

Evaluation Report

Bjerknes Centre for Climate Research (BCCR)

November 28, 2017

I Evaluation Committee

Members of the Evaluation Committee (EC) were selected and approved by RCN:

Prof. David Vaughan. Leader of Committee (Chair) - Professor in Glaciology, University of Swansea; Director of Science, British Antarctic Survey (BAS), dgv@bas.ac.uk

Dr. Ralf Döscher. Science Coordinator, Swedish Meteorological and Hydrological Institute (SMHI), Stockholm, Sweden, Ralf.Doescher@smhi.se

Prof. Inga Monika Koszalka. Junior professor in physical oceanography at the GEOMAR Helmholtz Centre for Ocean Research, Kiel, Germany, ikoszalka@geomar.de

Prof. Nick Bates. Senior Scientist and Director of Research, Bermuda Institute of Ocean Sciences (BIOS); Professor of Ocean Biogeochemistry, University of Southampton, Southampton, UK, nick.bates@bios.edu

Dr. Bette Otto-Bliesner. Senior Scientist and Deputy Director of the Climate and Global Dynamics Laboratory, UCAR/NCAR, Boulder, Colorado, USA, ottobli@ucar.edu

2 Executive Summary

1. Using evidence gained during a productive visit to the Bjerknes Centre for Climate Research (BCCR), and background material provided before and during that meeting, the Evaluation Committee (EC) has been able form a good, evidence-based opinion on the recent performance, current status and future plans of BCCR. The EC thank the Director, and BCCR staff, for their effort and hospitality in hosting our visit, the openness they showed in presenting material regarding their recent performance and future plans, and their candid approach to answering our questions.
2. Whilst understandable from the organizational perspective, the overlap of the site visit by the EC, the annual BCCR member symposium, and the visit of the Science Advisory Committee (SAC), was not an optimal arrangement for the EC, as it did not allow for detailed questioning of all presenters of science highlights. However, the EC believe that their visit provided sufficient opportunity to engage with the BCCR teams at all levels.
3. The panel noted the great commitment to the BCCR as an internationally recognized scientific institution, a regionally-important icon for Bergen, and a national Norwegian asset. This commitment was evident at all levels of the scientific leadership and in all the institutions contributing to BCCR. Many of the staff interviewed identify as strongly with the BCCR as they do their home organization, and derive considerable satisfaction and motivation from their connection to it. Without BCCR, it is unlikely that the partner institutes could attract the same quality or overseas scientific talent as it does at present.
4. The EC found that all institutional partners (i.e., University of Bergen, UiB; Uni Research AS, UNI; Institute for Marine Research, IMR; Nansen Environmental and Remote Sensing Centre, NERSC) included within BCCR, support BCCR in spirit and practice, and each identifies considerable benefits they derive from their association with BCCR.

5. The EC found the precise uses to which the SKD (Research Council of Norway, RCN and Ministry of Education and Research, SKD, funding to the Centre for Climate Dynamics) funding has been put, somewhat difficult to track, but recognize it as the 'glue', which allows the BCCR leadership to maintain and deliver a strategically-led programme of research.
6. The role of the SKD funding is an important question addressed by the panel. It is clear that as a fraction of the resource used by the BCCR each year, SKD funding represents only a small fraction, compared with that derived from grants (mostly RCN and EU), or indeed is contributed explicitly and implicitly by the partner institutes. The BCCR leadership is to be applauded in achieving this degree of leverage. However, if SKD funding were to be withdrawn, it is not clear whether BCCR would continue to exist in its present form. Hypothetically, it might be that faced with the removal of SKD funding, partner institutes would agree that the benefits of its continued existence would justify maintaining it via their own expenditure, but it is clear to the panel that such a situation would effectively put the BCCR at the mercy of changes in funding policy (RCN, EU, etc.), make it impossible to deliver a core of strategically-led science, reduce the influence of the director and his science leaders, and probably make BCCR unsustainable in the long-term. We recommend, continued support through SKD funding, with the intention that this maintains a core of strategically-led science for the remainder of the expected period, and beyond, but that the purpose of SKD funding is clarified.
7. Noting this reliance on SKD funding, the EC strongly recommends that the BCCR director and his team consider now the post-2021 future, with and without SKD funding, and begin to develop approaches that might yield other sources of funding to fill the gap if SKD funding is removed.
8. In recent years, BCCR has delivered several notable, world-class, science outcomes (e.g., in the development and use of the Norwegian Earth System Model (NorESM), and in carbon cycle studies). In addition, it has delivered a great number of significant outcomes.
9. The EC considered publication and citation performance across the partners. Against most scholarly metrics, most BCCR appear to be entirely satisfactory, within their national and discipline context. Overall, BCCR publication and citation rates are, however, not comparable with the highest-performing international institutions, which maintain a highly-competitive internal culture, rather than a collaborative one such as is found in BCCR.
10. While the EC understood that BCCR is not a legal entity, there may be some level of normal business process that is currently missing, and which could, if introduced allow better management of BCCR activities (e.g., risk register), and more coherent meeting of the needs of members. It is the EC's opinion, that not having the status of a legal entity and not employing staff, actually requires BCCR to be more precise, and visible in the definition of its ambition and strategic priorities. We note the role and position of BCCR is entirely comparable to several other entities (e.g., UK National Centre for Earth Observations, UK National Centre of Atmospheric Science).
11. Of the seven of the ending research groups (i.e. RG1 to RG7), some were more successful and some produced more excellent outcomes than others. The EC believes that sensible choices have been made in developing the new structure of four Research Themes and in the appointment of the new Research Leaders.
12. The transition from seven groups to four themes was conducted democratically and inclusively. The EC believes that the present structure of the centre and the leadership team is an improvement over what went before, but there is now a state of flux and an opportunity to consolidate and establish a new sense of unity, direction and purpose. Discussions with several early-career researchers indicate that some top-down setting of strategy would be welcome at this time. Indeed, steering BCCR through this period of transition, will require the new leadership team to take a firm and active role. A truly, thriving centre, with a strong esprit de corps cannot be sustained purely through a 'facilitation approach'.
13. There is still some work to be done to maximize the benefits of possible synergies between existing partners. Other expertise could be included such as social sciences which at present do not exist in the current partners.
14. The recent growth of the BCCR membership and in its competitively-won income means the BCCR is facing new challenges and the potential for widening of its research portfolio, and dilution of its core aims. There is a strong requirement to reinforce the core business of the BCCR, its identity and key strategic aims.
15. BCCR is facing the swing to applied research that is prevalent across EU and wider science funding. This presents a new challenge, and will require specific focus from theme leaders and the teams (e.g., defining interfaces to stakeholder engagement, applied focus, multi-disciplinary science, and how will this be achieved; and theme leader roles).

16. Given that the science that BCCR pursues is governed in large part by the opportunities to win funding, there is a requirement to ensure strong policies on what science BCCR will get involved with. For example, it may be useful to agree, to what extent, and in what role, BCCR would be involved in science that supports business cases for extractive industries in sensitive regions.
17. The work done to develop the BCCR as a locally, nationally, and internationally-recognized 'brand' is noted, and BCCR leadership should manage risks around damage to this significant asset.
18. EC recommend keeping track of postgrads and postdocs, as important tool for several purposes including attracting new staff.
19. Continuing professional development through postdoc to career-scientist is important, and not as well-served as for PhD students, and attention may be required to ensure development of a gender balanced, and diverse, management, leadership, and scientist teams.
20. The development of new training and development opportunities, available to all BCCR members, would be valuable in cementing peer-to-peer relationships across BCCR. These might include new training initiatives around proposal development and paper writing.
21. The EC heard some mixed messages around the Fast Track Initiative scheme and how it is viewed, but believes it is a key tool that might be used more effectively to develop new science ideas.
22. EC recognizes that model development is a long-term activity that simply, cannot be supported on short-term grants. This is widely accepted within the international community. It requires both a long-term and secure funding, and a core group of staff who are devoted to technical development, and whose career development is not judged purely by scientific metrics of publication, for example. The securing of the INES infrastructure programme funding has been a welcome step in securing the future of NorESM as a national asset that supports a wide range of Norwegian climate science. The current and future leverage of research funding for Norwegian researchers is an important and continued outcome.
23. National research infrastructure (e.g., FARLAB and EARTHLAB hosted by UiB) are successes, but there does need to be a firm understanding around the intentions to maintain these. Similarly, the requirement for new facilities should be identified and planned.
24. The EC note BCCR's major external and critical dependency on external high-performance computing (HPC) resources, and it is not clear to the EC if the computing resources available in coming months are sufficient to meet strategic goals. A clear agreement on the availability of HPC resources would be beneficial.
25. The EC wishes to make the following key recommendations for the consideration of the BCCR leadership:
 - a. There is a notable lack of understanding of the current scientific strategy within BCCR. Given the current state of flux this is understandable, but there is probably only a short window in which the new director and his leader team should develop and imprint this strategy on their organization, and agree and publicize their roles and responsibilities.
 - b. In addition, BCCR needs to define its identity through a vision and mission statements, and these could usefully state the core business of BCCR, and their ambition for BCCR, and the position BCCR intends to take within Norwegian and international research community. Together these will shape the organization in the future.
 - c. Similarly, a strong and strategic implementation plan, with goals for each of the research themes, would give each of the theme leaders a strong mandate and the teams a real sense of purpose and direction.
 - d. Such statements would clarify the role of the BCCR both for external audiences, but more importantly for BCCR's own members. For example, it would explain decisions on prioritization of funding.

