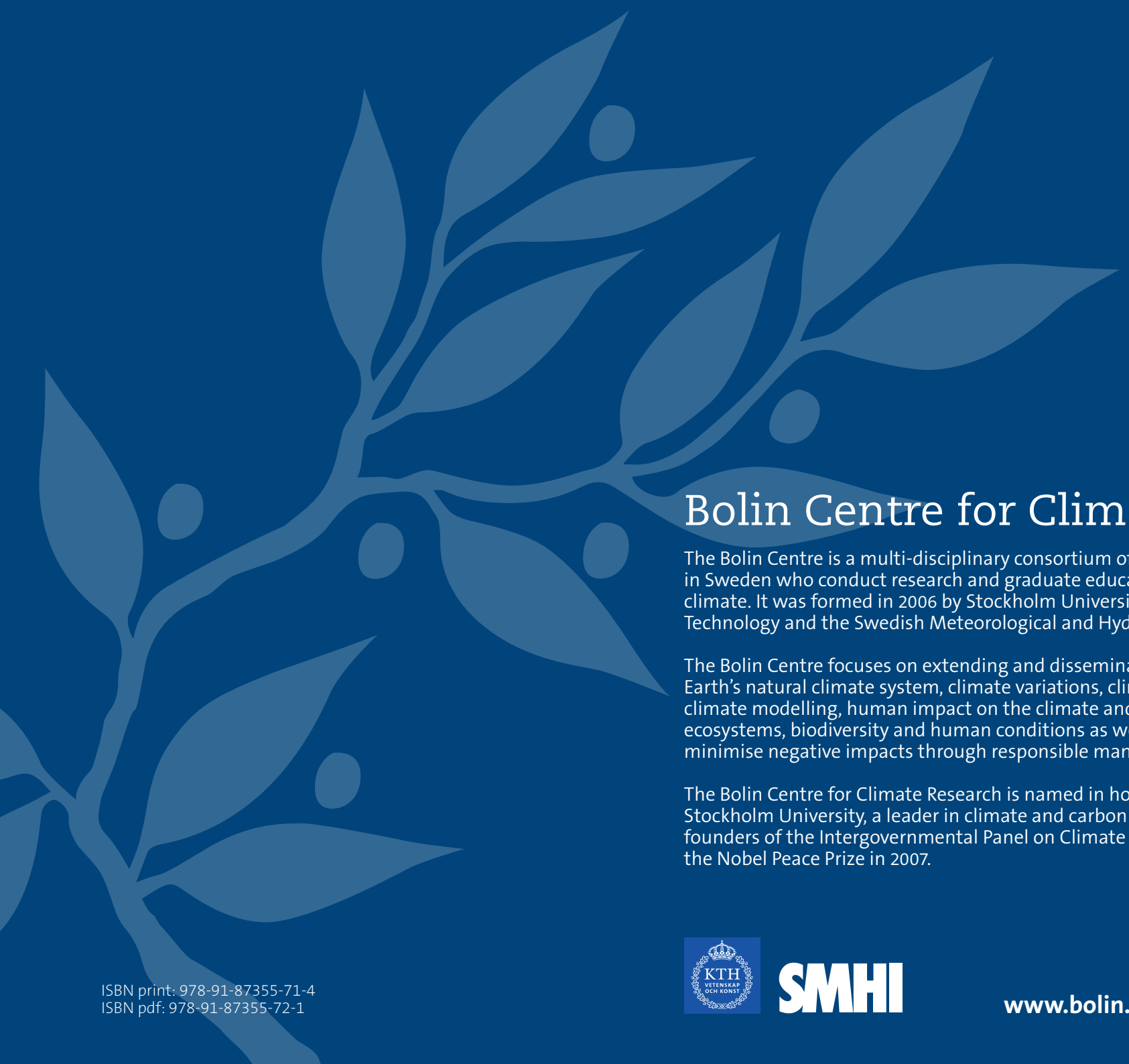
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Autumn at the Stockholm University Campus. Photo: Karin Jonsell

A large, stylized graphic of a leafy branch, rendered in a lighter shade of blue than the background, extending from the left side of the page towards the center.

Bolin Centre for Climate Research

The Bolin Centre is a multi-disciplinary consortium of more than 350 scientists in Sweden who conduct research and graduate education related to the Earth's climate. It was formed in 2006 by Stockholm University, the KTH Royal Institute of Technology and the Swedish Meteorological and Hydrological Institute (SMHI).

The Bolin Centre focuses on extending and disseminating knowledge about the Earth's natural climate system, climate variations, climate impacting processes, climate modelling, human impact on the climate and climate impacts on ecosystems, biodiversity and human conditions as well as how society can minimise negative impacts through responsible management.

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