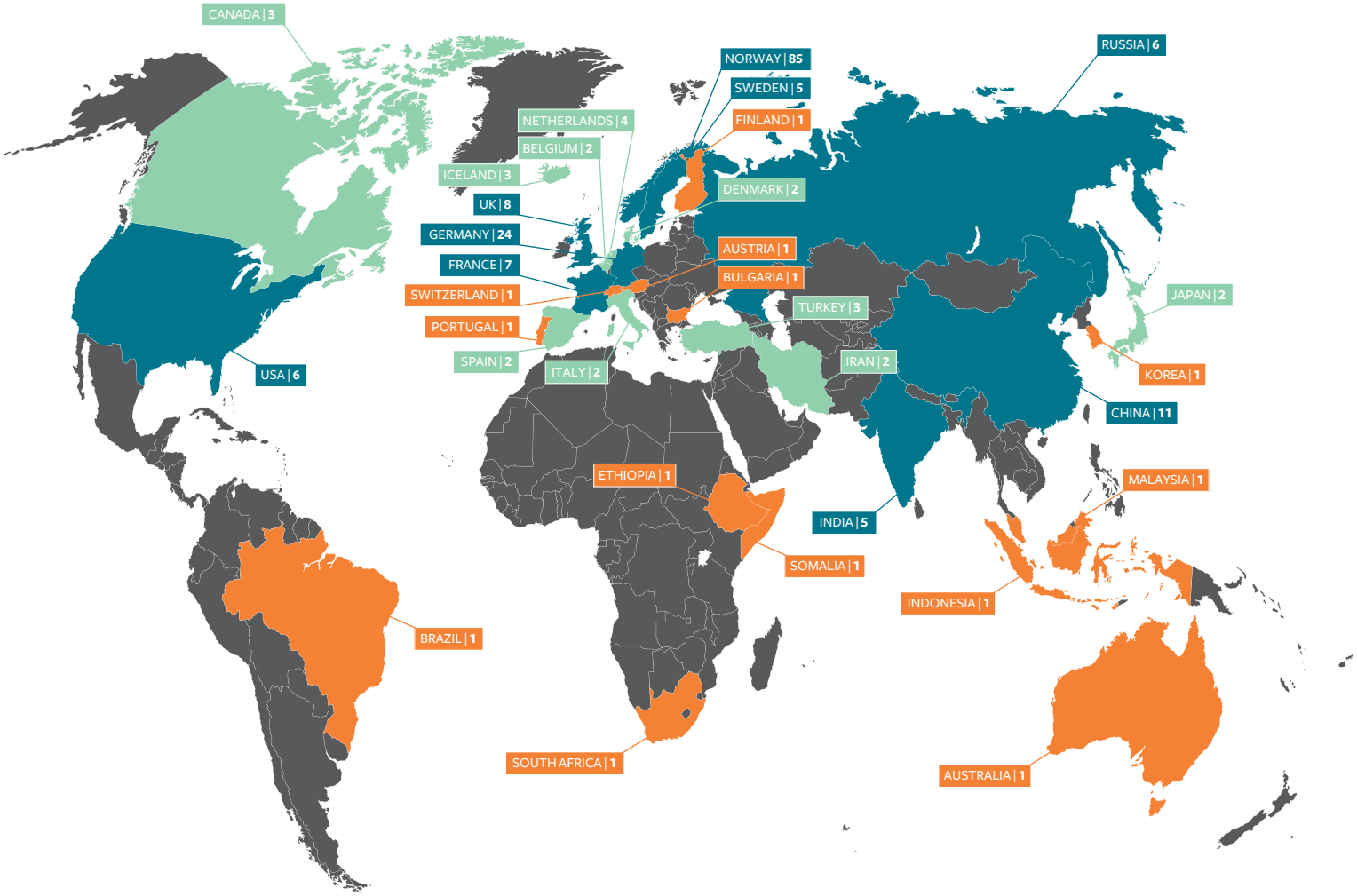
Bjerknes Centre for Climate Research 2014

Bjerknes Centre
for Climate Research



A year of expansion - researchers from 32 nationalities form the Bjerknes Centre in 2014
ILLUSTRATION: **HALTENBANKEN**

NERSC
Nansen Center, Bergen

uni Research

Statement from the board

The board is pleased with the high scientific production at the Bjerknes Centre. The many papers in high-profile journals show that the Centre's scientific impact is higher than ever before. The Centre is also complying with its societal duty through novel approaches regarding outreach, such as the launch of an annual, open event "Bjerknes day" and collaboration with the Bergen Science Centre.

Bjerknes scientists have had a high success rate in acquiring additional external funding over the last couple of years. As a consequence, the partners have increased their scientific personnel, and concomitantly, the number of Bjerknes affiliated scientists. However, this poses a challenge, not only in terms of logistics but also regarding the consolidation of the research groups around a common Bjerknes identity. In this regard, the University of Bergen´s commitment to securing working space for some of this large community is acknowledged.

The board endorses the merger of the Centre of Climate Dynamics with the Bjerknes Centre into a simplified and efficient structure. With re-defined scientific goals and strategies at all levels, the new governance will ensure that the scientific activities will thrive. The board looks forward to the continuing success of the Bjerknes Centre in pursuing its mission: to understand and quantify the climate system for the benefit of society.

A wet view of Bergen from the top of Mount Ulriken.

PHOTO: **ERIK KOLSTAD**

A year of expansion

TORE FUREVIK, DIRECTOR OF THE BJERKNES CENTRE FOR CLIMATE RESEARCH

The Bjerknes Centre has experienced a number of changes during the past year. There has been a new governance structure including changes to the board, a new leadership and new research groups. The vision, scientific goals and strategies have been re-defined, and science and implementation plans have further been developed for each research group. Eight new internal projects have been identified to pursue a variety of important and challenging scientific questions. These projects are funded by the core grant from the government, and are important for building new competence.

As a consequence of the Centre's high success rate in acquiring research grants from external funding sources, there has been a rapid growth in personnel. The total number of academic (scientists, post-docs, PhD candidates), technical and administrative staff increased from 150 to 195 during the year. The Centre is recruiting people from all corners of the world, and for the first time non-Norwegians are in the majority. A total of 32 nations and all six continents are now represented among the staff.

Producing good science

The number of peer-reviewed publications increased significantly and the Centre is more visible than ever in producing good science. Close to 150 articles in international journals have been published, with five in the Nature and Science suite of journals. With a number of new research projects just in their starting phase, and with many excellent PhD students and post-docs recruited, the potential for further growth should be good.

Focus on recruitment

The Centre continues its strong commitment to research training and recruitment, by offering a range of courses, workshops and summer schools organised by the National Research School in Climate Dynamics (ResClim), which is coordinated by the Bjerknes Centre. The activities this year included three summer schools: the IMPACT2C summer school on regional climate change impacts held in Rosendal, Norway, the ACDC2014 summer school on the Dynamics of the Greenland Ice Sheet at Disco Island, Greenland, and the Nansen-Tutu summer school on Agulhas in Cape Town, South Africa. Several other courses and workshops were initiated and organised by the PhD students themselves.

The Bjerknes Centre has also established collaborations with the Bergen Science Centre, where PhD candidates are teaching and supervising schoolchildren on various aspects of climate and climate change.

More records

During the course of the year it became more and more evident that 2014 would turn out to be record warm, not only in Norway, but also for northern Europe and the globe as a whole, although measurement limitations makes it impossible to state the latter with certainty. With warmer air comes more moisture to our latitudes, and severe flooding in many Norwegian west-coast villages in October reminded us about one aspect of climate change, i.e. increased frequency of extreme precipitation. On the other hand, extensive regions of the world are experiencing the opposite with concomitant dramatic impacts – a lack of water leading to long-lasting droughts and crop failures.

Solutions oriented research

In the national and international discourse there is gradually less focus on the causes of climate change, and more on the impacts and mitigation aspects of climate change. The challenges involved are huge for all nations in the world, although rich countries are generally less impacted and in better shape to handle the situation than less favoured countries. The funding agencies are also gradually turning their attention away from basic climate research towards ways to transform society to a more sustainable pathway. This poses a challenge to our future ability to generate funding for our own research. One path is to get involved in more societal oriented research, and in this regard, the Centre is exploring and expanding its venues of collaboration in that direction.

Sustainability on the agenda

The year that has started will be of particular importance for climate. Two major, and potentially game changing, conferences will be held only a few months apart. The United Nations summit for the adoption of the post-2015 development agenda in New York in September, and the United Nations climate change conference—COP21—in Paris in December can both have tremendous impact on how the world's society will move forward. While we hope for the best possible results, the Bjerknes Centre will continue to produce and deliver the most robust science-based knowledge for society in the years to come.

Objectives and Research

The aim of the Bjerknes Centre is to understand and quantify the climate system for the benefit of society.

The Bjerknes Centre for Climate Research aims at the understanding and quantification of the climate system for the benefit of society.

The Centre is a collaboration between four institutions: the Uni Research Ltd, the University of Bergen, the Institute of Marine Research and the Nansen Environmental and Remote Sensing Centre.

We engage 180 scientists from 32 countries, making the Centre one of the largest climate research units in Europe.

Our scientific activities are organised into seven research groups, each with specific goals, objectives and implementation plans.

Our strength relies in that we combine, in a unique fashion, observations with theoretical and modelling studies of past, present and future climates.

The Centre will

- Identify processes controlling natural and human-induced climate change.
- Understand large-scale teleconnections and couplings in the atmosphere and ocean.
- Understand and quantify past climate variations at regional and global scales
- Determine changes in the earth's cryosphere (sea-ice, permafrost, glaciers, ice sheets)
- Understand and quantify global and regional sea-level changes
- Quantify global biogeochemical cycles and their couplings to the climate system
- Provide scenarios for future climate at global and regional scales
- Develop methods for providing seasonal to decadal climate predictions
- Contribute actively to the climate change mitigation and adaptation processes
- Play an important role in the training of future generations of climate scientists
- Communicate research results to stakeholders and society at large.

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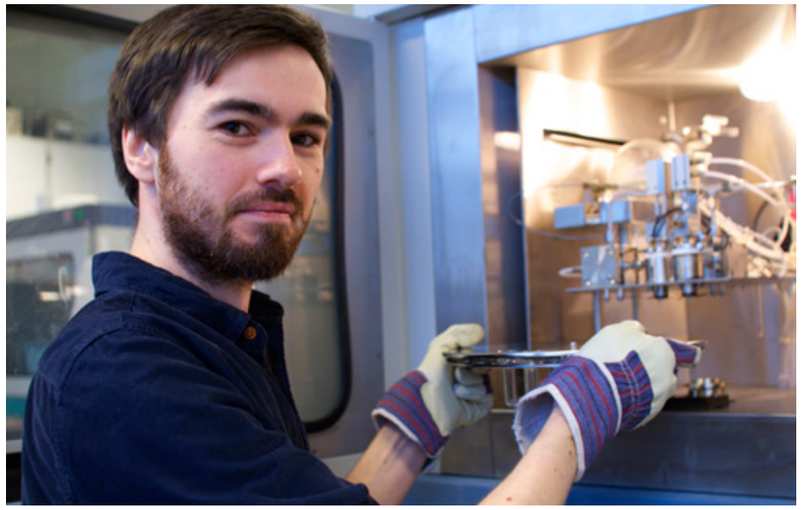
Unstable deep-ocean circulation during the last interglacial period

A study published in *Science* suggests that Atlantic deep-water formation may be more fragile than previously realised.



Eirik Vinje Galaasen is preparing foraminifera shells from the last interglacial period for stable isotope analyses in the mass spectrometer. Galaasen is lead author of the study published in Science February 2014.
PHOTO: GUDRUN SYLTE

During the last interglacial period, about 125,000 years ago, there was a series of sudden and large reductions in the influence of North Atlantic Deep Water in the deep Atlantic. These deep-water reductions lasted for some centuries before bouncing back. The unstable circulation operated as if it was near a threshold, flickering back and forth across it.

At this time, the North Atlantic was warmer, fresher and sea level was higher than it is today and looked similar to how climate models predict it will look by the end of this century.

In the study, led by researchers at the Bjerknes Centre, shells of tiny single-celled foraminifera found in marine sediment in the North Atlantic Ocean were used to reconstruct the surface ocean conditions and concomitant deep ocean circulation changes about 125,000 years ago.

Previously, the modern pattern of deep-water circulation has been considered relatively stable during warm climate states such as those projected for the end of the century.

Today, deep waters formed in the northern North Atlantic fill approximately half of the deep ocean globally. The formation process impacts on the Atlantic climate and regional sea level, and soaks up much of the excess atmospheric carbon dioxide from industrialisation, helping to moderate the effects of global warming. Changes in this circulation mode are considered a potential tipping point in future climate change that could have widespread and long-lasting impacts including on regional sea level, the intensity and pacing of Sahel droughts, and the pattern and rate of ocean acidification and CO_2 sequestration.