3 Introduction/Background

The Evaluation Committee (EC) has undertaken a review of the Bjerknes Centre for Climate Research according to the following methodology, guided by the mandate¹ as approved by the RCN Research Board for the Division for Energy, Resources and the Environment 16 June 2017:

¹ Throughout this report, text shown [*Thus*] is quoted from the EC Mandate.

- Introductory videoconference of the EC to introduce members, review the mandate and agree a methodology
- Initial videoconference of the EC, to review the package of background material (self-evaluation and others), and to agree individual responsibilities and the agenda for a site visit
- Preparatory videoconference EC-lead, RCN representative/secretary, and BCCR director to agree methodology and details of site visit agenda
- Visit to BCCR, including various presentations and interviews with leadership, site visits to each of the partner institutes with interviews of senior staff and early-career representatives (See Appendix 4 for agenda).

During this visit the EC was afforded excellent access to all it required to perform its duties. The director and his leadership team made themselves available for discussion and interview, and arranged individual site visits to the partner institutes, and informal meetings with early-career researchers. The initial outcomes of the visit and observations of the EC were shared, verbally, with the director and leadership team of BCCR before conclusion of the visit and prior to dispersal of EC.

The background material and access during the visit to Bergen has enabled the EC to form strong and evidence-based opinions on the performance, current status, and future plans for the BCCR. Our conclusions and recommendations expressed in this report to RCN emerge from that evidence.

4 The scientific quality of research, focusing on the period of SKD funding

4.1 General remarks

The BCCR has emerged as an organization with a critical mass of scientific expertise and with its own trademark ("brand") recognized both nationally and internationally. Based on its growing scientific reputation, the centre has been able to attract even more scientific potential in the form of skilled scientists and research projects.

All interviewed researchers, from the professor down to the PhD level, expressed their enthusiasm about the BCCR being a motivating and inspirational working environment, with collaborative spirit, and identified themselves with the BCCR brand at a comparable level as with their employer institution. This enthusiasm feeds back to the thriving environment and thus contributes to the success of the centre, and in most areas it sets an optimistic frame for the future.

Added value of the SKD: The EC note that the "basic funding" from the Ministry of Education and Research (SKD grant) has been instrumental to forming the BCCR brand and lifting it to the national and international recognition by "glueing/seaming together" the research environment and expertise from four different institutions in Bergen into a "*collaborative center*" who work together on cutting edge science, develop new ideas and open new research directions that eventually attract more external funding. The "seaming functionality" of the SKD funding made it hard to evaluate quantitatively its contribution to the scientific production of the BCCR.

4.2 Publication metrics

Measured by standard academic metrics, the BCCR has delivered an overall high quality. For the period of SKD funding (2010 - 2016), the centre self-reported 977 peer review publications in total, including 6 papers in Science, 5 in Nature, and 26 others in Nature Geoscience, Nature Communications or Nature Climate Change. There is an overall increase in the number of publications and the impact since 2010 in high quality journals.

Approximately half of the papers published by BCCR have been first-author peer-review publications by BCCR researchers (2010-2016). A simple-minded, arithmetic calculation suggests that BCCR researchers publish on average a first author paper every second year. However, this number cannot be considered a rigorous measure of productivity, as many 220 BCCR researchers have non-BCCR duties, and so are not

fully allocated to BCCR research, conversely, no effort has been made by EC to identify papers which were to some degree supported by BCCR research and projects.

The rate of publication per capita is however lower for BCCR than for high-profile international institutions with an internal culture of competition and there is an internal variation between the participating institutes with a couple of them delivering lower scores. We are cautious in interpreting these metric statistics and note the following caveats: (1) internal competition is not necessarily good and could jeopardize the uniquely enthusiastic and inspirational environment of the BCCR; (2) the BCCR is heavily set on global and regional model development and maintenance, which cannot be expected to generate as much publication metrics as pure scientific application of an infrastructure; and, (3) a couple of BCCR partners put a significant effort in communication of the relevant results to local communities and stakeholders (e.g., publications "Sealevel change for Norway", "Climate in Norway 2100", meetings with representatives of the local communities, Havforskningsrapport series). This effort arises either by virtue of the institutional mandate, or by the incentive the dialogue with the stakeholders gives for setting new and more applied research directions.

Added value of the SKD: We found it very hard to quantify the contribution of the SKD funding to the publication output in terms of the traditional metrics because of the indirect contributions of the SKD to the various projects of the BCCR scientists. A lower bound could be given by counting publications from the strategic projects (according to the BCCR provided "List of publications 2011-2016", 867 self-reported publications attributed to the SKD projects and activities for the period 2011-2016), noting that several of these projects are still ongoing. It was also difficult to quantify the number of publications from BCCR as a centre because not all scientists reported the BCCR affiliation (self-assessment report estimates this number as 20%). This comes from the fact that not all scientists report their BCCR affiliation given that it is not a legal entity. According to the explanation from the BCCR provided "Self-evaluation report 2010-2016", it has been an undesired consequence of the way publications are registered in the national research information system CRISTin (<http://www.cristin.no/english/>). Since double addresses in affiliations automatically have led to a 50% reduction of the publishing points registered at the Bjerknes scientist's mother institutions, many have felt a strong push from their leaders to not use more than one address. This problem has been solved now.

4.3 Projects

SKD strategic projects: The research activities of the BCCR were structured around the "strategic projects" financed by the SKD grant (about half of the SKD-funds was used for this purpose). These projects had concrete and ambitious goals meant to bring researchers from the different partner institutions together in view of developing novel methods and approaches that would lift the BCCR community on the national and international arena of excellence.

Seven projects run during the first phase (2011-2015): *IPCC*, *IMMUNITY*, *PRACTICE*, *REGSCEN*, *DYNAWARM*, *SEALEV*, *BIOFEEDBACK*; and eight projects during the second phase: *WACYEX*, *PARADIGM*, *FRESHWATER*, *BIGCHANGE*, *BASIC*, *INCREASE*, *MARGINS*, *MEDEVAC*.

We note that the centre did not develop the metrics to efficiently track success of the SKD projects in terms of traditional metrics (i.e., publications). However, these projects were cornerstones to developing scientific expertise, infrastructure and excellence areas (as indicated below).

Other projects: The SKD projects and attendant BCCR collaborations set a cornerstone for a competitive community and seeded several externally funded projects from RCN, EU H2020, EU ERC and Nordic Council. In total, there were 158 externally funded projects during the period 2010-2016. In 2016, the number was 76, of which 58 were coordinated by the BCCR scientists. The list of external projects includes four ERC grants (starting, consolidator, advanced, all in the last four years, and a coordinating synergy grant Ice2Ice - the only synergy-project in the Nordic countries), which is an impressive achievement for such small community. BCCR has four Bergen Research Foundation "Young Talents" grants and co-leadership/ participation in several EU H2020 grants. The externally funded projects represented 80% of the BCCR budget for the 2010-2016 (604 mill NOK) contrasted with the 167 mill NOK secured by the SKD, which means the SKD grant has thus a return rate of 400%.

4.4 Scientific achievements and excellence areas

The strategic areas and scientific strengths developed during the period of the SKD funding led to development of new expertise and outstanding performance in the following areas:

- The development and implementation of the Norwegian Earth System Model (NorESM), which was one of the strategic BCCR activities (SKD project: *IPCC*, and the nationally coordinated project *EVA*; additional investment of 8% SKD funds). The NorESM modelling framework is based on the US CESM, and the centre has managed very well to establish its own character with different model configurations (i.e., BCCRfast) and including its own key components (atmospheric chemistry, river routing, global ocean model MICOM, global ocean biogeochemistry model HAMOCC). Applications of NorESM has served CLIVAR OMCDP CORE II simulations for Atlantic and the Arctic, PlioVAR and the CMIP5 experiments contributing to the Intergovernmental Panel on Climate Change (IPCC) AR5 reports. The NorESM was the 2nd-most used model for the CMIP5/IPCC and currently the NorESM2 is being finalized for CMIP6 participation including ~20 MIP experiments. The success of the NorESM initiative evolved into the successful RCN proposal for the Infrastructure for Norwegian Earth System Modelling (INES), which will secure the further development and open for the continued Norwegian participation in the future international climate assessment experiments (CMIP7).
- Development of the biogeochemical component of the NorESM encompassing process studies (e.g., permafrost feedbacks, non-linear marine carbon dioxide (CO₂) uptake, marine dimethyl sulphide (DMS) cycle, implementing the sediment core models for comparison with paleogeographic observations) and its integration into NorESM (i.e., SKD project: *BIOFEEDBACK*). This was a contribution to future climate projections CMIP5 of IPCC AR5 and enabled investigation of the carbon cycle in the past, interglacial periods (i.e., SKD project: *BIGCHANGE*).
- Understanding of polar climate, related climate processes and inter-linkage of the Arctic with lower latitudes in the oceans and atmosphere, focus on the fresh water forcing (SKD project: *FRESHWATER*), and implications of warming of the Atlantic Inflow on the regional climate and sea ice in the Barents Sea region (i.e., SKD project: *BASIC*, *Nansen Legacy*).
- Understanding of global climate processes bridging different periods to past, present and future climate and addressing climate variability. This was possible by the combination of empirical, dynamical, and modelling approaches. Particular strengths in the areas of multidecadal variability of the Northern Hemisphere with a focus on Atlantic Multidecadal Variability, AMV and Atlantic Multidecadal Oscillation, AMO (i.e., SKD projects: *IMMUNITY* and *MEDEVAC*) and the dynamics of the past warm climates (Pliocene, 3-5 mill years ago; SKD project *DYNAWARM*), the latter made a substantial contribution to PlioMIP and PlioVAR (*PAGES*). Ability of combining the paleo-observations and paleo-modelling capability and expertise, has been influential on international scale. In the second phase, the paleo scale encompassed the carbon cycle under the SKD project: *BIGCHANGE*. Development of a database of Eurasian deglaciation (i.e., evolution of Eurasian ice sheets extent through the last glacial cycle from sediments and bedrock datings, *DATED*), publicly available as a reference data set to the paleogeographic and climate modelling community.
- Studies of ice sheet dynamics (Greenland, Scandinavia, Antarctic) that bring the present ice sheet-ocean-atmosphere interactions into the paleo-time scales perspectives by both modelling and paleogeographic reconstruction approaches which is unique on international scale (i.e. SKD project: *MARGINS*, ERC Synergy project *ice2ice*).
- Predictability of Arctic/North Atlantic climate on seasonal-to-decadal time scales. BCCR has been established in the first league of research organisations providing knowledge of predictability sources and regional impact assessment, with the focus on connecting the North Atlantic, the Norwegian Sea and the Barents Sea, and with the overarching topic of the poleward advection of ocean heat anomalies and their impacts on the local marine ecosystem with implications for local communities as well as the prediction of the sea ice extent. This was enabled by the development of the cutting edge prediction system, Norwegian Climate Prediction Model (NorCPM, SKD project: *PRACTICE*) featuring an efficient data assimilation scheme, as well as by the development of the dynamical downscaling methods for the climate simulations (SKD projects: *REGSCEN* and *PARADIGM*). There is a big potential to further improve these capabilities which are beneficial for

the long-term marine ecosystem services performed by the IMR and the national marine economy, as well as hazards for the Norwegian coastal communities (i.e., due to sea level rise, SKD projects: *SEAELEV* and *INCREASE*, and precipitation extremes, SKD project: *WACYEX*).

- Links between the BCCR natural science research and the socio-economic impacts of the changing climate for Norwegian communities. This scientific production being relevant to the society either directly communicated to the Norwegian society through the partners, dialogue, complementing the activities of the IMR and UNI relevant to the local policy makers and industry fostering the society relevant prognosis (fish stocks). Examples are the ongoing projects *HordaKlim* and *HordaFlom* as well as contribution to the national assessment reports: *Sea Level Change for Norway*, *Climate in Norway 2100* as well as local assessments for each of the Norwegian counties (e.g. *Klimaprofil Hordaland*).

The excellent performance in the research fields above have lifted the BCCR's position in international climate research and the status as an attractive partner in international collaborations, as testified by the number of externally funded projects listed above.

4.5 Scientific infrastructure

- The scientific achievements of BCCR were accompanied by the development of internal and externally funded laboratory infrastructure: *EarthLab* (marine and lake sediment, chronology, magnetism, LIDAR, coring devices) and *FarLab* (stable isotopes, e.g., clumped isotopes for accurate temperature reconstructions) serving the paleo-oceanographic BCCR community which is unique on international scale.
- The oceanographic observations are available through IMR and UiB as their contribution to the BCCR. These include long-term time series from the ocean (*Ocean Weather Station M* and the mooring lines and hydrographic sections intersecting the warm Atlantic inflow into the Nordic Seas: *Svinøy* and *Faroe* sections, *Barents Sea Opening*) and the growing array of the *ARGO* floats in the Nordic Seas, as well as the data bases for the marine ecosystem of the Norwegian and Barents Seas. Apart of some expenditure in 2012, these observations have not been directly funded by the SKD grant, notably however, the IMR personnel engaged in data collection and funding acquisition has been partly funded by the SKD grant due to their engagement in the SKD projects. The EC prompts the BCCR to a stronger engagement in the international community hosting long-term time series elsewhere in the Atlantic Ocean in view of future studies of signal propagation, climate variability and predictability which would increase the international visibility and impact of the BCCR, as well as fostered the scientific production.
- A Norwegian Argo Infrastructure – a contribution to the European and global Argo infrastructure (*NorArgo2*) coordinated by IMR: 100 floats will be deployed in the Nordic Seas, Barents Sea and the Arctic, collaboration with Euro-Argo Research Infrastructure Consortium (*ERIC*) and the data from these floats will be assimilated to the Arctic forecast and reanalysis system (*TOPAZ*, contribution of the Nansen Centre).
- The *Bjerknes Climate Data Centre (BCDC)* collects the data from BCCR projects and either stores them or forwards to national and international databanks (*NMDC*, *NorStore*, *PANGAEA*). BCCR has data storage for *Marine Biogeochemistry*, *ICOS (Integrated Carbon Observation System)*, coordinates *GLODAP (Global Ocean Data Analysis Project)* and contributes to *SOCAT (Surface Ocean Carbon Atlas)*.
- We note that the access to the research ships is not secured and may jeopardize the planned BCCR Norwegian participation in the *Nansen Legacy* initiative and planned BCCR participation in *Mosaic* and *YOPP*.
- The success of the *NorESM* initiative, and prompted by the need for modelling infrastructure funding, led to the successful proposal for the *Infrastructure for Norwegian Earth System Modeling (INES)* which will secure the further development and open for the continued Norwegian participation in the future international climate assessment experiments (*CMIP7~2023*). *INES* encompasses model development and infrastructure

for focused model simulations and storage. INES will be a national facility, where the Bjerknes partners UNI, UiB and NERSC collaborate with University of Oslo and the Meteorological institute.

- The EC notes that the allocation procedure of the High Performance Computing (HPC) resources was unclear, and in addition, recently the allocation of HPC resources in Norway has changed (before the professors were applying for the time and it was for free, now it has changed into a paid service system) and may be precarious for the BCCR projects as dependent on soft funding. Looking into the future, it is unclear whether running time and storage is going to be secured for the planned ambitious modelling projects (preparing contribution to CMIP6 IPCC AR6 and planning for CMIP7, biogeochemistry and paleo-modelling experiments).
- Development of a database of Eurasian deglaciation (i.e., evolution of Eurasian ice sheets extent through the last glacial cycle from sediments and bedrock datings, DATED). The version DATED-1 is open access, publicly available through the BOREAS and PANGAEA systems to the paleo-geographic and climate modelling community. DATED-2 is currently under development.