The types of deep ocean changes that this study revealed are so short-lived that they had not been noticed before. Ocean changes on a century scale are difficult to detect this far back in time, and had not been focused on earlier. At the location south of Greenland that Galaasen et al. (2014) studied, mud builds up 10–15 times faster than normal, recording much shorter changes than at other sites.

The international team, with researchers from Norway, the United States, France and the United Kingdom, studied traces of deep-ocean properties imprinted in the sediments on the seafloor. Coring into the seafloor mud they could look back in time to reconstruct changes in the abyssal ocean. The study demonstrates that deep-water formation can be disrupted by freshening of the regional surface water, which might happen due to enhanced precipitation and glacier melting under future climate change scenarios.

Reference

Galaasen, Eirik Vinje, Ninnemann, Ulysses S., Irvali, Nil, Kleiven, Helga F., Rosenthal, Y., Kissel, C. Hodell, D. A. (2014): Rapid reductions in North Atlantic Deep Water during the peak of the last interglacial period. *Science*, 343: 1129–1132. doi: 10.1126/science.1248667

While the Arctic is melting the Gulf Stream remains

The melting Arctic is not the source for less saline Nordic Seas. It is the Gulf Stream that has provided less salt.

A study published in Nature Geoscience documents that the source of fresher Nordic Seas since 1950 is rooted in the saline Atlantic as opposed to Arctic freshwater that is the common inference. The Nordic Seas have freshened substantially since 1950, coincidental with observed increased river runoff and net ice melting in the Arctic. The concurrence of a less saline ocean and Arctic freshwater input has given the climate research community reason for concern, as a layer of Arctic freshwater could impede the Gulf Stream's Arctic branch.

Going back in time – into and through ice ages – such a freshwater lid has been understood to reduce ocean circulation and thus the Gulf Stream's poleward heat transport.

The researchers from the Bjerknes Centre have analysed the available observations back to 1950 and conclude that the changing salt content in the Nordic Seas is explained by the variable salinity of the Gulf Stream's Arctic branch entering the seas from the south. The mode of operation is also realised in a numerical ocean model forced by the observed state of the atmosphere during the period in question.

Mirijam Sophia Glessmer.
PHOTO: PRIVATE

Although not part of the present study, there appears to be several reasons for the freshening of the Atlantic source waters. A dominant explanation is a general increase in net precipitation over the North Atlantic Ocean (which may very well relate to global climate change). The contribution is spread over the Gulf Stream system, and accordingly transported farther northward.

The analysis of Glessmer and colleagues further shows, and in line with the above, that the salt deficit in the Nordic Seas is not related to a surface layer of freshwater. The low-salinity anomaly since 1950 is distributed throughout the water column following the Gulf Stream's northern overturning from warm surface flow to cold deep water.

The study has important practical implications, for example relating to the Bjerknes Centre's current development of the Norwegian Climate Prediction Model into a Norwegian operational system for climate prediction on seasonal to decadal time scales. The study documents how large-scale changes in our marine climate propagate with the extension of the Gulf Stream into the Nordic Seas. This suggests that the marine climate could be predictable on the time scale that a climate signal is travelling north.

Reference

Glessmer, Mirijam Sophia, Eldevik, Tor , Våge, Kjetil, Nilsen, Jan Even Ø. and Behrens, Erik. (2014): Atlantic origin of observed and modelled freshwater anomalies in the Nordic Seas. *Nature Geoscience*, 7, 801–805.

The age of the Sahara desert

Climate simulations double the Sahara's age – it might be twice as old as previously estimated.

Zhongshi Zhang.
PHOTO: PRIVATE

It is widely believed that the Sahara desert first appeared during the last 2 to 3 million years, but recent discoveries such as ancient sand dunes and dust records in marine cores push the possible onset of Saharan aridity back in time by several million years. Until now, however, there have been no good explanations for such an early Sahara onset.

The Sahara is the world's largest subtropical desert. During past decades, numerous scientific studies have probed its geological and archeological archives seeking to reveal its history. Despite some important breakthroughs, there are still basic questions that lack satisfactory answers.

In a study published in Nature in September 2014, the Tortonian stage (~7-11 million years ago) is pinpointed as a pivotal period for triggering North African aridity and creating the Sahara desert. Using snapshot simulations with the Norwegian Earth System Model (NorESM), the researchers, led by Zhongshi Zhang at Uni Research and the Bjerknes Centre, explored the climate evolution of North Africa through major tectonic shifts over the last 30 million years.

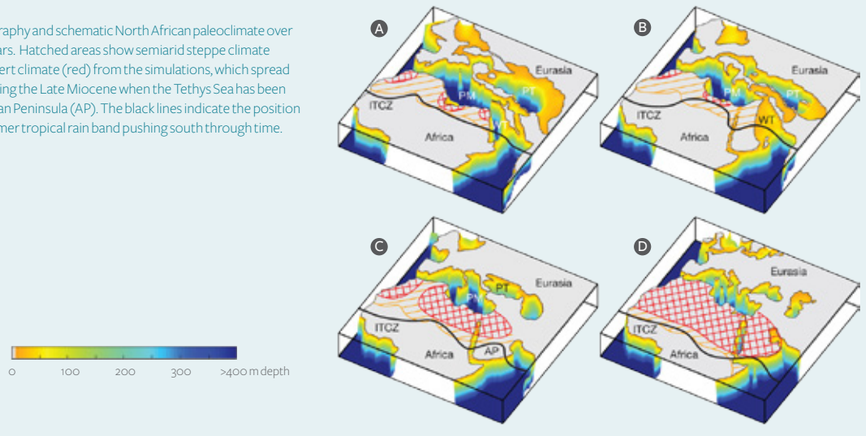
The international team of researchers found that the region underwent aridification with the shrinking of the Tethys—a giant ocean that was the origin of the modern Mediterranean, Black and Caspian Seas—during the Tortonian.

The simulations are the first to show that the Tethys shrinkage has two main consequences for North African climate. First, it weakens the African summer monsoon circulation and dries out North Africa. Second, it enhances the sensitivity of the African summer monsoon and its associated rainfall to orbital forcing. The Tortonian stage thus marks the time when North Africa shifted from a permanently lush, vegetated landscape to a landscape experiencing arid/humid cycles on orbital time scales.

Reference

Zhang, Zhongshi, Ramstein, G., Schuster, M., Li, Camille, Contoux, Camille and Yan, Q. (2014): Aridification of the Sahara desert caused by Tethys Sea shrinkage during the Late Miocene. *Nature*, 513, 401–404

Tethys paleogeography and schematic North African paleoclimate over the past 30 million years. Hatched areas show semiarid steppe climate (orange) and arid desert climate (red) from the simulations, which spread over North Africa during the Late Miocene when the Tethys Sea has been replaced by the Arabian Peninsula (AP). The black lines indicate the position of the simulated summer tropical rain band pushing south through time.



Cottongrass. Field work at Finse, September 2024.
PHOTO: ANNE BJUNE

Trapping modern pollen rain

Eight years of trapping modern pollen has provided data to study the relationship between the presence of plants in the current vegetation and their representation in pollen samples. Knowledge of this relationship is important to be able to reconstruct past plant presence and abundance, as well as changes in past tree-line positions. For eight years Anne E. Bjune at the Bjerknes Centre and Uni Research has collected and analysed pollen deposited in small bottles placed at different elevations at Upsete and Finse. The study is now published in Vegetation History and Archaeobotany and shows that there are large variations in both pollen percentages and pollen accumulation rates (PAR) from year to year, but also shows that the amount of pollen from trees decreases with distance from the source vegetation. Pollen traps placed in the vegetation reflect a more local signal than traps placed in a small lake at Upsete. Further pollen trapping is recommended to get a robust long-term average.

Reference

Bjune, Anne Elisabeth (2014): After 8 years of annual pollen trapping across tree line in western Norway – are the data still anomalous? *Vegetation History and Archaeobotany*, 23, 299-308.

Pollen and macrofossil traps at Upsete that have collected pollen and plant remains since 2004. Traps are emptied every autumn and theirs contents are analysed to show annual variation in production and deposition of fossils from different plants near the present day tree line.
PHOTO: **ANNE BJUNE**

Detecting the oceanic CO_2 sink today and in the future

The surface ocean partial pressure of CO_2 (pCO_2) can be directly measured and is an indicator of long-term climate and ocean carbon uptake change. A study led by Jerry Tjiputra at the Bjerknes Centre for Climate Research, quantified the long-term growth rate of surface ocean pCO_2 over various broad-scale oceanic domains. Using the latest collection of pCO_2 data and state-of-the-art Earth system models, the researchers confirm that ocean pCO_2 has steadily increased following the atmospheric CO_2 concentration in the past four decades.

A large portion of this increase is attributed to the ongoing invasion of anthropogenic CO_2 into the ocean, whereas the increase in sea surface temperature contributes only marginally. It is evident from the models that in order to monitor the oceanic CO_2 sink accurately, long-term records of surface pCO_2 in key ocean regions are required. The study shows that, despite a substantial increase in the number of measurements over the past years, only two ocean regions have a sufficient spatial and temporal coverage, namely the subtropical North Atlantic and the western subpolar North Pacific. For the rest of the ocean, particularly in the southern hemisphere, poor data coverage hinders the full picture of the pCO_2 trend.

Reference

Tjiputra, Jerry F., Olsen, A., Bopp, L., Lenton, A., Pfeil, B., Roy, T., Segschneider, J., Totterdell, I., and Heinze, Christoph. (2014): Long-term surface pCO_2 trends from observations and models. *Tellus B*, 66, 23083.

Reduced sea-ice area also in winter

The Arctic sea-ice area has been measured using satellites since 1979. During recent decades, warmer Atlantic Water has caused a retreat of the ice-edge north of Svalbard. A paper published in Tellus by Ingrid Husøy Onarheim and co-workers demonstrate large changes in the sea-ice cover north of Svalbard, with ice cover decreasing for all months, but with largest ice reduction during winter. This is in contrast to the observed changes in more central parts of the Arctic Ocean, where the largest ice decline is happening during summer. The study shows that the sea ice has retreated above the pathway of the Atlantic Water north of Svalbard. This indicates a direct influence from the Atlantic Water on the sea-ice conditions. Observations of the Atlantic Water temperature show a gradual warming over the last decades. There is thus more heat available for melting the sea ice, and it is also more difficult to form sea ice because the ocean needs more cooling to reach the freezing point.

Reference

Onarheim, Ingrid Husøy, Smedsrud, Lars Henrik, Ingvaldsen, Randi B. and Nilsen F. (2014): Loss of sea ice during winter north of Svalbard. *Tellus A*, 66, 23933.

On track to climate prediction

In a study published in Tellus A, Francois Counillon and co-authors at the Bjerknes Centre test seasonal-to-decadal predictions with an advanced initialisation method that has proven successful in weather forecasting and operational oceanography. "Ordinary" climate projections are designed to represent the persistent change induced by external forcing. Such "projections" start from initial conditions that are distant from today's climate and thus fail to "predict" the year-to-year variability and most of the decadal variability such as the pause in the global temperature increase (hiatus) or the spate of harsh winters in the northern hemisphere. In contrast, seawater predictions rely entirely on the accuracy of their initial state as the influence of the external forcing is almost imperceptible. The Norwegian climate prediction model (NorCPM) combines the Norwegian Earth System model with the Ensemble Kalman Filter. The Ensemble Kalman Filter uses statistics from an ensemble of predictions to estimate the relationship between the observations and all variables for their correction. NorCPM demonstrated decadal predictability for the Atlantic meridional overturning and heat content in the Nordic Seas that were close to the model's limit of predictability. Although these results are encouraging, the idealised framework assumes that the model is perfect and lower skill is expected in a real framework.

Reference

Counillon, Francois, Bethke, I., Keenlyside, N., Bentsen, M., Bertino, L., Zheng, F. (2014): Seasonal-to-decadal predictions with the Ensemble Kalman Filter and the Norwegian Earth System Model: a twin experiment. *Tellus A*, 66, 21074.

Surprising future trends in Scandinavian floods

In a paper published in Global and Planetary Change, Eivind Støren and coauthor examine the potential co-variability between winter precipitation and floods at millennial time scales. Most climate models agree on a general increase in future precipitation in the northern hemisphere, but not on how this will perturb flooding rates. In the study, reconstructed winter precipitation from five records in Scandinavia was compared to data from two high-resolution flood records from southern Norway over a period of 6000 years. Winter precipitation as snow explains around 40% of changes in the flood frequency. This indicates that the spring snowmelt flood peak that dominates the present discharge regime in the major rivers in southern Norway is dominant over long timescales as well.