4.6 Research training

- During the period 2010–2016, 45 PhD candidates affiliated with BCCR have graduated. Most BCCR PhD candidates and postdocs are financed through externally funded projects, and some through positions allocated by the UiB to its institutes. In addition, the UiB has allocated 5 PhD and 2 postdoc positions as in kind to the centre. The interviewed PhD students and postdocs strongly identified themselves with BCCR, stressed the value of the networking activities offered by the BCCR and described the environment as inspiring and supportive.
- During 2009–2017, the Norwegian Research School in Climate Dynamics (ResClim) has been coordinated by the BCCR (Tore Furevik) and become the Norwegian National Graduate School for climate research, supporting PhD candidates and their supervisors. Since 2017, the ResClim network and activities have been continued as the new Research school on Changing Climates in the Coupled Earth System (CHESS), also coordinated by the BCCR partner Geophysical Institute at the University of Bergen (Thomas Spengler). Both ResClim and CHESS got dedicated funding from RCN but were coordinated and tightly linked to BCCR. The research schools have provided the BCCR PhD students an opportunity to network and exchange. It also organized a series of academic courses (i.e., grant writing, data analysis), Advanced Climate Dynamics Courses (collaboration with MIT, WHOI and UW), interdisciplinary Bergen Summer Research School and Nordic PhD conference. The EC has been impressed by the Research Schools' ambitious approach, program and activities. However, the EC notes that their activities strongly focused on the PhD career stage, i.e., disproportionately little attention is given to future academic career perspectives and alternative career pathways.
- Although the graduated PhD students and postdocs have been tracked individually by the RGs and by ResClim, an alumni network is not existing.

5 The BCCR organization

The assessment considered whether the centre's organization provides excellent research conditions with respect to the overall performance and research output of the center. The following outcomes are summarized as:

- The reorganization of the research groups and the BCCR appears timely given the growth of research conducted through the centre. The organizational transition of the BCCR provides challenges and offer opportunities, but there is an evident willingness and ability from the leadership team and individual members of the BCCR to solve future challenges and to dynamically adjust to benefit from opportunities that will enhance the performance and research output of the BCCR.
- The BCCR offers an enhanced environment for coordinated, collaborative and integrated research compared to that simply offered by the individual partner organizations. The capacity building and

ability to conduct research under the nexus of the BCCR is a sum greater than the individual parts. The streamlining, consolidation and strengthening related to the change from seven research groups to four overarching research themes appears timely and beneficial to the BCCR.

- The organization of the BCCR appears highly appropriate and fit for purpose for the research strategies, with successful conduct of research facilitated through SKD funding. All the four partner institutions appear supportive of the BCCR, and the research coordinated through BCCR, in spirit and practice, provides appropriate pathways and interactions for communication and challenge/issue solving.
- BCCR is mindful of the challenges given the growth of the BCCR during this transition. There appears a good balance of top-down and bottom-up direction, with a willingness of individuals involved in BCCR to benefit from clearly articulated guidance and direction provided by the leadership team.

The EC also assessed the added value of organizing the SKD funding under the BCCR and not as a separate entity or individual research projects. The following outcomes are summarized as:

- Clearly demonstrated value of organizing SKD funding under BCCR due to the coordination, collaboration and cross-bridging offered by the “gathering place” that the centre offers to researchers, students and post-doctoral fellows.
- The organization of research through the BCCR offers a clear and unambiguous augmentation of research capability and capacity for the four partner institutions, the pre-eminent national stature of the BCCR and the growing international reputation of the centre.
- The organization of research through the BCCR and the emergent and iconic “branding” of the BCCR offers added value to the tool box of recruiting of high quality graduate students, postdoctoral fellows, scientists and faculty to BCCR and the four partner institutions. It would be harder to attract such a cohort of researchers to Bergen without the benefit of the BCCR.
- The provision of SKD funding and a fostering structure evident across BCCR and partner-institutions clearly provide an attractive environment to conduct nationally important and world class research.

The EC recommends that given the growth and transitions of the BCCR, the processes and practices of the centre should be clearly articulated, and consideration should be made as to the benefit of a risk registry contributing to the proactive and responsive capability of the organization to existential threats, and to changing and emergent conditions.

5.1 The strategy plans for the next five to ten years

The assessment used the evaluation criteria and indicators for the future period (2017->), according to mandate provided to the EC. The following outcomes are summarized as follows:

- The transition from the seven research groups to four research themes (RT: Global Climate, Polar Climate, Carbon System, and Climate Hazards) was conducted democratically and inclusively. These research themes emphasize the strengths from the research groups as well as the BCCR expertise to address some of the grand challenges with climate change. Each RT is led by a research leader now full-time funded through the SKD grant, and a co-leader from one of the four partner institutions. Four of the eight RT leaders/co-leaders are female. We believe that the new research theme structure is an improvement over what went before, but there is now a state of flux, with the opportunity to consolidate and establish a new sense of unity, direction and purpose.
- BCCR needs to define its own identity through vision and mission statements that include the ambition, core business, and strategic implementation plan and goals for each of the research themes. This would clarify the role of the BCCR both for external audiences, but very importantly for BCCR's own partner institutions. It would explain decisions on prioritization of funding. The strategy should consider means to maximize benefits of synergies between the partner institutions. A statement of the role that the BCCR intends to take within Norway is imperative.
- The new leader team needs to focus on developing a real strategy, mapping out their roles and responsibilities, both for their individual research themes and as members of the leader team. The success and sustainability of BCCR require a strong and active leadership team. A truly, thriving

centre, with a strong esprit de corps cannot be sustained purely through a 'facilitation approach'. BCCR is facing the swing to applied research that is prevalent across, EU and wider science. This presents a new challenge, and will require specific focus from theme leaders and the teams (e.g., interfaces towards stakeholder engagement, applied focus, and multi-disciplinary science - how will this be achieved). Some skills, such as social sciences and climate services, may require connections outside BCCR rather than adding to the internal mission of the research themes. Given that the science that BCCR pursues is governed in large part by the opportunities to win funding, there is a requirement to ensure strong policies on what science BCCR will get involved with.

- Four cross-cutting activities (e.g., Model Development, Data Management, Research Training, and Dissemination/Outreach) are essential to BCCR achieving its research strategy for 2017-2021. In addition, they provide contributions that enhance the profile of the BCCR: locally, in Norway, and internationally. The EC recognizes that model development is a long-term activity that simply, cannot be supported on short-term grants. This is widely accepted within the international community. It requires both long-term and secure funding, and a core group of staff who are devoted to technical development, and whose career development is not judged purely by scientific metrics of publication. The securing of the INES infrastructure programme funding has been a welcome step in securing the NorESM as a national facility.
- The availability of HPC resources is a major external critical dependency for BCCR to meet its strategic goals. As such, a clear agreement on the availability of HPC resources would be beneficial. National research facilities (e.g., FARLAB and EARTHLAB) are successes, but there does need to be a plan around how to enhance and upgrade these facilities post-2021.
- The EC noted mixed messages around the Fast Track Initiative scheme, but this is a key tool and perhaps it could be used more effectively to develop new science ideas.

5.2 How effective the goals set for the SKD funding are met

[The role of SKD funding in the period to date, and its likely importance in the future is a central question addressed by the panel]

A detailed audit of what SKD funding has been spent on year-by-year in the review period has not been reviewed by the EC, and this would be a difficult task given the multiple partners, differing overhead rates and specific funding requirements. However, it is clear that as a fraction of the resource used by the BCCR each year, SKD funding represents only a small fraction, when compared with that derived from competitively-won grants (mostly RCN and EU), or indeed that which is contributed explicitly and in-kind by the partner institutes. Thus the leverage that the SKD funding achieves is considerable and appears to deliver strong outcomes for RCN and the Ministry.

What is clear, from all partners, and the BCCR director, is that the SKD funding is the 'glue' that holds the entire BCCR enterprise together. It has provided the funding to support the long-term development of the NorESM models, and to encourage their application through the research projects, and groups. Without the SKD funding during the report period, these core achievements of the BCCR, would not have been delivered, and the BCCR would not exist in its present form. We believe the investment, represented by SKD funding, has been a wise one, which has delivered and continues to deliver a significant capability to the Norwegian science community.