Projections for future winter precipitation over central Scandinavia for the next 100 years suggest a continued increase. This tends to imply that the number of floods will increase in response to a wetter regime. According to this study, and somewhat surprisingly, this seems to be a passing effect. The accompanying warming causes the increase of precipitation to fall as rain rather than snow, and is likely to cause a rapid reduction in snowmelt triggered floods.

Reference

Støren, Eivind N. and Paasche, Øyvind. (2014): Scandinavian floods: From past observations to future trends. *Global and Planetary Change*, 113, 34-43.

Poleward ocean heat transport

A model was created to study the relationships between Arctic sea-ice area and ocean heat transport through the primary Arctic gateways, such as the Fram Strait and the Barents Sea Opening. In this study, Anne Britt Sandø and colleagues show that the negative trend in sea-ice area is greater in the Barents Sea than in the central Arctic Ocean. In the Barents Sea, increased heat transport in the Barents Sea Opening has a strong influence on sea-ice area in terms of reduced congelation growth, where new ice forms on the bottom of established ice cover. In the central Arctic Ocean, bottom melting is important for the observed variability. Even though the central Arctic Ocean area is much larger than the Barents Sea, the negative trend in sea-ice area is considerably greater in the latter because of the major positive trend in heat transport in the Barents Sea Opening. Three models in the CMIP5 archive were compared for the analysis of the relationships between Arctic sea-ice area and poleward ocean heat transport. Based on an evaluation, the NorESM1-M model was found to be the most suitable, and the conclusions are based on results from this model. The model results also suggest that the ocean has a stronger direct impact on changes in sea-ice mass in terms of freezing and melting than the atmosphere does, both on average and with respect to variability.

Reference:

Sandø, Anne Britt, Gao, Y.Q. and Langehaug, H. (2014): Poleward ocean heat transports, sea ice processes and Arctic sea ice variability in NorESM1-M simulations. *Journal of Geophysical Research-Ocean*, 119 (3), 2095-2108, http://dx.doi.org/10.1002/2013JC009435

It's all in the detail

Detail is of high importance when working with macrofossils. Professor Hilary Birks turned 70 in 2014, but the palaeoecologist is not stopping her scientific work.

BY GUDRUN SYLTE

Hilary Birks is one of the veterans of the Bjerknes Centre. She was in the original interdisciplinary Bjerknes collaboration team who applied for a Centre of Excellence in 2002 at the Research Council of Norway. PHOTO: GUDRUN SYLTE

In February 2015, Professor Emerita Hilary Birks was elected a fellow of the American Association for the Advancement of Science, thus becoming the third Fellow from Norway. The AAAS honoured her for "extraordinary contributions to Quaternary palaeoecology, particularly in reconstructing landscapes across the periglacial northern hemisphere based on pollen and plant macrofossil assemblages".

Half a year earlier, her anniversary seminar in Bergen was titled, "It's all in the detail". Her colleagues Anne Bjune and Kathy Willis had quietly gathered lecturers, old friends, and collaborators – but what should have been a secret, was not a secret for long.

"My husband is incapable of keeping a secret from me" Hilary laughs, but adds that John was not the only one revealing the secret. The head of the biology institute also mentioned he would attend her seminar – before she was expected to know about it.

In addition to the seminar, her colleagues wrote a special issue of Vegetation History and Archaeobotany dedicated to her.

"We really want to honour Hilary and her many contributions to science. Both the seminar and Festschrift demonstrate her broad and diverse scientific work", says Anne Bjune, scientist at Uni Research and the Bjerknes Centre.

A new life with macrofossils

In the mid-1980s John and Hilary Birks moved to Bergen from Cambridge. What should have been a one-year research visit, quickly turned into thirty years, as a job offer at UiB conveniently appeared. And because their 12-year old son liked Bergen better than Cambridge, the choice was easy to make. For Hilary, it was also a chance to establish a scientific career.

"In Cambridge I was treated as John's wife. But here in Bergen we were treated as two individuals, where I also had the chance to get funding for research projects" she says.

In Cambridge she worked in a music shop. As John already had a position at the University she could not also get a permanent position, as the employment of a married couple in one department was not allowed. Selling music was fun, but it was a job with zero macrofossils!

Building up palaeoecology at UiB

In the small UiB community, news of the Birks couple spread. The geologist Jan Mangerud and his colleague John Inge Svendsen, both Bjerknesians today, asked Hilary to join a project on Svalbard. She was on track with research again.

Her main research area is vegetation and ecosystems of the past. Her projects have always been multi-disciplinary, cooperating with biologists, geologists, palaeolimnologists, geographers and archaeologists. Her macrofossil analyses have given insights into how ecosystems have changed in response to climate change and human activity from the last glacial maximum until today.

"At the Bjerknes Centre it has been inspiring to meet people from other disciplines. They provide new perspectives on my own research; they broaden my horizons" Hilary says.

From project work to professorship

Hilary's employment at UiB was project funded until 2002, when she received a personal professorship.

On retirement, she can now take a look back at a fruitful life in science; reconstructing past ecosystems based on plant macrofossils and pollen from sedimentary deposits and inferring past climates, especially during the late-glacial and early Holocene, developing multi-disciplinary projects in four continents, and contributing to method developments and improvements in radiocarbon chronology.

Her CV counts more than 120 scientific publications, five books, and a long list of presentations. In addition, she has enjoyed teaching undergraduates and supervising MSc and PhD students. 'Hobby Botany' has included over 70 adventurous botanical expeditions to many of the alpine areas of the world. She is also a skilled plant and landscape photographer and has won a number of prizes for her photographs.

"Her scientific work is outstanding and world leading", Anne Bjune says.

It is fitting that the American Association for the Advancement of Science recognised this and elected Hilary a Fellow. Hilary will receive another honour this year: The International Palaeolimnological Association will award Hilary a Lifetime Achievement Medal at their conference in Lanzhou in August 2015.

Professor Emeritus Tor Gammelsrød has worked in Mozambique since the 80's, in between research trips to both the Arctic and the Antarctic. PHOTO: GUDRUN SYLTE

A practical view on physics and food

During a long career as an oceanographer, Tor Gammelsrød has worked in both the Arctic and Antarctic. But he would rather talk about Africa.

BY ELLEN VISTE

When Tor Gammelsrød turned 70 last year, the anniversary seminar featured a surprise visit by an old colleague. Mubango Houguane had travelled all the way from Mozambique to talk about their projects there. In the coastal town of Quelimane, the tides are a source of food, energy and MSc degrees.

Together with Hoguane, Tor Gammelsrød has been central in developing the oceanography programme at the School of Coastal and Marine Sciences at the University Eduardo Mondlane. The school already offered a Bachelor degree, and with support from the Norwegian Agency for Development Cooperation (NORAD), they were able to add a Master degree programme in 2008.

"The teachers were the first to be offered to study for the degree", Tor says – so they would be qualified to teach the students afterwards. The tides reach tens of kilometres inland because of the flat, coastal landscape of Mozambique, and the difference between high and low tides is several metres. This represents energy that the students in Quelimane learn to exploit. The tides are a central part of their education, for both their intrinsic quality and as a driver of an active society.

Shrimp farming is an important business in the region, and the shrimp farms pump in water at high tide and release it when the water is at its lowest. This way, water is renewed twice a day. Another research area on tide differences is how to use the difference between high and low tides for energy production, and for desalination of brackish water.

Simple solutions and hands-on studies

"It's possible to do things simply and inexpensively", Tor says, and tells how cups were attached to bushes and trees, so that the students could measure how far and how high the tides go. At the same time, he explains, they have benefited greatly from the increasing number of electronic instruments in recent years.

He also emphasises the social conscience of the Quelimane students: they choose to work on relevant, practical problems, not just theory. "It's a question of food, and of producing things that can be sold", he adds.

The same equations

In addition to visiting Mozambique several times, and undertaking projects in Namibia, Angola and South Africa, the polar regions have been Tor's main research area. Last autumn, he had two field cruises in the waters around Svalbard. The large geographical span does not hinder physical coherence.

"The same equations apply, and the same theory and the same techniques for measuring things. I learned techniques in Antarctica that I could use in Mozambique, and techniques in Mozambique that may be used in the Arctic", concludes Tor.

New strategic projects

The first round of strategic projects under the Centre for Climate Dynamics at the Bjerknes Centre (SKD) comes to an end in 2015. Early in 2014, the Centre had an internal call for new strategic projects running for the next 3.5 years. Bjerknes scientists came up with ideas for 156 MNOK – four times the available funding! The leader group at the Centre was overwhelmed by the many good ideas, and managed to group twenty out of the thirty submitted research ideas into eight new SKD projects, each receiving 4 or 6 MNOK in total.

Total budget from SKD funding	42 MNOK.
Additional in-kind contribution	69 MNOK.

SKD CENTRE FOR CLIMATE DYNAMICS AT THE BJERKNES CENTRE

Boundary Layers in the Arctic Atmosphere, Seas and Ice Dynamics (BASIC)

"We are excited to look at Earth's future climate already today. As the Atlantic Arctic is warming faster and stronger than the rest of the world, we have the opportunity to observe environmental shifts which will happen in 20–40 years on the pan-Arctic scale."
Igor Ezau

The boundary between the ocean and the atmosphere in the Arctic is changing. Observations show a "new Arctic", with thinner sea ice, stronger storms and turbulence, enhanced precipitation, increased ecosystem productivity and thawing permafrost. BASIC focuses on complex boundary processes in the marginal ice zone, a zone that is becoming more widespread, and where the exchange of heat, moisture and CO_2 between the air, sea and ice has a strong influence on both the ocean and the atmosphere. Specific attention is given to interacting air-sea boundary layer processes, which are key to controlling the sea-ice extent. The project will use data from several field campaigns, as well as high-resolution models that include turbulence.

FACTS
Leader — Igor Ezau
Partners — NERSC, UNI, UiB
Duration — 2015–2017
Budget — NOK 6 mill.

Biogeochemical change and detection (BIGCHANGE)

"I am really excited about the collaboration between Bjerknes biogeochemists and palaeoceanographers that this project makes possible."
Are Olsen

Circulation strongly affects the ocean's capacity for taking up CO_2 from the atmosphere. A good understanding of this relationship is thus essential for projecting the uptake of fossil-fuel CO_2 emissions and to allow the interpretation of carbon-based proxies in palaeo records that can then be used to study the ocean circulation of the past. BIGCHANGE will investigate the Atlantic carbon cycle and related circulation for the present-day, the recent past, past inter-glacials and the mid-Pliocene, about three million years ago. As a period when the global mean temperature was 2–3°C higher than today, carbon records from the mid-Pliocene can say something about what may be expected in a warmer future. BIGCHANGE will also improve a climate model's representation of ocean acidification, as well as methane and CO_2 in permafrost ground.

FACTS
Leaders — Are Olsen and Jerry Tjiputra
Partners — NERSC, IMR, UNI, UiB
Duration — 2015–2018
Budget — NOK 6 mill.

Freshwater from the shelf to the interior ocean: effect on climate and water-mass transformation in the Nordic Seas (FRESHWATER)

"With the objective to improve process understanding of the role of 'Freshwater' in the Nordic Seas, this project has a particular importance for the prediction of future response to a warming climate."
Øystein Skagseth

Freshwater from the Arctic Ocean and the Greenland ice sheet is transported southward by the East Greenland Current along the western boundary of the Nordic Seas. Some of this freshwater is diverted into the Iceland Sea, where wintertime formation of dense water provides a source to the lower limb of the Atlantic Meridional Overturning Circulation. This process is very sensitive to the salinity of the surface layer. In the Freshwater project we will combine sea-shell records and historical observations of sea-ice drift with instrumental observations and models to investigate how freshwater from the East Greenland Current impacts dense-water formation in the Iceland Sea as well as the composition and exchange of water masses between the various basins of the Nordic Seas. The expected increase in the freshwater loading of the East Greenland Current due to global warming makes the Freshwater project particularly timely and important.

FACTS
Leaders — Øystein Skagseth og Kjetil Våge
Partners — NERSC, IMR, UNI, UiB
Duration — 2015–2017
Budget — NOK 4 mill.

Northern European and Arctic Sea level (iNcREASE)

"With this project we have the opportunity to focus on the largest and most uncertain component of sea-level change along our coasts that also has immediate potential for improvement in the climate models, the internal processes of the oceans!"
Jan Even Øie Nilsen

iNcREASE seeks to improve projections of future sea level in the North Sea and along the Norwegian coast. Global warming causes sea-level changes in several ways. Obviously, melting of ice sheets adds more water to the oceans, but the temperature itself also has an effect: warmer water takes up more space. With more water to heat and expand, the effect will be larger in the deep oceans than on shallow shelves around the continents. As a result, water will flow towards land to level out the difference. In the North Sea and on the Norwegian continental shelf, variations in the speed of the Norwegian Atlantic Current also affect the sea level. iNcREASE will take into account these effects and provide updated projections of coastal sea level for the coming century.

FACTS
Leader — Jan Even Øie Nilsen
Partners — NERSC, UiB
Duration — 2015–2017
Budget — NOK 4 mill.

Greenland Margins: Glacial Ice, Ocean and Atmospheric Dynamics (MARGINS)

"MARGINS represents an exciting opportunity for real cross-disciplinary research on one of the hottest topics out there – and one of the coolest places there is."
Martin Miles

The small ice caps, mountain glaciers and outlet glaciers along the margins of Greenland respond more quickly to climatic changes than the vast Greenland ice sheet. MARGINS seeks to understand how these glaciers interact with the atmosphere, ocean and Arctic sea ice. Glaciers that calve into the fjords of southeast and west Greenland are exposed to sea water, and affected differently depending on whether this is temperate water from the Atlantic or polar water from the north. This means that sediment cores and other glacier-related geological data can be used to detect circulation changes in the ocean and atmosphere in the past. As such interpretations require knowledge of how the glaciers respond to circulation changes today, satellite data, and models of glacier dynamics, fjord circulation and hydrology, will be used to investigate how the glaciers vary in the present time. Importantly, MARGINS is organised across components (glaciers, ocean, atmosphere), rather than along disciplinary lines.

FACTS
Leader — Jostein Bakke and Martin Miles
Partners — NERSC, IMR, UNI, UiB
Duration — 2015–2017
Budget — NOK 6 mill.

Water Cycle Extremes across Scales (WaCyEx)

"Including people with knowledge of processes at all scales – from local topography to planetary waves – may allow us to understand completely new aspects of precipitation extremes."
Asgeir Sorteberg

In Norway, extreme precipitation events and flooding normally occur when strong low pressure systems enter the Norwegian Sea. How much rain there will be depends on how much moisture the air contains, and to what degree strong winds drive moist air in over land. Global warming will likely lead to more moisture in the air, and the number of extreme rainfall events has already increased in many parts of the world. WaCyEx will quantify observed changes in extreme precipitation events in Norway since 1900, as well as investigate the weather systems that caused them and how such systems may be influenced by the sea-surface temperature in the Gulf Stream and sea ice in the Arctic. Also, the project will use a model that combines meteorology and hydrology to investigate how rivers respond to various types of extreme events. With this project the scientists may finally be able to answer a question that has been asked for a long time: where does the water that rains down over Norway come from?

FACTS
Leader — Asgeir Sorteberg
Partners — NERSC, UNI, UiB
Duration — 2015–2017
Budget — NOK 4 mill.

Mechanisms of multi-Decadal Varibility in the Climate system (MEDEVAC)

"It will be particularly exciting to find out what sea-shells can teach us about climate in the past millennium. They can be considered the 'tree-rings of the ocean', and can give us climate information back in time on seasonal to annual time scales, which is truly amazing."
Odd Helge Otterå

During the past millennium, the climate in the Northern Hemisphere has varied substantially on scales of decades to centuries. However, causes of this variability and the mechanisms involved are poorly understood. For instance, did volcanic eruptions initiate the Little Ice Age (AD 1450–1850), and did increased solar activity cause warm periods, such as the Medieval Warm Period (AD 950–1250) and the warm decades from 1920 to 1940? And how important is long-term variability arising purely from internal variations in large-scale ocean and atmospheric circulation? These are some of the questions that will be addressed in MEDEVAC. The project will use climate models to study and better characterise the mechanisms of decadal to centennial scale climate variability, and instrumental and proxy data from various sources, such as tree-rings, sea-shells, ice cores, glaciers, and lake and ocean sediments, to learn about the climate in the past. A particular existing aspect of the project is the inclusion of sea-shells as a climate archive. These shells can provide climate information for the ocean back in time on annual time scales, and can thus be considered the ocean equivalent to tree-rings on land.

FACTS
Leader — Odd Helge Otterå
Partners — NERSC, UNI, UiB
Duration — 2015–2017
Budget — NOK 6 mill.

Prediction and Regional Downscaling Models (PARADIGM)

"In addition to the potential of achieving realistic short-term climate predictions for regions on land, I find it extremely exciting that we may be able to use climate predictions in future fisheries management."
Anne Britt Sandø

Weather forecast models provide detailed charts for the coming days: global climate models project the large-scale climate for the coming century. PARADIGM steps into the gap between, aiming to provide predictions for the next decade, sufficiently detailed to be useful for society. Just like the weather next week depends on the weather systems already present in the atmosphere today, the climate in the Nordic region during the coming decades is influenced by the state of the North Atlantic Ocean today. PARADIGM will use the Norwegian Climate Prediction Model to improve regional climate predictions. This model takes into account both changes in the greenhouse effect, and the current state of the oceans and sea ice. A primary focus will be to improve the way sea ice is treated in the model. The model will then be used to make climate predictions on a more local scale than global climate models can provide – useful for the fisheries in the ocean and for various sectors on land.

FACTS
Leader — Anne Britt Sandø
Partners — NERSC, IMR, UNI, UiB
Duration — 2015–2017
Budget — NOK 6 mill.

At the Ocean Sciences Meeting in Honolulu, February 2014, ClimateSnack and ResClim held a town-hall event to discuss scientific writing and communication skills. A team of four expert science communicators joined Mathew Reeve in the discussion panel. From left to right: Heather Galindo, Assistant Director of Science, COMPASS; Kim Martini, University of Washington and DeepSea News; Mathew Reeve, founder of ClimateSnack and PhD student at the Bjerknes Centre; Christie Wilcox, University of Hawaii and Discover Blogs; and Christina Schallenberg, University of Victoria.

ResClim Activities 2014

During the year ResClim have offered their 85 students a variety of high-level courses including advanced climate modelling, advanced statistics, a scientific writing course, good presentation techniques, a town-hall debate, summer schools, and, new this year, a PhD Conference.

The PhD Conference was a joint arrangement between PhD students at the Bjerknes Centre and the Bolin Centre in Stockholm. The conference was for PhD students only, with no senior scientists on the podium or in the audience. The idea was to create an arena for the PhD students to discuss ideas and results with less pressure, and was a great success according to the participants.

ClimateSnack around the world

2014 was an exciting year for ClimateSnack, the community of young and early-career scientists who work together to improve their writing and communication skills. This year we welcomed more groups to the community. Now there are ClimateSnack writing groups at several research institutes and universities around the world. ClimateSnack started in Bergen in 2012.

The ClimateSnack members contribute with posts – or snacks as we call them – that are published on the climatesnack.com website. In total, ClimateSnackers published 48 snacks in 2014. Some of these were translated into Norwegian and appeared in newspapers such as Bergens Tidende and Aftenposten. We also tested out some new concepts. We put on science communication debates at Ocean Sciences in Honolulu and the EGU conference in Vienna. We arranged presentation and podcast courses in collaboration with Resclim, and we launched our new fancy website.

In 2015, ClimateSnack plans to become SciSnack, so that we can invite early-career scientists from all scientific disciplines to think differently about their scientific writing and communication skills. We will revamp the new website to make it easier for present ClimateSnackers and new SciSnackers to practice and publish their science writing.

ACTIVITY	DURATION	LECTURER	LOCATION
Course in Advanced Climate Modelling	20th–24th January	Robert Hallberg NASA/NOAA and Geoffrey Vallis, University of Exeter	Bergen
Presentation Techniques	2nd–5th February	Matt McGarity, Washington University	Bergen
Town-hall event at the Ocean Science Meeting	24th February		Honolulu, Hawaii
Ice Sheet System Modeling Workshop (ISSM)	2nd–4th June	Collaboration with NASA-JPL	Bergen
Creating Scientific Podcasts	2nd–4th July	Jack Soper freelance producer at BBC	Imperial College London, UK
Regional Climate Change Impacts	June 30th–July 4th	IMPACT2C Summer School	Rosendal
ACDC Summer School	16th–31st August		Disko Island, Greenland
Writing workshop	11th–15th August	Dallas Murphy, professional writer from New York	Bergen
PhD Conference	29th–30th September	ResClim and Bolin Centre (Stockholm)	Osterøy
Writing course and workshop	6th–10th October	Daniel Soule, professional writer from Belfast	Rosendal
Advanced statistics course	3rd–11th November	David Stephenson and Theo Economou from University of Exeter	Bergen
Ocean, Climate and Marine Ecosystems	1st–8th December	The Nansen Tutu Summer School	Cape Town, South Africa

Rosendal Hiking Malmangernuten. View from Malmangernuten. In Rosendal, the group went on a hike to both the Bondhusdalen glacier and to the Malmangernuten mountain top.
PHOTO: OSCAR LANDGRENN

Video photographer Frode Ims, is interviewing the Summer School leader Kerim Nisancioglu, associate professor at UiB research and leader at the Bjerknes Centre, and ACDC organiser Iselin Medhaug, postdoc at UiB and the Bjerknes Centre.
PHOTO: UiB

Uniting disciplines and cultures

Addressing climate change, its impacts and adaptations to it requires a multi-disciplinary approach. The ResClim/Impact2C/NansenZhu Summer School in Rosendal, took this approach when 24 participants from Europe, Bangladesh and China met in the first week of July with an overarching AIM: to Assess, Integrate and Make a plan!

Participants were climate scientists with a variety of backgrounds: impact and dynamical modelling, atmospheric sciences, ecology, environmental economics, agriculture, and hydrology. Working on real data, the researchers were split into inter-disciplinary teams and given five regions to concentrate on – China, the Maldives, West Africa, the Mediterranean, and Bangladesh. At the end of each day, the groups gave short press briefings of their findings.

Communication across disciplines and cultures can be a challenge, but Stefan Sobolowski, head of the Summer School, was impressed by the participant's willingness to think creatively on how to communicate their findings and to step outside the comfort zone of their specialised research areas.

Summer school at Greenland on tape

As in previous years lately, around 20 highly qualified PhD candidates and early-career scientists attended the Advanced Climate Dynamics Course (ACDC) Summer School. The ACDC 2014 was held on Disko Island on the west coast of Greenland in late August, in spectacular iceberg-laden scenery. The topic of the Summer School was the Dynamics of the Greenland Ice Sheet, including the basic principles and dynamics behind changes to the Greenland ice sheet in the past, present and future. Together with the international team of lecturers and students, Frode Ims, video photographer in the UiB Communication division, accompanied the Summer School. Ims joined the researchers on their two-day trek through rough and challenging terrain, and produced an informative set of videos both for the summer school and the Ice2Ice project. Films can be viewed at the web page of the Bjerknes Centre, UiB and ACDC or via the QR code underneath.

More channels for popularised science

A media trend today is increasing channels and possibilities for popularised scientific outreach. Large national and regional media houses such as NRK, Aftenposten, Dagens Næringsliv and Bergens Tidende are offering columns for popular science written by scientists, both in print and on the web.

Several members of the Bjerknes Centre have grabbed this opportunity, including seniors and younger scientists in the ClimateSnack group. In total the number of articles featuring the Bjerknes Centre in the broad media was 660, slightly higher than the previous three year's figure of roughly 600. As in previous years, a broad spectrum of Bjerknes scientists gave popular talks at conferences and various events such as the science week "Forskningsdagene", and special arrangements in Bergen and Norway.

Contributing to the IPCC is of high importance for the Bjerknes Centre. In November 2014 the Fifth Assessment Report was completed with the Synthesis Report. This followed the report from Working Group 1, The physical science basis, in September 2013, Working Group 2, Impacts, adaptation and vulnerability, in March and Working Group 3, Mitigation of climate change, in April 2014. The reports are of high importance for our global society as they set the stage for international adaptation and mitigation efforts. All reports and their summaries for policymakers are easily accessible at the IPCC Homepage.

In recent years we have seen a shift from the need for understanding the physical science basis to greater focus on impacts, adaptation and mitigation in the national and international climate discourse. As mentioned in the "Directors Comment" on page three, this is also true for those funding climate research both at national and international levels. Bjerknes scientists will continue to explore and communicate the many unsolved puzzles surrounding natural and anthropogenic climate change, and at the same time be aware of, and open for collaboration on, various aspects of adaptation and mitigation research.

The 2° magazine is produced and distributed in cooperation with the Norwegian NGO Norsk Klimastiftelse. This magazine is widely distributed to schools and to stakeholders, businesses and politicians. For the 2014 issue, many early-career scientists contributed to the articles in the magazine. The theme this year was water, covering aspects from politics in the Nile Basin to extreme precipitation and floods in Norway.