It is on this basis that the EC recommends the continuance of SKD funding to 2021, with the clear intention that this funding is used to maintain a core of strategically-led science. Although RCN or the Ministry may consider whether it wishes that purpose of SKD funding is clarified, if this funding becomes too prescribed, then it would become less valuable to the director in controlling the strategic direction of the BCCR and its partners.

The panel was not requested to provide any recommendation after 2021, and it will not. However, it is worth speculating around the outcome if, hypothetically, SKD funding were to cease in 2021. It is possible, although far from certain, that under this scenario, BCCR would be seen as so important to the institutional partners, that they would seek to ensure its continued existence through their own funds, but it is also clear to the EC that such a situation would effectively put the BCCR at the mercy of changes in funding policy (RCN, EU, etc.) and make it impossible for its director to deliver a core of strategically-led science or maintain the identity of BCCR. The influence of the director and his leader team would diminish,

and in all likelihood make BCCR unsustainable in the long-term. The EC believes this would be an adverse outcome for BCCR and for Norwegian science, and have discussed several options, by which these risks could be (partially) mitigated.

The EC recommends that the BCCR leadership consider the potential scenarios for funding after 2021, and put into place a plan to mitigate the risks to their organization that this presents.

6 Statement

On behalf of the EC, I confirm that the statements above were agreed by the members of the EC and represent their findings concerning the review of the Bjerknes Climate Centre for Research according to the agreed mandate.

Professor David G. Vaughan

A handwritten signature in black ink, appearing to read "D. Vaughan", with a horizontal line underneath it.

November 28, 2017

APPENDICES

Appendix I - EC Panel Composition

Evaluation of the Bjerknes Centre for Climate Research - Evaluation committee

The Research Council of Norway (RCN) will perform a scientific evaluation of the Bjerknes Centre for Climate Research (BCCR) during autumn 2017. The evaluation is carried out for the Ministry of Education and Research which is providing direct funding to the Centre for Climate Dynamics (SKD) at BCCR for a 12 year period since 2010. This direct funding stream was set up in order to secure and maintain the expertise in climate research successfully built up during the period of RCN Centre of Excellence funding in the period 2003-2012. The evaluation shall form the basis and justification for the possible Ministry decision of continued funding to SKD. RCN, the Ministry and BCCR has agreed that the evaluation will cover the full activity program of BCCR while at the same time identifying and highlighting the added value of the SKD funding.

Expertise according to Mandate description June 2017:

According to the mandate, the evaluation committee will consist of 5 independent international experts with the following competences that cover the scientific priorities of BCCR (some members will naturally cover more than one of the competencies below):

- Global/regional modelling, climate modelling, contribution to IPCC/CMIP
- Natural and anthropogenic climate variability with special focus on the Atlantic/Arctic sector
- Prediction and predictability of North Atlantic and Arctic climate
- Carbon cycle processes with emphasis on the marine North Atlantic and forest biogeochemistry
- Past climate, paleoclimate research, glaciology and marine geology
- Modelling of ice caps and sea level

The committee will also need to possess broad experience in the management of research groups/centers, center organization, operation and strategy work, research education and outreach. The experts shall be internationally recognized and may have participated in previous evaluation work for RCN.

Evaluation Committee nominees and expertise:

The nominated committee consists of 3 senior professors, 1 junior professor and 1 senior scientist (PhD). It is chaired by a science director at a leading climate research institute and is gender balanced. An assessment of impartiality and conflicts of interest was performed.

Name	Profile/expertise according to mandate	Position and appointments	Country	Sex
Prof. David Vaughan	<p>Leader of Committee (Chair), Ice sheets, paleo and sea level, organization and strategy:</p> <ul style="list-style-type: none">• <i>Natural and anthropogenic climate variability with special focus on the</i>	<p>Professor in Glaciology, Director of Science, British Antarctic Survey (BAS), dgv@bas.ac.uk, https://www.bas.ac.uk/profile/dgv/</p> <p><i>Member of BAS Science strategy team, Management team and</i></p>	UK	♂

	<p>Atlantic/Arctic sector</p> <ul style="list-style-type: none"> • Prediction and predictability of North Atlantic and Arctic climate • Past climate, paleoclimate research, glaciology and marine geology • Modelling of ice caps and sea level • Management, organization and strategy 	<p><i>Executive team, representative in EU-PolarNet, member of NERC science board, (Antarctica, Remote Sensing,..), Lead Author of IPCC WG II.</i></p> <p><i>Coordinator for ice2sea, a large-scale research programme funded by the European Union (2009 – 2013) involving 24 institutions. The role of ice2sea was to reduce uncertainty in the projections of the contribution of melting ice to sea-level rise.</i></p>		
Dr. Ralf Döscher	<p>ESM model development:</p> <ul style="list-style-type: none"> • Global/regional modelling, climate modelling, contribution to CMIP • <i>Natural and anthropogenic climate variability with special focus on the Atlantic/Arctic sector</i> • Prediction and predictability of North Atlantic and Arctic climate 	<p>Science coordinator, Swedish Meteorological and Hydrological Institute (SMHI), Ralf.Doescher@smhi.se, https://www.smhi.se/en/research/research-departments/climate-research-rossby-centre2-552/ralf-doscher-1.9305</p> <p><i>Global modelling activities and model development, Chair of the Steering Committee of EC-Earth, Coordinator of European contributions to the CMIP6 Scenario MIP in the EU-CRESCENDO project, SMHI representative in the MERGE SG, Swedish representative in ECRA (European Climate Research Initiative).</i></p>	Sweden	♂
Junior Prof. Inga Monika Kozalka	<p>Marine sciences, ocean circulation and young member:</p> <ul style="list-style-type: none"> • <i>Global/regional modelling, climate modelling, contribution to IPCC/CMIP</i> • Natural and anthropogenic climate variability with special focus on the Atlantic/Arctic sector • <i>Prediction and predictability of North Atlantic and Arctic climate (selected topics: NAO/AO predictability)</i> • <i>Modelling of ice caps and sea level (selected topics: ice sheet-ocean interactions)</i> 	<p>Junior professor in physical oceanography at the GEOMAR Helmholtz Centre for Ocean Research, Kiel. ikoszalka@geomar.de, http://www.geomar.de/en/mitarbeiter/fb1/po/ikoszalka/</p> <p>Member of the LAPCOD (Lagrangian Analysis and Prediction of Coastal and Ocean Dynamics) and ASOF (Arctic-Subarctic Ocean Fluxes) communities. Working with Lagrangian methods in ocean circulation and transport, subpolar North Atlantic circulation and its variability, ocean-glacier interactions, dense water overflows, stirring and mixing processes and their parametrization in models, mesoscale eddies, oceanographic data analysis and development of analysis methods.</p>	Germany	♀
Prof. Nick Bates	<p>Marine biogeochemistry:</p> <ul style="list-style-type: none"> • Carbon cycle processes with emphasis on the marine North Atlantic and forest biogeochemistry 	<p>Senior Scientist and Director of Research, Bermuda Institute of Ocean Sciences (BIOS), Professor of Ocean Biogeochemistry, University of Southampton. Nick.Bates@bios.edu, http://www.bios.edu/about/team-members/nicholas-bates/.</p> <p><i>Several appointments including member of the Challenger Society UK, Partnership for Observation of the Global Ocean (POGO), Consortium for Ocean Leadership (COL), North American Marine Laboratories (NAML). Ocean (Atlantic and Arctic) biogeochemical cycling of carbon, nitrogen and dissolved organic matter, physical and biological processes influencing ocean-atmosphere gas exchange of carbon dioxide, coupling between ocean biogeochemical processes and climate variability, carbon cycling in the Arctic Ocean and surrounding polar seas, ocean acidification.</i></p>	USA/UK	♂
Dr. Bette Otto-Bliesner	<p>Atmospheric sciences, modern and future climate:</p> <ul style="list-style-type: none"> • Global/regional modelling, climate modelling, contribution to IPCC/CMIP • <i>Natural and anthropogenic climate variability with special focus on the Atlantic/Arctic sector</i> • <i>Past climate, paleoclimate research, glaciology and marine geology</i> • Modelling of ice caps and sea level 	<p>Senior Scientist and Deputy Director of the Climate and Global Dynamics Laboratory, UCAR/NCAR. ottobli@ucar.edu, https://staff.ucar.edu/users/ottobli.</p> <p>Synoptic meteorology, climate diagnostics, and climate change modelling. Involved in educational activities, teaching, research and community service. Development of a climate models used to understand the modern climate system and past climate change. Has chaired the International Geosphere-Biosphere Programme (IGBP), Past Global Changes for the last 3 years, Lead Author in the IPCC 4th and 5th assessment reports. Involved in a number of committees, panels, and advisory boards. Recent scientific activities on development and testing of the Community Earth System Model (CESM), for understanding of past climate change to enhance the credibility of future projections.</p>	USA	♀

Dr. Jon Børre Ørbæk was the RCN administrative responsible and acted as secretary for the EC.