Torsdag ØKONOMI Fredag TEKNOLOGI Lørdag FORSKNING

Oppvarming til lands og til vanns

Tilbake til fremtiden

FORSKNING VISER ... TOR ELDEVIK (L.BJØRG ROSSRØ-BAKKEN ANNE S. JUNE

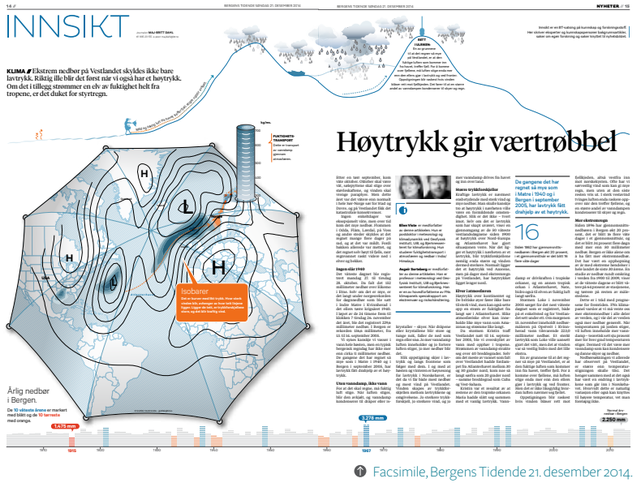
Facsimile, Dagens Næringsliv 20. september 2014.


INNSIKT

Svakere vinder kan redde Sydhavsøyene – enn så lenge

Truer nasjonal suverenitet

Facsimile, Bergens Tidende 28. september 2014.


INNSIKT

Høytrykk gir værtrøbbel

Årlig nedbør i Bergen.

Facsimile, Bergens Tidende 21. desember 2014.


All tickets were sold out for the movie theatre MB1 during the first Bjerknes Day on October.
PHOTO: PRIVATE

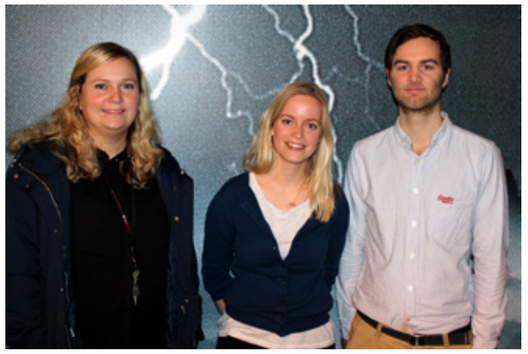


PHOTO: CATHRINE STRØM NØSTVOLD, VILVITE

One documentary and six popular talks

A new event for the Bjerknes Centre in 2014 was the launch of the first Bjerknes Day. In collaboration with the Bergen International Film Festival (BIFF) we invited festival participants, local politicians, high-school pupils and teachers, journalists, climate bureaucrats, NGOs, many Bjerknesians and partner institutions for a day with one documentary and six popular talks. The MB1, which seats over 200 persons, had no spare seats when the day arrived.

The documentary *Thule Tuvalu* is a portrait of people living in Thule, East Greenland and on Tuvalu, an island in the Pacific; both places are facing challenges due to climate changes such as ice melting and sea-level rise. To illustrate the documentary from a popular scientific point of view, six talks were given. Professor in social anthropology Edvard Hvidding started off with an anthropological view on the challenges of Tuvalu, followed by five ten-minute talks on sea-level rise, both globally and in the Pacific, the melting of the Greenland ice sheet, and questions about the weather patterns of a warm Arctic and cold continents by Bjerknesians Noel Keenlyside, Jan Even Øie Nilsen, Ellen Viste, Kerim Nisancioglu and Svetlana Sorokina.

Meet a climate scientist

A new collaboration between the Bjerknes Centre and the Bergen Science Centre Vilvite began in 2014. A group of PhDs led by Kerim Nisancioglu have developed both educational slides and the "Meet a climate scientist" session, which is part of the VilVite programme offered to schools in the Bergen area. The first two meetings were held in the autumn, and will continue in spring 2015. A key point is to introduce topics in climate science and to show how we work by giving examples both from field work and in the office. In February, Mari Fjalstad Jensen and Henning Åkesson (middle and right in the picture) met students from Nordahl Grieg's high school. The teacher Mariann Valsvik (to the left in the picture) was very pleased with the good dialogue between the scientists and the young audience.

Engagements 2014

GLOBAL DIMENSION

IPCC: 5th Assessment report: Prof. Eystein Jansen and Senior Researcher Peter W. Thorne were Lead Authors in Working Group 1 for chapters 5 and 2, respectively. Prof. Christoph Heinze and Senior Scientist Ken Drinkwater were Review Editors in Working Groups 1 and 2, respectively. Drs. Peter Thorne, Trond Dokken, Camille Li and Jerry Tjiputra were Contributing Authors in Working Group 1. Dr. Peter Thorne was Contributing Author to Summary for Policy Makers, Technical Summary.

ASOF Arctic-Subarctic Ocean Fluxes: Prof. Tor Eldevik is a member of the International Scientific Steering Group.

Climatecode.org: Dr. Peter Thorne is Science Advisory Board member.

FOO/GOOS: Framework of Ocean Observing: Prof. Christoph Heinze is a member of the Ocean Observing Panel for Biogeochemistry.

FIX03: Truls Johannessen is a member of the Steering Committee.

GCOS: Co-Chair of the Global Climate Observing System working group on the GCOS Reference Upper Air Network (and precursor Working Groups) (Dr. Peter Thorne).
Editor, Global Chapter, State of the Climate annual report (Dr. Peter Thorne).
Chair of steering committee for International Surface Temperature Initiative (Dr. Peter Thorne).

Global Climate Forum: BCCR is a member of the Global Climate Forum (GCF), a non-profit organization located at PIK in Potsdam, Germany. GCF is a platform for joint studies and science-based stakeholder dialogues on climatic change and brings together representatives of different parties concerned with the climate problems.

Global Ocean Acidification Observing Network (GOA-ON): Dr. Benjamin Pfeil is an executive council member.

ICES:

- Working Group on Hydrography: Dr. Kjell Arne Mork is co-chair, Senior Scientist Svein Østerhus, Dr. Randi Ingvaldsen and Dr. Øystein Skagseth are members.
- Study Group on Ocean Acidification: Dr. Are Olsen is a member.
- Working Group on Modelling Physical/Biological Interactions WGPBI, member (Prof. Corinna Schrum)
- Working Group on Operational Oceanographic Products for Fisheries and Environment WGOOFE, member (Prof. Corinna Schrum)
- Working Group on Integrated Assessments of the North Sea WGNIOSE, member (Prof. Corinna Schrum)

IMAGES

Prof. Ulysses S. Ninnemann is the Norwegian representative for the International Marine Global Changes Program (IMAGES).

International Geosphere-Biosphere programme (IGBP) and World Climate Research Program (WCRP):

- Large-scale integrating project CARBOCHANGE, coordinated by Prof. Christoph Heinze, was endorsed by the IGBP/SCOR sponsored projects SOLAS and IMBER.
- Surface Ocean Lower Atmosphere Study (SOLAS). Prof. Christoph Heinze is a member of the SSC.
- International Ocean Carbon Coordination Project (IOCCP). Drs. Are Olsen and Benjamin Pfeil are steering committee members
- Integrated Marine Biogeochemistry and Ecosystem Research (IMBER). Senior Scientist Ken Drinkwater is an SSC member.
- Ecosystem Studies of Subarctic Seas (ESSAS). Senior Scientist Ken Drinkwater is co-chair of this IMBER regional program.
- PAGES (Past Global Changes). Prof. Ulysses Ninnemann is on the SSC of IMAGES, the marine component of PAGES.
- PAGES Arctic 2k working group. Prof. Jostein Bakke is co-leader.
- PAGES/CLIVAR joint working group. Prof. Eystein Jansen is a member.
- CLIVAR Climate Variability and Predictability. Dr. Ken Drinkwater is a member of the Scientific Steering Group (SSG).
- CLIVAR Global Synthesis and Observations Panel: Dr. Are Olsen is a member
- Prof. Helge Drange is co-leader of the CLIVAR Working Group for Ocean Model Development (WGOCMD).
- Scientific Advisory Boards. Prof. Eystein Jansen is a member of the scientific advisory board of IC3-Climate Centre, Barcelona.
- Dr. Yvan Orsolini is member of the WMO-WCRP Working Group for Seasonal to Interannual Predictability (WGSIP).

International Ocean Carbon Coordination Project (IOCCP): Dr. Are Olsen is a scientific steering committee member.
International Union of Geodesy and Geophysics: Dr. Solfrid Hjøllo is national IAPSO correspondent and member of National Committee.

INTIMATE – INTegrating Ice-core, Marine and Terrestrial records 8000-60,000 years ago: Prof. Hilary Birks is on the Programme Management Committee and is co-leader of Working Group 4 'Climate impacts on Ecosystems'.

NAVIS North Atlantic Virtual Institute: Prof. Tor Eldevik is member of the NSF collaborative project's steering committee.

OceanSITES: Senior Scientist Svein Østerhus is a member of the Steering Committee.

Surface Ocean CO_2 Atlas (SOCAT): Drs. Benjamin Pfeil and Are Olsen are members of the Global Coordination Group.

World Universities Network (WUN)
Global Challenge – Responding to Climate Change: Prof. Tore Furevik in steering group

EUROPEAN DIMENSION

COST: Senior Scientist Svein Østerhus is a member of the European Cooperation in Science and Technology (COST) action project Everyone's Gliding Observatories Management Committee.
Prof. Christoph Heinze is a member of COST action "terrabites".
Drs. Anne Britt Sandø and Laurent Bertino are members of COST Action "Evaluation of Ocean Syntheses".

ECO_2: Prof. Christoph Heinze is a member of the Scientific Advisory Board of the EU FP7 project "Sub-seabed CO_2 Storage: Impact on Marine Ecosystems" (ECO_2).

ECRA – European Climate Research Alliance: Prof. Lars Henrik Smedsrud is co-chair of the Programme on Arctic Climate Stability and Change. Dr. J. Even Ø. Nilsen is co-chair of the Collaborative Programme on Sea Level and Climate Change.

ESSAC: Dr. Helga F. Kleiven is Norwegian national delegate in the Ecord Science Support and Advisory Committee (ESSAC).

European Consortium for Pacific Studies (ECOPAS): Prof. Noel Keenlyside is a member of the scientific advisory board.

European Marine Board: Dr. Helga Flesche Kleiven is the Norwegian academic representative
FORMAS Review Panel Climate Change, panel chair (Prof. Corinna Schrum).

JPI Climate – Module 1: Prof. Tore Furevik is national representative.

KLIWAS Impacts of climate change on waterways and navigation - Searching for options of adaptation; research program of the German Federal Ministry of Transport, Building and Urban development BMVBS, scientific advisory board (Prof. Corinna Schrum).

NERC (UK National Environmental Research Council): Dr. Peter Thorne is Steering Committee member for Research Network on Surface Temperatures (Earthtemp).

NATIONAL DIMENSION

Research Council of Norway:
KLIMAFORSK programme board:
Prof. Tore Furevik, vice chairman.

Research Council of Norway: Norway–India Programme Advisory Committee:
Prof. Eystein Jansen, member.

Nansen legacy ("Arven etter Nansen")
– a national consortium for a coordinated research programme. Prof. Nils Gunnar Kvamstø is a member of the steering committee.

IASC (International Arctic Science Committee)
Assoc. Prof. Thomas Spengler is a representative for Norway in the Atmospheric working group.

ICDM (International Commission on Dynamical Meteorology)
Assoc. Prof. Thomas Spengler is a member of the commission.

COSPAR (Committee for Space Research)
Dr. Yvan Orsolini is a national representative.

National Platform for Ocean Research, Hav21, issued by the Norwegian Ministry of Fisheries and coastal affairs:
Prof. Helge Drange is a member.

SUCCESS: Board Member for UiB (Prof. Truls Johannessen).

Norwegian Climate Foundation:
Dr. Helga Flesche Kleiven is on the board of directors.

Finances

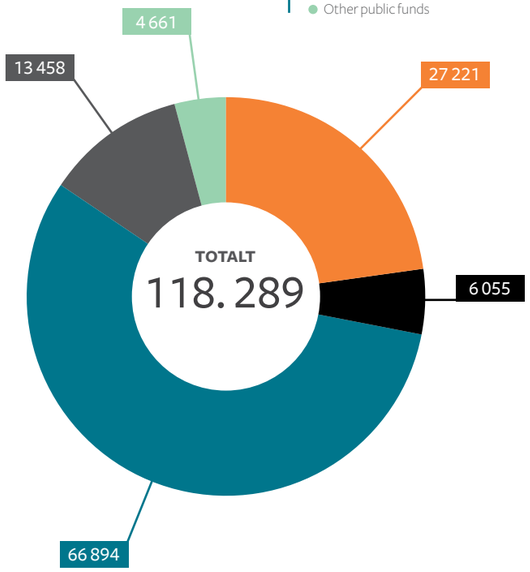
The main sources of income for the Bjerknes Centre are a 12-year grant from the Ministry of Research and Education to the Centre for Climate Dynamics (SKD), and research projects funded by the Research Council of Norway (RCN) and the European Commission (EU).