1. Framework and mandate for the evaluation of the Bjerknes Centre for Climate Research / Centre for Climate Dynamics

The Research Council of Norway, June 2017

1. Introduction

The Bjerknes Centre for Climate Research (BCCR)² is a cooperation between the University of Bergen (UiB), Uni Research (UNI), Institute of Marine Research (IMR) and the Nansen Environmental and Remote Sensing Centre (NERSC). The formal cooperation started in 2000 and received during the period 2003-2012 funding from the Research Council of Norway (RCN) as a Centre of Excellence (SFF)³.

As the Ministry of Education and Research emphasized the importance of securing continuation of the excellent research environment and expertise established under the Bjerknes SFF, the initiative was taken to establish the Centre for Climate Dynamics (SKD) under UiB in 2010. According to the requirement set down by the Ministry, the centre should be an independent unit within the university organisation and with its own governance system (steering board and statutes).

At their board meeting 30.09.2010, UiB decided to establish SKD, and identified an interim period of two years (until the end of the Bjerknes SFF contract) to agree on statutes, organization and governance issues. However, the BCCR partners early identified the need to merge and integrate the activities of the SKD with the BCCR⁴.

All scientific and technical staff is employed by the different partner institutions involved in the BCCR collaboration. The BCCR had in 2016 approximately 210 employees, with 117 scientists, 33 postdocs, 45 PhD-students and 15 technical/administrative personnel, and recruits scientists and students internationally with 37 nationalities represented in the staff in 2016.

2. Background

The extraordinary funding from the Ministry to SKD started in 2010, with 20 MNOK per year the first three years, increasing to 25 MNOK per year from 2013. The center reports directly to the Ministry, except for the first year (2010) when the funding was allocated through the RCN. The funding is for a 12 year period, ending in 2021, under the condition of a successful midterm evaluation.

The SKD funding from the Ministry has partly supported research leaders and internal strategic flagship projects under BCCR. The SKD-funded activities thus represent an integral part of the overall BCCR, and a separate evaluation of SKD would not be possible. Consequently, the Ministry has tasked the RCN to perform a *full evaluation of BCCR, which the same time identifies and highlights the added*

² BCCR website: <http://www.bjerknes.uib.no/en/>

³ The Centre of Excellence (SFF) programme gives Norway's best scientists the opportunity to organize their research in centres to reach ambitious scientific goals through collaboration and long-term basic funding. The RCN provides the basic source of funding for the scheme. The SFF home page: [www.forskingsradet.no/prognett-sff/About the CoE scheme/1224067001878](http://www.forskingsradet.no/prognett-sff/About%20the%20CoE%20scheme/1224067001878)

⁴ The integration is described in the BCCR annual report from 2013 and 2014.

value of the SKD funding to the overall activity program of BCCR (hereafter called the evaluation of SKD/BCCR).

3. Objective

The primary objective of the evaluation is to form the basis for the Ministry decision regarding whether or not to continue the funding for SKD for the second half of the 12-year period. The Ministry need to know if the goals set for the centre⁵ are met, according to the requirements set by the Ministry in its 2010 allocation letter to RCN and in the RCN contract with UiB.

The criteria, questions and indicators listed below will be the basis for the evaluation committee recommendations and assessment on the centre's performance with respect to scientific quality, organisation and future strategy. The choice of SKD/BCCR evaluation criteria and method is well in line with the midterm evaluation of the RCN-funded SFFs from its 2011 call.

4. Procedure and outcome

The evaluation of SKD/BCCR will cover the period of SKD-funding, i.e. 2010-2016, as well as the strategy plans set for BCCR for the remaining part of the SKD funding and beyond (next five to ten years). The evaluation committee should take into account that the BCCR cooperation existed before it received SFF and SKD funding, and will continue to exist also after the end of the dedicated SKD funding.

The evaluation will cover the full activity program of BCCR, with special focus on the added value of the SKD funding, both with respect to the overall performance and research output of the center, but also added value of organizing the SKD funding under the center and not as individual research projects. BCCR will therefore need to identify and highlight how the SKD funding is used, and provide concrete examples of its impact on the quality and overall activity level of BCCR.

An evaluation committee with international experts will be appointed specifically for the evaluation. Based on the *background material* and a *site visit*, the evaluation committee will write an evaluation report that will comment on how well the centre meets the evaluation criteria.

The evaluation report shall also encompass concrete recommendations for the further continuation and development of SKD/BCCR. The evaluation committee shall provide a basis for the Ministry to conclude on the continued funding. Thus, the evaluation committee need to provide a basis and justification for the following three possible Ministry decisions:

1. Continue the SKD funding for the remaining period.
2. The centre should take corrective actions according to the evaluation recommendations, before the SKD funding is continued.
3. The SKD funding should be terminated.

The RCN will forward the evaluation committee recommendations and report to the Ministry, together with advice and comments from Research Board for the Division for Energy, Resources and the Environment.

The evaluation shall be performed according to the time schedule given below.

5. Evaluation criteria

The following three main criteria will be used in the evaluation:

1. The scientific quality, focussing on the period of SKD funding
2. The centre organisation

⁵ The goals set for the centre, given in the Ministry decision and allocation letter to RCN and the RCN contract letter to UiB in 2010, are reflected in the evaluation criteria. The original letters will also be provided to the evaluation committee as part of the background material.

3. How effective the goals set for the centre are met, and the strategy plans for the next five to ten years

The committee may also discuss to what extent the original scientific goals set for BCCR/SKD were well formulated and have turned out to be in line with those targeted during the period. This also allows a consideration of the centre's influence on structuring the field of climate research. The criteria are the same main criteria as those used in SFF midterm evaluations and the midterm evaluation of BCCR in 2006. The evaluation committee should, however, note that the evaluation of SKD/BCCR need to take into account that the center now has a different and broader mission and organization and reports differently than the previous and more specialized SFFs.

The committee shall address the following points:

- In general how well the goals set for the center are met, with specific reference to the statutes originally set for SKD and its work program (description of scientific profile of the center and the provisions set by the Ministry).
- To what degree the center has developed into a leading research community that provides state of the art knowledge about climate change and variability, as well as better understanding and modelling of the past, present and future regional and global climate.
- The center's position in international climate research and its international recognition.
- The center's position in national climate research and its recognition.
- The center's role in climate research education, contribution to research recruitment locally, nationally and internationally. To what degree the center maintains and develops young researchers and talents.
- The center's role in assessment work, such as in relation to the UN IPCC AR5, or roles in other national or international advisory processes, white papers etc.
- The center's contribution to understanding decadal variability and prediction, the carbon cycle and feedback mechanisms in the climate system, as well as regional climate scenarios for Norway and other countries.
- How the SKD funding has been used as well as the added value of the SKD funding for the overall activity program of the BCCR.
- The general scientific production of the center (quantity, quality)
- The center's local, national and international cooperation and roles
- Outreach activities and societal relevance, visibility in society
- The center's strategy for the next five to ten years

2. Evaluation criteria and indicators for the first period (2010-2016)

This scheme follows the same format as that performed under the SFF midterm evaluation. The main criterion is the scientific quality:

3. *Is the quality of the scientific output from the centre on the level of "excellent international research"?*

The organisation of the centre is also to be evaluated:

4. *Is the centre's organisation excellent for the research?*

Under this point, there are additional sub-points to be evaluated:

- *Has the scientific output been profiting from the "organisation as a centre" (e.g. interaction between researchers / research groups)?*
- *Does the research management contribute to improved research?*
- *Is the quality of researcher training (PhD) on a high international level?*
- *Are the plans for career development for junior researchers good and is independence encouraged?*
- *Is the international research cooperation excellent and contributing to research?*
- *Is the national research cooperation excellent and contributing to research?*
- *Is the centre attracting excellent research talents and researchers?*
- *Is the outreach/dissemination of high quality and of a suitable volume?*

- *Have the actions to improve gender balance, in particular among the senior researchers or potential senior researchers, been functioning well?*
- *Are the partner institutions contributing to the centre?*
- *Is the administration and technical support of high quality?*
- *Is the physical organisation (distributed, co-located) of the centre working well?*
- *Is the centre well supported by the host institution management?*

The evaluation criteria shall be applied to the full activity program of BCCR, with special focus on the added value of the SKD funding.