The grant from the Ministry was for about 27 million kr in 2014 while the University of Bergen—SKD´s host—funds seven recruitment positions (PhD & postdocs) at BCCR. Grants from the RCN and EU accounted for almost 70% of the Centre´s total income in 2014. Other public funds included research grants from the *Nordic Top Initiatives, NordForsk, EEF Norway, The Norwegian Centre for International Cooperation in Education* (SIU), and *Hordaland County Council & Regional Research Fund.*

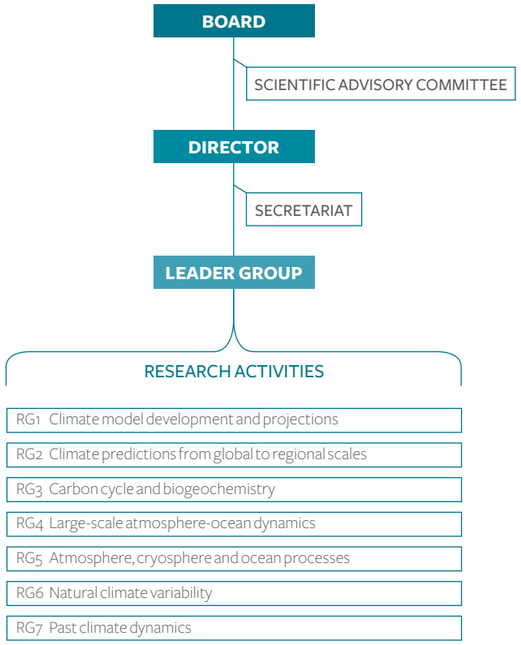
In-kind contributions from the partner institutions (e.g. staff salary, ship time, computer resources, etc.) are not included in the table below.

SOURCES OF INCOME	1 000,–
Ministry of Research and Education	27 221
University of Bergen	6 055
Research Council of Norway	66 894
European Commission	13 458
Other public funds	4 661
Total income	**118 289**

BCCR´S SOURCES OF INCOME IN 2014



Organisation



THE LEADER GROUP

The leader group comprises the director, head of administration, research leaders of the Centre for Climate Dynamics and leaders of the Bjerknes research groups. Their mandate includes the forging and implementation of the Centre´s strategic scientific development, and to act as a channel of communication among the partners.

TORE FUREVIK	Professor (Director), Climate dynamics, UiB
TOR ELDEVIK	Professor, Oceanography, UiB
CAMILLE LI	Associate professor, Atmospheric dynamics, UiB
KERIM NISANCIOGLU	Associate professor, Past climate dynamics, UiB
ARE OLSEN	Associate professor, Biogeochemistry, UiB
HELGE DRANGE	Professor, Climate modelling, UiB
ANNE BRITT SANDØ	Scientist, Oceanography, IMR
CHRISTOPH HEINZE	Professor, Carbon cycle modelling, UiB/Uni Research
IGOR EZAU	Scientist, Meteorology, NERSC
BJØRG RISEBROBAKKEN	Scientist, Palaeoclimatology, Uni Research
ODD HELGE OTTERÅ	Scientist, Climate modelling, Uni Research
BEATRIZ BALINO	Dr scient, Head of administration, UiB

RESEARCH GROUPS	LEADER (CO-LEADER)
RG1 Climate model developments and projections	H. Drange (M. Bentsen)
RG2 Climate predictions from global to regional scales	A. B. Sandø (N. Keenlyside)
RG3 Carbon cycle and biogeochemistry	C. Heinze (A. Olsen)
RG4 Large-scale atmosphere-ocean dynamics	C. Li (T. Eldevik)
RG5 Atmosphere, crysophere and ocean processes	I. Ezau (L.H. Smedsrud)
RG6 Natural climate variability	O. H. Otterå (J. Bakke)
RG7 Past climate dynamics	B. Risebrobakken (K. Nisancioglu)

BOARD OF DIRECTORS

ANTON ELIASSEN	Director, MET Norway (leader)
ANNE LISE FIMREITE	Pro-rector, UiB
AINA BERG	Managing director, Uni Research Ltd
STEIN SANDVEN	Director, NERSC
HARALD LOENG	Research director, IMR

SCIENTIFIC ADVISORY COMMITTEE

JENS HESSELBJERG CHRISTENSEN	Danish Meteorological Institute, Denmark
MICHAEL SCHULZ	Center for Marine Environmental Sciences, University of Bremen, Germany
DETLEF STAMMER	Center for Marine and Climate Research, University of Hamburg, Germany
DAVID THOMPSON	Department of Atmospheric Science, Colorado State University, USA
ANDREW WATSON	College of Life and Environmental Sciences, University of Exeter, UK

SECRETARIAT

BEATRIZ BALINO	Head of administration, UiB
GUDRUN SYLTE	Head of communications, Uni Research
ELLEN GRONG	Senior secretary, UiB
QUYNH-GIAO THI DO	Finances, UiB

Staff

SCIENTISTS

Lars	Asplin	Norway	IMR	Oceanography, modelling
Irina P.	Asteman	Russia	Uni Research	Palaeoclimates
Jostein	Bakke	Norway	UiB	Palaeoclimates
Mats	Bentsen	Norway	Uni Research	Climate modelling
Jon	Bergh	Sweden	NERSC	Oceanography & sea ice
Laurent	Bertino	France	NERSC	Data assimilation
Ingo	Bethke	Germany	Uni Research	Climate modelling
Hilary	Birks	UK	UiB	Palaeoecology
John	Birks	UK	UiB	Palaeoecology
Anne	Bjune	Norway	Uni Research	Palaeoecology
Paul	Budgell	Canada	IMR	Oceanography, modelling
Alberto	Carrassi	Italy	NERSC	Geophysics & mathematics
Linling	Chen	China	NERSC	Meteorology
Youmin	Chen	China	Uni Research	Meteorology & climate modelling
Camille	Contoux	France	Uni Research	Palaeoclimates
François	Counillon	France	NERSC	Oceanography
Ute	Daewel	Germany	NERSC	Marine biology
Svein Olaf	Dahl	Norway	UiB	Palaeoclimates
Carin A.	Dahl	Sweden	Uni Research	Palaeoclimates
Stijn	De Schepper	Belgium	Uni Research	Palaeoclimates
Teferi	Demissie	Ethiopia	Uni Research	Climate modelling
Trond	Dokken	Norway	Uni Research	Palaeoclimates
Helge	Drange	Norway	UiB	Climate modelling
Ken	Drinkwater	Canada	IMR	Oceanography & marine ecosystems
Tor	Eldevik	Norway	UiB	Oceanography, climate dynamics
Igor	Esau	Russia	NERSC	Meteorology
Elizabeth	Farmer	UK	UiB	Palaeoclimates
Ilker	Fer	Turkey	UiB	Physical oceanography
Tore	Furevik	Norway	UiB	Ocean dynamics and modelling
Yongqi	Gao	China	NERSC	Oceanography
Nadine	Goris	Germany	UiB	Carbon cycle modelling
Haflidi	Haflidason	Iceland	UiB	Palaeoclimates
Bjarte	Hannisdal	Norway	UiB	Geobiology
Peter	Haugan	Norway	UiB	Polar oceanography
Christoph	Heinze	Germany	UiB	Carbon cycle modelling
Solfrid	Hjøllo	Norway	IMR	Physical oceanography
Mehmet	Ilicak	Turkey	Uni Research	Ocean dynamics and modelling
Nil	Irvali	Turkey	UiB	Palaeoclimates
Detelina	Ivanova	Bulgaria	NERSC	Climate modelling
Natalia	Ivanova	Russia	NERSC	Remote sensing & sea ice
Eystein	Jansen	Norway	UiB	Palaeoclimates
Emil	Jeansson	Sweden	Uni Research	Biogeochemistry
Truls	Johannessen	Norway	UiB	Biogeochemistry
Noel	Keenlyside	Australia	UiB	Tropical meteorology
Martin	King	Malaysia	Uni Research	Meteorology
Helga	Kleiven	Norway	UiB	Palaeoclimates
Erik	Kolstad	Norway	Uni Research	Meteorology
Shunya	Koseki	Japan	UiB	Meteorology
Trond	Kristiansen	Norway	IMR	Physical oceanography
Nils Gunnar	Kvamstø	Norway	UiB	Meteorology
Helene R.	Langehaug	Norway	NERSC	Palaeoclimates
Stein Erik	Lauritzen	Norway	UiB	Palaeoclimates
Hanna	Lee	Korea	Uni Research	Terrestrial biogeochemistry
Camille	Li	Canada	UiB	Atmospheric dynamics
Lu	Li	China	Uni Research	Atmospheric modelling
Øyvind	Lie	Norway	Uni Research	Palaeoclimates
Henriette	Linge	Norway	UiB	Palaeoclimates
Torbjørn	Lorentzen	Norway	Uni Research	Economics & statistics
Kjetil	Lygre	Norway	NERSC	Biogeochemistry & modelling
Jan	Mangerud	Norway	UiB	Palaeoclimates
Stephanie	Mayer	Germany	Uni Research	Meteorology
Michel	Mesquita	Brazil	Uni Research	Atmospheric dynamics
Victoria	Miles	Russia	NERSC	Environmental remote sensing
Martin	Miles	USA	Uni Research	Palaeoclimates
Kjell Arne	Mork	Norway	IMR	Ocean modelling
Atle	Nesje	Norway	UiB	Palaeoclimates
Jan Even Øie	Nilsen	Norway	NERSC	Oceanography
Ulysses	Ninnemann	USA	UiB	Palaeoclimates
Kerim	Nisancioglu	Norway	UiB	Palaeoclimates
Einar	Olason	Iceland	NERSC	Sea ice dynamics
Are	Olsen	Norway	UiB	Biogeochemistry
Abdirahman	Omar	Somalia	Uni Research	Biogeochemistry
Marek	Ostrowski	Norway	IMR	Physical oceanography
Odd-Helge	Otterå	Norway	Uni Research	Climate modelling
Stephen	Outten	UK	NERSC	Atmospheric dynamics
Pierre	Rampal	France	NERSC	Physical oceanography & glaciology
Joachim	Reuder	Germany	UiB	Meteorology
Bjørg	Risebrobakken	Norway	Uni Research	Palaeoclimates
Annette	Samuelsen	Norway	NERSC	Physical oceanography
Anne Britt	Sandø	Norway	IMR	Ocean modelling
Corinna	Schrum	Germany	UiB	Oceanography & marine ecosystems
Jörg	Schwinger	Germany	Uni Research	Carbon cycle modelling
Mao-Lin	Shen	China	UiB	Meteorology
Øystein	Skagseth	Norway	IMR	Physical oceanography
Ingunn	Skjelvan	Norway	Uni Research	Biogeochemistry
Morten	Skogen	Norway	IMR	Ocean modelling
Rannveig	Skoglund	Norway	UiB	Palaeoclimates
Lars H.	Smedsrud	Norway	UiB	Polar oceanography

Stefan	Sobolowski	USA	Uni Research	Atmospheric dynamics
Asgeir	Sorteberg	Norway	UiB	Meteorology
Thomas	Spengler	Germany	UiB	Meteorology
Jørund	Strømsøe	Norway	Uni Research	Palaeoclimates
Eivind	Støren	Norway	UiB	Palaeoclimates
Lingling	Suo	China	NERSC	Meteorology
John-Inge	Svendsen	Norway	UiB	Palaeoclimates
Henrik	Søiland	Norway	IMR	Physical oceanography
Peter	Thorne	UK	NERSC	Oceanography
Jerry	Tjiputra	Indonesia	Uni Research	Carbon cycle modelling
Thomas	Toniazzo	Italy	Uni Research	Meteorology
Kristian	Vasskog	Norway	Uni Research	Palaeoclimates
Frode	Vikebø	Norway	IMR	Climate & marine ecosystems
Kjetil	Våge	Norway	UiB	Physical oceanography
Henning	Wehde	Germany	IMR	Physical oceanography
Zhongshi	Zhang	China	Uni Research	Palaeoclimates
Svein	Østerhus	Norway	Uni Research	Physical oceanography
Bjørn	Ådlandsvik	Norway	IMR	Physical oceanography