5. Evaluation criteria and indicators for the future period (2017->)

This scheme follows the same as that performed under the SFF midterm evaluation.

The centre' strategic project plan for the future period may refer to the present research and state that all or parts of the present research will be continued. In addition, new directions of the research (if any) must be emphasized, and dis-continued research must be mentioned. A rough implementation plan for the research is an important part of the description.

When it comes to the organisation, emphasise plans to employ researchers with specific new expertise (if any), re-organisations (if any), changes in the researcher training (if any), the plan for submitting proposals to international funding schemes, plans for improving gender balance and plans for the centres' research after the 12-year financing of the SKD ends.

Evaluation criteria for the research plans:

- *To what extent are the proposed research and objectives still ambitious, with the potential to achieve ground breaking results?*
- *To what extent is the outlined scientific approach for the second period feasible?*
- *To what extent are the proposed timescales (implementation plan) and resources (financial, use of research infrastructures, etc.) necessary and properly justified?*
- *To what extent are changes in the research positive and well justified?*

Evaluation criteria for the organisation of the centre:

- *Are there offensive plans for preparing and submitting proposals to Horizon 2020 or other international funding schemes appropriate for this field of research?*
- *If the scientific field is characterized by a gender imbalance, are the plans to support development of research talents of the under-represented gender towards qualification for more senior-level positions appropriate?*
- *To what extent are changes in the organization positive and well justified?*

Is the strategy for continuation of the most successful research realistic and sufficient?

The evaluation criteria shall be applied to the full activity program of BCCR, with special focus on the added value of the SKD funding. The evaluation committee may also formulate additional questions and request additional quantitative information as they find appropriate.

6. Composition of the evaluation committee

The committee will consist of five independent international experts with the following competences that cover the scientific priorities of BCCR (some people may cover more than one of the competencies below):

- Global/regional modelling, climate modelling, contribution to IPCC/CMIP
- Natural and anthropogenic climate variability with special focus on the Atlantic/Arctic sector
- Prediction and predictability of North Atlantic and Arctic climate
- Carbon cycle processes with emphasis on the marine North Atlantic and forest biogeochemistry
- Past climate, paleoclimate research, glaciology and marine geology

- Modelling of ice caps and sea level

The committee will also need to possess broad experience in the management of research groups/centers, center organization, operation and strategy work, research education and outreach. The experts shall be internationally recognized and may have participated in previous evaluation work for RCN.

The members of the evaluation committee will receive the background material in due time before the evaluation *site visit*. The committee members are asked to:

- Read the self-assessments and annual reports from the centre. Other information available through websites, science indexes, journals etc. may also be assessed for a fuller picture.
- Prepare a sketch for the evaluation report and formulate some questions to be sent to the centre before the *site visit*. (Other questions may pop up and be discussed at the *site visit*.)
- Conduct a *site visit*.
- Write a consolidated assessment report. Correct any factual mistakes after consulting the centre on the final text.

7. Timetable

The evaluation committee will perform the major part of its work during September, October and November 2017. The final evaluation report shall be concluded by 15 November 2017. The progress plan will be prepared by the evaluation committee in cooperation with the RCN.

Appendix 3 - Background material for the EC

September 1st 2017:

- Activity report Bjerknes Centre for Climate Research 2010-2016 - included report on Finance and Personell p. 5 and links to Bjerknes Annual reports 2010-2016 p.17.
- SKD årsmeldinger 2010-2016. These annual reports are in Norwegian and have been sent to the Ministry for Research and Education each year. The activity report listed above, is a synthesis of these annual reports.
- SKD projects 2011-2015 Final reports. This document is a collection of the final reports from the SKD-projects 2011-2015.
- Doctoral dissertations 2010-2016.
- Publications 2010-2016, to be replaced by new publication list sent 15th of September.

September 15th 2017:

- Publications 2011-2016.
- Self-evaluation reports
 - Institute for Marine Research, IMR
 - Nansen Centre for Remote Sensing, NERSC
 - Uni Research Climate, URC
- Report from the host institution University of Bergen.
- Finances at Bjerknes Centre for Climate Research.
- Self-evaluation report 2010-2016, from the centre director.
- Strategy report 2017-2021 (and beyond), from the centre director.

Appendix 4 - Agenda for Site visit

AGENDA FOR THE MEETING BETWEEN THE BJERKNES CENTRE, THE BJERKNES CENTRE EVALUATION COMMITTEE (EC)

Monday 23. October

Venue: Scandic City Bergen Hotel, Håkonsgt 2-7

- 09.00-10.00 EC Private meeting (Internal Briefing for EC).
- 10.00-12.00 The Bjerknnes Centre, organization and strategy (with SAC and EC present)
- 10.40-12.00 Status and future plans, presentations by research leaders
- Global Climate (Camille Li)
 - Polar Climate (Tor Eldevik)
 - Climate Hazards (Anna Nele Meckler)
 - Carbon System (Are Olsen)
- 13.00-13.30 EC – Summing up morning session, planning interviews
- 13.30-17.00 Interviews with Bjerknnes Research Group leaders (7 scientists)
- Mats Bentsen and Odd Helge Otterå (RG1: Climate model development and projections, UNI)
 - Anne Britt Sandø, Noel Keenlyside and Stefan Sobolowski (RG2: Climate prediction and climate service, IMR)
 - Christoph Heinze and Are Olsen (RG3: Carbon cycle and biogeochemistry, Geophysical Inst., UiB)
 - Camille Li, Tor Eldevik and Jan Even Nilsen (RG4: Large-Scale atmosphere-ocean dynamics. Geophysical Inst., UiB)
 - Igor Ezau and Lars Henrik Smedsrud (RG5: Atmosphere, cryosphere and ocean processes, NERSC)
 - Jostein Bakke, Anne Bjune and Martin Miles (RG6: Natural climate variability – extending the instrumental record, Dept. of Geosciences, UiB)
 - Bjørg Risebrobakken, Kerim Nisancioglu and Anna Nele Meckler (RG7: Past climate dynamics, UNI)
- 17.00-18.00 EC – summing up afternoon session/interviews – key messages

Tuesday 24 October

- 09.00-12.00 Scientific highlights and research training (with SAC and EC)
- Climate - carbon feedbacks (Christoph Heinze)
 - Atmospheric dynamics, jets and storm tracks (Erica Madonna)
 - Atlantic inflow and ecosystem responses (Vidar Lien)
 - AMO variability and linkages to the Arctic (Martin Miles)
- 10.10-10.30 Research training (Thomas Spengler)
- 10.50 - 11.05 Bjerknnes Climate Data Centre (Benjamin Pfeil)

Highlights

- Past AMOC stability (Ulysses Ninnemann)
- Deglaciation dynamics and DATED data set (Anna Hughes)

- Attribution and projection of regional sea level (Jan Even Nilsen)
- Quantification and interpretation of the Suess Effect (Marie Eide)

13.00-13.30

- Climate modeling, climate prediction and future priorities (Mats Bentsen, Noel Keenlyside)
- Antarctic field work and process understanding (Svein Østerhus)
- Atmospheric boundary layer and global warming (Richard Davy)
- Communication: Bridging the gap between science and society (Gudrun Sylte, Øyvind Paasche)

14.30-15.15 EC – Interviews on Organizational aspects and Education/Career development

15.15-16.00 EC – Interview on Finance and personnel

- Ragnhild Stolt-Nielsen (Administrative leader)
- Gudrun Sylte (Communication leader)

16.00-18.00 EC – summing up morning and afternoon sessions – key messages

Wednesday 25 October

09.00-11.00 EC – Site visit to the partner institutions

- NERSC – David Vaughan
- IMR – Inga Koszalka
- UNI-Research – Ralf Doescher
- UiB – Nick Bates / Bette Otto-Bliesner

11.00-12.00 EC private meeting – Summing up site visits and interviews – key messages

13.00-13:30 EC – Clarifying session with Bjerknes Centre leader group

- Tore Furevik (Centre Director)
- Ragnhild Stolt-Nielsen (Administrative Leader)
- Tor Eldevik (Research leader Polar Climate)
- Anna Nele Meckler (Research leader Climate Hazards)
- Are Olsen (Research leader Carbon System)
- Francois Counillon (Representative Nansen Center)
- Frode Vikebø (Representative Institute of Marine Research)
- Petra Langebroek (Representative Uni Research)

13:30-16.00 EC – Summing up, evaluation agree and record key findings

16:00 Panel Disperses.