POSTDOCS

Muralidhar	Adakudlu	India	Uni Research	Atmospheric modelling
Roohollah	Azad	Iran	UiB	Meteorology
Sylvain	Bouillon	Belgium	NERSC	Sea ice dynamics
Catherine	Bradshaw	UK	UiB	Biogeochemistry
Jo	Brendryen	Norway	UiB	Palaeoclimates
Laura	Ciasto	USA	UiB	Atmospheric dynamics
Elin	Darelius	Sweden	UiB	Physical oceanography
Richard	Davy	Norway	NERSC	Climate physics
Christian	Dylmer	Denmark	Uni Research	Palaeoclimates
Eirik	Galaasen	Norway	UiB	Palaeoclimates
Shuang	Gao	China	UiB	Biogeochemistry
Chun-cheng	Guo	China	UiB	Physical oceanography
Yanchun	He	China	NERSC	Oceanography/modelling
Paul	Hezel	USA	UiB	Atmospheric dynamics
Anna	Hughes	UK	UiB	Palaeoclimates
Petra	Langebroek	Netherlands	Uni Research	Palaeoclimates
Siv	Lauvset	Norway	Uni Research	Biogeochemistry
Iselin	Medhaug	Norway	UiB	Oceanography
Clio	Michel	France	UiB	Meteorology
Mari S.	Myksvoll	Norway	IMR	Physical oceanography
Fumiaki	Ogawa	Japan	UiB	Meteorology
Sædis	Ólafsdóttir	Iceland	UiB	Palaeoclimates

Nour-Edine	Omrani	Germany	UiB	Tropical meteorology
Vivi	Pedersen	Denmark	UiB	Palaeoclimates
Susana Mendes	Reuder	Portugal	UiB	Meteorology
Sebastian	Schemm	Switzerland	UiB	Atm, ocean & climate dynamics
Svetlana	Sorokina	Russia	NERSC	Meteorology
Ellen M.	Viste	Norway	UiB	Meteorology
Yiguo	Wang	China	NERSC	Statistics
Johannes	Werner	Germany	UiB	Palaeoclimates
Marius	Årthun	Norway	UiB	Oceanography, climate dynamics

PHD CANDIDATES

Paul	Bachem	Germany	Uni Research	Palaeoclimates
Mostafa	Bakhoday	Iran	UiB	Physical oceanography
Bhuwan	Bhatt	India	Uni Research	Regional modelling
Patrik	Bohlinger	Germany	UiB	Meteorology
Fabian	Bonitz	Norway	Uni Research	Palaeoclimates
Helle	Botnen	Norway	UiB	Biogeochemistry
Caroline	Clotten	Germany	Uni Research	Palaeoclimates
Kjersti	Daae	Norway	UiB	Physical oceanography
Pierre	de Wet	South Africa	UiB	Physical oceanography
Marie	Eide	Norway	UiB	Oceanography
Vivian	Felde	Norway	Uni Research	Palaeoclimates
Friederike	Fröb	Germany	UiB	Biogeochemistry
Marthe	Gjerde	Norway	UiB	Quaternary geology, palaeoclimates
Stephanie	Gleixner	Germany	UiB	Tropical meteorology
Lisbeth	Håvik	Norway	UiB	Physical oceanography
Mari F.	Jensen	Norway	UiB	Climate dynamics, palaeoclimates
Stefan	Keiderling	Germany	UiB	Meteorology
Erlend Moster	Knudsen	Norway	UiB	Climate dynamics
Valerie	Kumer	Austria	UiB	Meteorology
Erwin	Lambert	Netherlands	UiB	Climate dynamics
Sigrid G.	Lind	Norway	IMR	Physical oceanography
Tor	Mjell	Norway	Uni Research	Palaeoclimates
Anne	Moree	Netherlands	UiB	Biogeochemistry
Aleksi	Nummelin	Finland	UiB	Ocean dynamics
Ingrid H.	Onarheim	Norway	UiB	Physical oceanography and sea ice
Lea Toska	Oppedal	Norway	UiB	Palaeoclimates
Algot	Petersson	Norway	UiB	Physical oceanography
Rocio Castaño	Primo	Spain	UiB	Physical oceanography
Roshin Pappuk	Raj	India	UiB	Oceanography
Balamuralli	Rajasakaren	India	Uni Research	Biogeochemistry
Mathew	Reeve	UK	Uni Research	Meteorology

Lander	Rodriguez-Crespo	Spain	UiB	Climate dynamics
Torgeir	Røthe	Norway	UiB	Palaeoclimates
Mari	Sandvik	Norway	UiB	Meteorology
Clemens	Spensberger	Germany	UiB	Meteorology
Lea	Svendsen	Norway	NERSC	Climate dynamics
Silje	Sørland	Norway	UiB	Meteorology
Amandine A.	Tisserand	France	Uni Research	Palaeoclimates
Tamara	Trofimova	Russia	Uni Research	Palaeoclimates
Willem	van der Bilt	Netherlands	UiB	Palaeoclimates
Hella	Wittmeier	Germany	UiB	Palaeoclimates
Tobias	Wolf	Germany	NERSC	Meteorology
Henning	Åkesson	Sweden	UiB	Palaeoclimates, glaciology

TECHNICAL & ADMINISTRATIVE STAFF

Beatriz	Balino	Norway	UiB	Head of administration, Bjerknes secretariat
Ragna	Breines	Norway	UiB	Project manager, RESCLIM
Tor	de Lange	Norway	UiB	Chief Engineer, GFI
Mahaut	de Vareilles	France	UiB	Project Manager, PREFACE
Grong	Ellen	Norway	UiB	Senior secretary, BCCR secretariat
Alok Kumar	Gupta	India	Uni Research	Engineer, Climate modelling
Friederike	Hoffmann	Germany	UiB	Science coordinator, GFI
Kristine	Jackson	USA	UiB	Senior Engineer, GFI
Catherine	Jenks	UK	UiB	Senior Research Technician, EERCG
Camilla	Landa	Norway	UiB	Data manager, Bjerknes Climate Data Center
Stefanie	Meyer	Germany	UiB	Project manager, CARBOCHANGE
G. Benjamin	Pfeil	Germany	UiB	Data manager, GFI
Thi Do	Quynh-Giao	Norway	UiB	Finances, Bjerknes secretariat
Erik	Sandquist	Norway	Uni Research	Science coordinator, Uni Climate
Gudrun	Sylte	Norway	UNI Research	Head of communications, Bjerknes secretariat

STAFF BY NATIONALITY

The BCCR encompassed 32 nationalities in 2014

COUNTRY	PERSONNEL
Norway	85
Germany	24
China	11
UK	8
France	7
USA	6
Russia	6
Sweden	5
India	5
Netherlands	4
Canada	3
Iceland	3
Turkey	3
Spain	2
Italy	2
Belgium	2
Denmark	2
Japan	2
Iran	2
Australia	1
Austria	1
Brazil	1
Bulgaria	1
Ethiopia	1
Finland	1
Indonesia	1
Korea	1
Malaysia	1
Portugal	1
Somalia	1
South Africa	1
Switzerland	1
Total	195

STAFF FROM 32 DIFFERENT NATIONALITES

STAFF BY PARTNER INSTITUTION

Number of scientific personnel, sorted by category and partners

	PERSONNEL						
Category	UiB	Uni Research	NERSC	IMR	Total	Foreigners %	Women %
Scientists	39	33	20	14	106	52%	26%
Postdocs	21	4	5	1	31	74%	47%
PhD candidates	30	10	2	1	43	56%	51%
Total	90	47	27	16	180		

Eggum, Lofoten, Norway. Field trip to collect shells

PHOTO: CARIN ANDERSSON DAHL

Research projects

PROJECTS FUNDED BY THE RESEARCH COUNCIL OF NORWAY

ACRONYM	TITLE	PERIOD	PROGRAM	Leader*/Partner**
POLARBUOY	Real-time climate observations at the position of the weather ship Mike	2009-14	FORINFRA	Ø. Skagseth*
RESCLIM	Norwegian research school for climate dynamics	2009-16	FORSKOLE	T. Furevik*
NACO	Norwegian Atlantic Current Observatory	2010-15	FORINFRA	P. Haugan*
NORCWARM	North Atlantic ocean-climate variability in a warmer world	2011-14	FRINATEK	H. Kleiven*
EARTHCLIM	Integrated Earth System approach to explore natural variability and climate sensitivity	2011-14	KLIMAFORSK	H. Drange*
BIO-DIVERSE	Terrestrial biodiversity through time - novel methods and their application	2011-14	MILJØ2015	A. Bjune*
OVERFLOW	Faroe-Bank channel overflow: dynamics and mixing	2011-15	FRINATEK	I. Fer*
SHIFTS	Shifting climate states of the polar regions	2011-15	FRINATEK	J. Bakke*
NORINDIA	Climate change and its impacts on selected Indian hydrological systems using Earth System and high-resolution modelling	2011-15	KLIMAFORSK	M. Mesquita*
HIMWARC	High Impact Weather in the Arctic: Fundamental understanding and future projections	2011-15	POLARFORSK	T. Spengler*
DECCAPH	Decadal trends in global ocean pH: From data and methods to analysis and understanding	2012-14	FRINATEK	S. Lauvset*
NORARGO	A Norwegian Argo Infrastructure	2012-15	FORINFRA	K.A. Mork*
ICEBED	Quantifying ice sheet response to variations in initial bedrock topography	2013-16	FRINATEK	P. Langebroek*
INTERACT	Ocean-atmosphere-ice sheet interactions in the polar north, 50-150 ka BP: Implications for climate system processes	2013-16	FRINATEK	J. Brendryen*
NOACLIM	No-analogue climates and ecological responses in the past and future	2013-16	KLIMAFORSK	J. Birks*
GLACINDIA	Water-related effects of changes in glacier mass balance and river runoff in western Himalaya	2013-16	MILJØ2015	A. Nesje*
AISSESS	Antarctic Ice Shelf-shelf-slope exchange study	2013-16	POLARFORSK	S. Østerhus*
BJERKNES	Bjerknes compensation mechanism	2013-16	POLARFORSK	I. Ezau*
OCCP	Ocean Controls on high-latitude Climate sensitivity – a Pliocene case study	2013-17	FRINATEK	B. Risebrobakken*
PAVE	Atlantic water pathways to the Arctic: Variability and effects on climate and ecosystems	2013-17	NOR-POL	Ø. Skagseth**
ICOS	Follow up of ICOS Norway	2014-15	FORINFRA	T. Johannessen*
GOCE-MTD	GOCE studies of mean dynamic topography and ocean circulation in the high latitude and Arctic Ocean	2014-15	ROMFORSK	J. Johannessen*
SIMECH	Sea-ice mechanisms: from satellites to numerical models	2014-16	FRINATEK	S. Bouillon*
ESPERGE	Exploiting international synergies with PREFACE to enhance understanding of the relationship between regional and global model errors	2014-16	KLIMAFORSK	T. Toniazzo*
EARTHLAB	Earth Surface Sediment Laboratory	2014-17	FORINFRA	J. Bakke*

EASTGREEN	East Greenland Ice: constraining the extent and effects of the Earth´s largest ice and freshwater pathway	2014-17	FRINATEK	M. Miles*
EUROPEWEATHER	Does the Arctic sea-ice loss have an impact on winter weather patterns in Europe?	2014-17	FRINATEK	L. Chen*
MOCN	Meridional overturning circulation in the western Nordic Seas	2014-17	FRINATEK	K. Våge*
EISCLIM	Eurasian ice sheet and climate Interactions	2014-17	KLIMAFORSK	J. I. Svendsen*
EPOCASAA	Enhancing seasonal-to-decadal prediction of climate for the North Atlantic sector and Arctic	2014-17	KLIMAFORSK	N. Keenlyside*
EVA	Earth system modelling of climate variation in the Anthropocene	2014-17	KLIMAFORSK	C. Heinze*
NICE	On thin ice: Role of ocean heat flux in sea ice melt	2014-17	KLIMAFORSK	I. Fer*
NORTH	Northern constraints on the Atlantic thermohaline circulation	2014-17	KLIMAFORSK	T. Eldevik*
RCN-PREFACE	Simulation of the west African monsoon and climate in the tropical Atlantic Ocean	2014-17	KLIMAFORSK	N. Keenlyside*
SNACS	Sub-polar North Atlantic climate states	2014-17	KLIMAFORSK	A. Olsen*
VENTILATE	Ventilation age and remineralisation rates in polar and sub-polar regions as an indicator for climate change	2014-17	KLIMAFORSK	E. Jeansson*
PEGSIE	Pliocene East Greenland current and sea ice evolution	2014-17	POLARFORSK	S. De Schepper*