Appendix 5 - Summary of visits to Partners Institutes

6.1 NERSC

The Nansen Environmental and Remote Sensing Centre is an independent non-profit research foundation conducting basic and applied environmental and climate research. Working in seven science teams, under a recently appointed director, the centre has scientific expertise in Earth system environmental and climate research, satellite remote sensing, modelling and data assimilation.

The site visit, undertaken by David Vaughan, met with several senior science staff, including Johnny Johannessen) and then separately with four representatives for early-career research staff (PhD students and Postdocs).

The NERSC is a vigorous institute with wide ranging research expertise and ambition. It has contributed notable scientific outcomes to BCCR.

6.2 IMR

The EC member Inga Koszalka met with the Research Director Geir Huse, Program Leader Frode Vikebø and several Senior Scientists members of the Oceanography and Climate (OK) Research Group (strongly engaged in the BCCR activities) as well as a PhD student.

The IMR emphasizes that its mandate is to provide advice to Norwegian authorities on aquaculture and the ecosystems of marine areas under Norwegian jurisdiction and their research is not simply academic but supports the IMR's societal responsibilities. The common activities within BCCR constitute just a small part of the IMR overall activities and are restricted to the Oceanography and Climate (OK) group but the collaboration with BCCR is considered strategic because:

- The BCCR offers IMR a broader expertise in physical oceanography and climate variability that are essential parts of the marine ecosystem dynamics. Of particular relevance to IMR is the collaboration involving the BCCR modeling framework: Earth system model (NorESM) with regional downscaling capability and a decadal prediction model (NorCPM). The collaboration with BCCR thus improves the IMR ecosystem services.
- The PhD network of BCCR offers the PhD students at IMR a round education, broader expertise and future collaborations. This is important as the doctoral education of their students is an element of the IMR staff recruitment process.
- IMR has growing ambitions on publishing in international scientific journals and considers their participation in BCCR activities as one of the ways to achieve that.

Added value of the SKD funding: IMR has received SKD funds of ~3 Mio NOK yearly during 2011-2016. Most of these funds was dedicated to pay researchers' hours for the OK group members engaged in the SKD projects.

Engagement in the SKD projects: In the I phase, IMR participated in 6 out of 7 SKD strategic projects with the following contribution to the total project Personal Months (PM): IPCC (21%), IMMUNITY (23%), PRACTICE (7%), REGSCEN (33%), SEALEV (12%) and BIOFEEDBACK (20%). In the II phase, IMR participated in 4 out of 8 projects: PARADIGM (34%), MARGINS (5%), FRESHWATER (40%), BIGCHANGE (13%).

IMR has allocated a part of its financing from its owner, the Ministry of Industry and Fisheries to support both the external projects and the BCCR research, compensating the researchers' salaries and providing access to the operational oceanographic facilities and oceanographic data.

Future outlook: IMR plans to get more involved in the BCCR activities in the future, and hopes that the BCCR activities will become more relevant to the IMR services (as expected because of growing emphasis of the funding for the applied science). In general, the IMR supports the ongoing re-organization of the IMR and the new leadership. All four new Research Groups are potentially relevant to IMR, The Polar Climate group is seen as the most relevant. There is a concern about some aspects of the current strategy of the BCCR and its relation to IMR (the unclear focus of the Hazards Group, the new strategy for the modeling

activities as a cross-theme and the changing rules for access to modelling services within INES, and a strong branding of the BCCR). IMR has no representatives in the new leadership of the BCCR but Svein Sundby became a member of the Board with a mission to advocate the IMR interests.

6.3 UNI Research

The EC, represented by Ralf Döscher, was given the possibility to talk to the directors, the senior leaders and early career scientist. Unanimously, the view of BCCR as the main identity for researchers was confirmed. UNI Research provided ample opportunity for exploring the strategic situation and perspective for research and the staff involved in the research. Important considerations with respect to UNI Research are:

- The task of leading the global and regional climate model development results in a central role. The approach of developing NorESM based on CESM and several own component models succeeded very well thanks to a thoughtful strategy, skilled staff and the more than critical mass of co-developers and model users at BCCR and elsewhere.
- Regional climate modelling provides a link to BCCR-external players in the field of climate services, which was under-emphasized on a BCCR level so far.
- Global and regional model developers would benefit from an even more dense integration with process knowledge in the center, e.g. with glacier, sea ice and hydrography research as well as with marine impact research.
- A more advanced career support for early career scientists after the PhD is considered desirable.

6.4 UiB

The Geophysical Institute (GFI) and the Department of Geosciences at the University of Bergen (UiB) provide a wide range of Earth and ocean science studies through a diverse academic faculty and associated researchers. The site visit, undertaken by Nick Bates and Bette Otto-Bliesner, met with a diverse group of UiB staff and students, including Director of GFI, early to senior career faculty, post-doctoral fellows and PhD students, in separate and group meetings. The value of and the commitment to BCCR was evident from the Director to the PhD students. The EC representatives were also shown facilities such as EarthLab and FarLab.

The UiB's Geophysical Institute and Department of Geosciences are diverse and dynamic, with wide ranging research expertise and ambition. As with other partners of the BCCR, they have contributed notable scientific outcomes of the centre.

Appendix 6 - Check-list of Criteria

The following three main criteria will be used in the evaluation:

[The scientific quality, focussing on the period of SKD funding]

EC – Some areas of real excellence, especially in climate modelling, and carbon flux, some areas of nationally significant work, no areas of significant weakness.

The centre organisation

[How effective the goals set for the centre are met, and the strategy plans for the next five to The committee shall address the following points:

...In general how well the goals set for the center are met, with specific reference to the statutes originally set for SKD and its work program (description of scientific profile of the center and the provisions set by the Ministry).]

EC – Well met

[To what degree the center has developed into a leading research community that provides state of the art knowledge about climate change and variability, as well as better understanding and modelling of the past, present and future regional and global climate.]

EC – Well achieved

[The center's position in international climate research and its international recognition]

EC – As an institute BCCR is building an international reputation, and is already internationally-competitive in some areas.

[The center's position in national climate research and its recognition.]

EC – Nationally, we judge it to be pre-eminent

[The center's role in climate research education, contribution to research recruitment locally, nationally and internationally. To what degree the center maintains and develops young researchers and talents.]

EC – Well met.

[The center's role in assessment work, such as in relation to the UN IPCC AR5, or roles in other national or international advisory processes, white papers etc.]

EC – We believe the BCCR, e.g. in CMIP6, and is playing an active role these activities (Check annual reports)

[The center's contribution to understanding decadal variability and prediction, the carbon cycle and feedback mechanisms in the climate system, as well as regional climate scenarios for Norway and other countries.]

EC – Well met for decadal, carbon etc. Regional climate through CORDEX, and national assessment reports

[How the SKD funding has been used as well as the added value of the SKD funding for the overall activity program of the BCCR]

EC – It is not entirely clear how all SKD money has been spent, but it appears to be glue for all BCCR activities.

[The general scientific production of the center (quantity, quality)]

EC – Our analysis of outputs shows a good level of scientific output. Note some areas of BCCR activity are unlikely to produce significant numbers of publications (e.g., model development). Encouragement should be given to early-career scientists to publish highest-quality papers, and maintain a good and consistent rate of publication.

[The center's local, national and international cooperation and roles]

EC – Well met

[Outreach activities and societal relevance, visibility in society]

EC – A strength

[The center's strategy for the next five to ten years]

EC – See the main recommendation above -there is a urgency to update BCCR strategy

[Evaluation criteria and indicators for the first period (2010-2016)]

EC – Well met.