PROJECTS FUNDED BY THE EUROPEAN COMMISSION

ACRONYM	PROJECT TITLE	PERIOD	PROGRAM	INSTRUMENT	Leader*/Partner**
PAST4FUTURE	Climate Change: Learning from the past climate	2010-14	FP7-ENV	CP-IP	T. Dokken**
SIOS	Svalbard integrated Arctic Earth observing system	2010-14	FP7-INFRA	CP-CSA-Infra-PP	S. Østerhus**
SUMO	Supermodelling by combining imperfect models	2010-14	FP7-PEOPLE	MC-IRG	N. Keenlyside**
EURO-BASIN	Basin-scale analysis, synthesis and integration	2010–14	FP7-ENV	CP-IP	E. Jeansson**
GEOCARBON	Operational global carbon system	2011-14	FP7-ENV	CP-IP-SICA	C. Heinze**
GREENSEAS	Development of global plankton database and model system for eco-climate early warning	2011-14	FP7-ENV	CP-FP-SICA	J. Johannessen*
GROOM	Gliders for research, ocean observation and management	2011-14	FP7-INFRA	CP	P. Haugan**
ECO2	Sub-seabed CO_2 storage: impact on marine ecosystems	2011-15	FP7-OCEAN	CP-IP	A. Omar**
CARBOCHANGE	Changes in carbon uptake and emissions by oceans in a changing climate	2011–15	FP7-ENV	CP-IP	C. Heinze*
IMPACT2C	Quantifying projected impacts under 2°C warming	2011–15	FP7-ENV	CP-IP	M. Mesquita**
ECOPAS	European Consortium for Pacific Studies	2012-15	FP-SSH	CSA-SA	N. Keenlyside**
EU-HIMWARC	High impact weather in the Arctic, fundamental understanding and future projections	2012-16	FP7-PEOPLE	MC-CIG	T. Spengler*
SOCCLI	The role of Southern Ocean Carbon cycle under CLImate change	2012-16	FP7-PEOPLE	MC-IRSES	C. Heinze**
NACLIM	Predictability of the North Atlantic climate	2012-17	FP7-ENV	CP	S. Østerhus**
ARAMACC	Annually resolved archives of marine climate change	2013-17	FP7-PEOPLE	MC-ITN	C. Andersson**
FIX03	Fixed-point open ocean observatories	2013-17	FP7-INFRA	CP-CSA-Infra	C. Heinze**
NEXOS	Next generation, cost-effective, compact, multi-functional web enabled ocean sensors systems	2013-17	FP7-OCEAN	CP	S. Østerhus**
PREFACE	Enhancing prediction of tropical Atlantic climate and its impacts	2013-17	FP7-ENV	CP	N. Keenlyside*
SWARP	Ships and Waves Reaching Polar Regions	2014-16	FP7-SPACE	CP-FP	L. Bertino
Ice2ice	Arctic sea ice and Greenland ice sheet sensitivity	2014-18	FP7-IDEAS	ERC-SyG	E. Jansen*
IS-ENES2	Infrastructure for the European network of Earth System modelling	2014-18	FP7-INFRA	CP-CSA-Infra	C. Heinze**

INSTRUMENT

CP-CSA — Combination of CP and CSA
CP-FP — Small or medium-scale focused research project
CP-IP — Large-scale integrating project
CP — Collaborative project
CSA-SA — Support actions
ERC-SyG — European Research Council Synergy Grant
Infra — Construction of New Research Infrastructures
MC-CIG — Marie Curie Action Career Integration Grants
MC-IRG — International Re-integration Grants
MC-IRSES — Marie Curie Action International Research Staff Exchanges
MC-ITN — Marie Curie Action - Networks for Initial Training (ITN)
PP — Preparatory Phase
SICA — Specific cooperation actions dedicated to international cooperation partner countries
SSH — Socio economics, sciences and humanities

PROJECTS FUNDED BY OTHER SOURCES

ACRONYM	PROJECT TITLE	PERIOD	FUNDING	Leader*/Partner**
IOA	Partners in higher education: ice, ocean, atmosphere interactions	2012-16	SIU-NNA	K. Nisancioglu*
GREENICE	Impact of future cryospheric changes in the Northern Hemisphere	2014-16	Top Nordic Initiatives	N. Keenlyside*
CLIMLINK	Climate forcing factors for marine environmental change during the mid and late Holocene	2014-16	EEF Norway	B. Risebrobakken**
HORDAKLIM	Climate Service for Hordaland	2014-16	Hordaland County Council & Regional Research Fund	E. Kolstad*

Selected publications

Bjerknes scientists are indicated in bold

1. **Azad, R., Sorteberg, A.** (2014). The vorticity budgets of North Atlantic winter extratropical cyclones life in MERRA reanalysis, Part I: Development phase. *Journal of Atmospheric Sciences*, 71(9): 3109–3128. doi: 10.1175/JAS-D-13-0267.1
2. **Azad, R., Sortberg, A.** (2014). The vorticity budgets of North Atlantic winter extratropical cyclones life in MERRA reanalysis, Part II: Lysis phase. *Journal of Atmospheric Sciences*, 71(9): 3129–3143. doi: 10.1175/JAS-D-13-0266.1
3. Ba, J., **Keenlyside, N. S.**, Latif, M., Park, W., Ding, H., Lohmann, K., Mignot, J., Menary, M., **Otterå, O. H.**, Wouters, B., Salas y Melia, S., Oka, A., Bellucci, A., Volodin, E. (2014). A multi-model comparison of Atlantic multidecadal variability. *Climate Dynamics*, 43: 2333–2348. doi 10.1007/s00382-014-2056-1
4. **Bhatt, B. C., Sobolowski, S., King, M. P.** (2014). Assessment of downscaled current and future projections of diurnal rainfall patterns for the Himalaya. *Journal of Geophysical Research: Atmosphere*, 119: 12533–12545. doi: 10.1002/2114JD022134
5. **Birks, H. H.**, Aarnes, I., **Bjune, A. E.**, Brooks, S. J., **Bakke, J.**, Kühl, N., **Birks, H. J. B.** (2014). Lateglacial and early-Holocene climate variability reconstructed from multi-proxy records on Andøya, northern Norway. *Quaternary Science Reviews* 89: 108–122. doi: 10.1016/j.quascirev.2014.01.018
6. **Birks, H. H., Birks, H. J. B.** (2014) To what extent did changes in July temperature influence late-glacial vegetation patterns in NW Europe? *Quaternary Science Reviews*, 106: 262–277. doi: 10.1016/j.quascirev.2014.06.024
7. **Bjune, A. E.**, Willis, K. J. (2014). It's all in the detail: a tribute to Hilary Birks and her contributions to palaeoecology. *Vegetation History and Archaeobotany*, 23: 175–176. doi: 10.1007/s00334-014-0443-5
8. Briner, J. P., **Svendsen, J. I., Mangerud, J.**, Lohne, Ø. S., Young, N. E. (2014). A 10Be chronology of south-western Scandinavian Ice Sheet history during the Lateglacial period. *Journal of Quaternary Science*, 29: 370–380. doi: 10.1002/jqs.2710
9. **Ciasto, L. M.**, Simpkins, G. R., England, M. H. (2014). Teleconnections between tropical Pacific SST anomalies and extratropical southern hemisphere climate. *Journal of Climate*, 28: 56–65. doi: 10.1175/JCLI-p.14-00438.1
10. **Counillon, F., Bethke, I., Keenlyside, N., Bentsen, M., Bertino, L.**, Zheng, F. (2014). Seasonal-to-decadal predictions with the ensemble Kalman filter and the Norwegian Earth System Model: Atwin experiment. *Tellus A*, 66: 21074. doi: 10.3402/tellusa.v66.21074
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Doctoral Dissertations 2014

In 2014, BCCR scientists provided supervision and training in climate research to 43 PhD candidates. The following defended their dissertations:

January 10. 2014
- **Roshin Pappukutty Raj**
  (UiB & NERSC)
  "The circulation of the Norwegian Sea – An investigation from space and ocean"

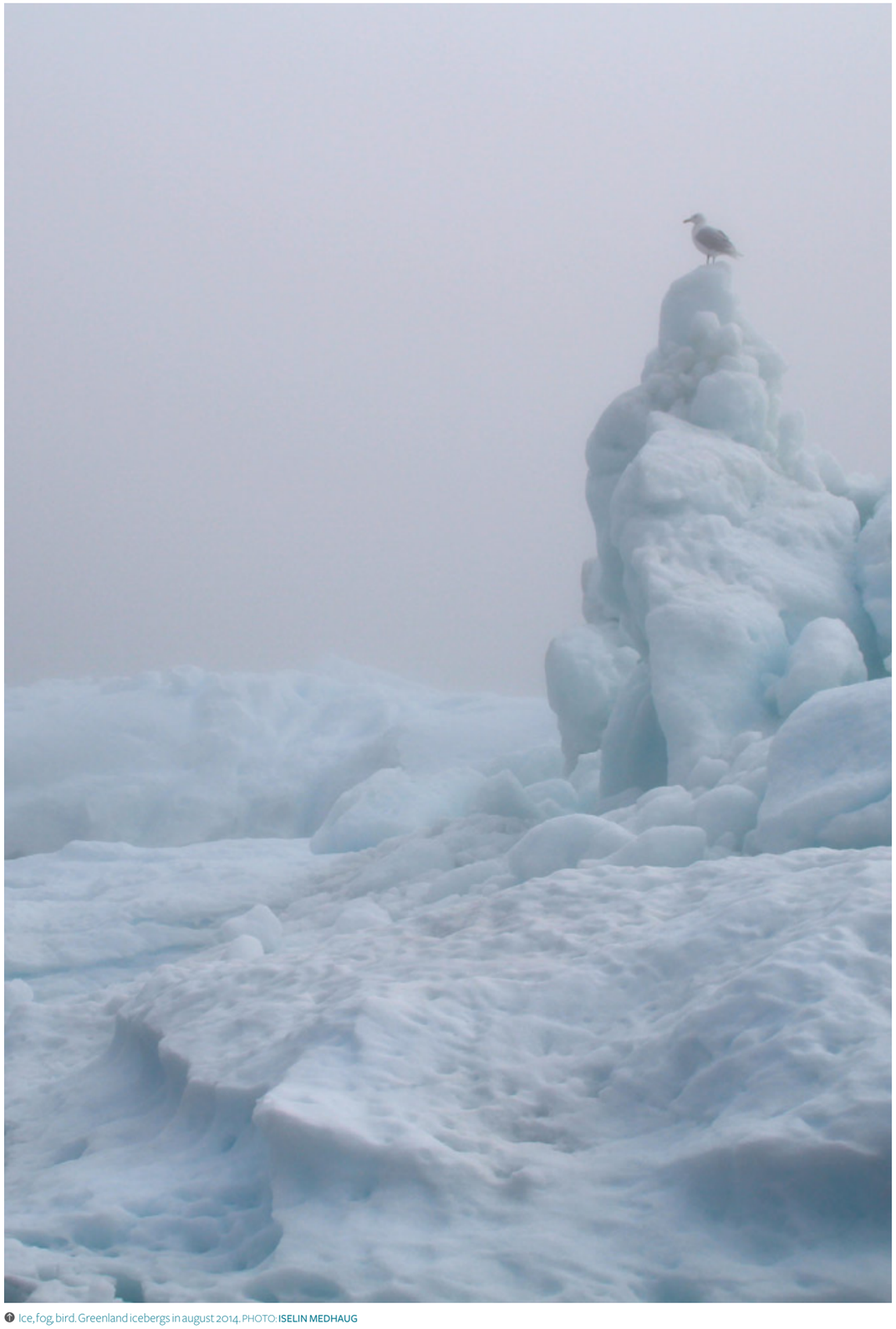
March 14. 2014
- **Jørund Raukleiv Strømsøe**
  (UiB & Uni Research)
  "Physical and spatial characteristics of the Paleic surface of Norway"

April 24. 2014
- **Eirik Galaasen**
  (UiB)
  "Instability of ocean ventilation during warm climates: insights from proxy reconstructions"

June 13. 2014
- **Svetlana A. Sorokina**
  (UiB & NERSC)
  "Certain aspects of high-latitude climate variability"

December 1. 2014
- **Tor Mjell**
  (UiB)
  "Decadal to millennial scale variability in Iceland-Scotland overflow water and its relationship to climate"

December 11. 2014
- **Hella Elisa Wittmeier**
  (UiB)
  "Late glacial and Holocene glacier activity in Arctic Norway"



Ice, fog, bird. Greenland icebergs in august 2014. PHOTO: **ISELIN MEDHAUG**

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↑ Sunset at Kongsfjorden/ Kings Bay, Svalbard. A geologist lake-coring expedition blessed with good weather in a beautiful scenery.
PHOTO: **MARTHE GJERDE**