Forskningsrådet

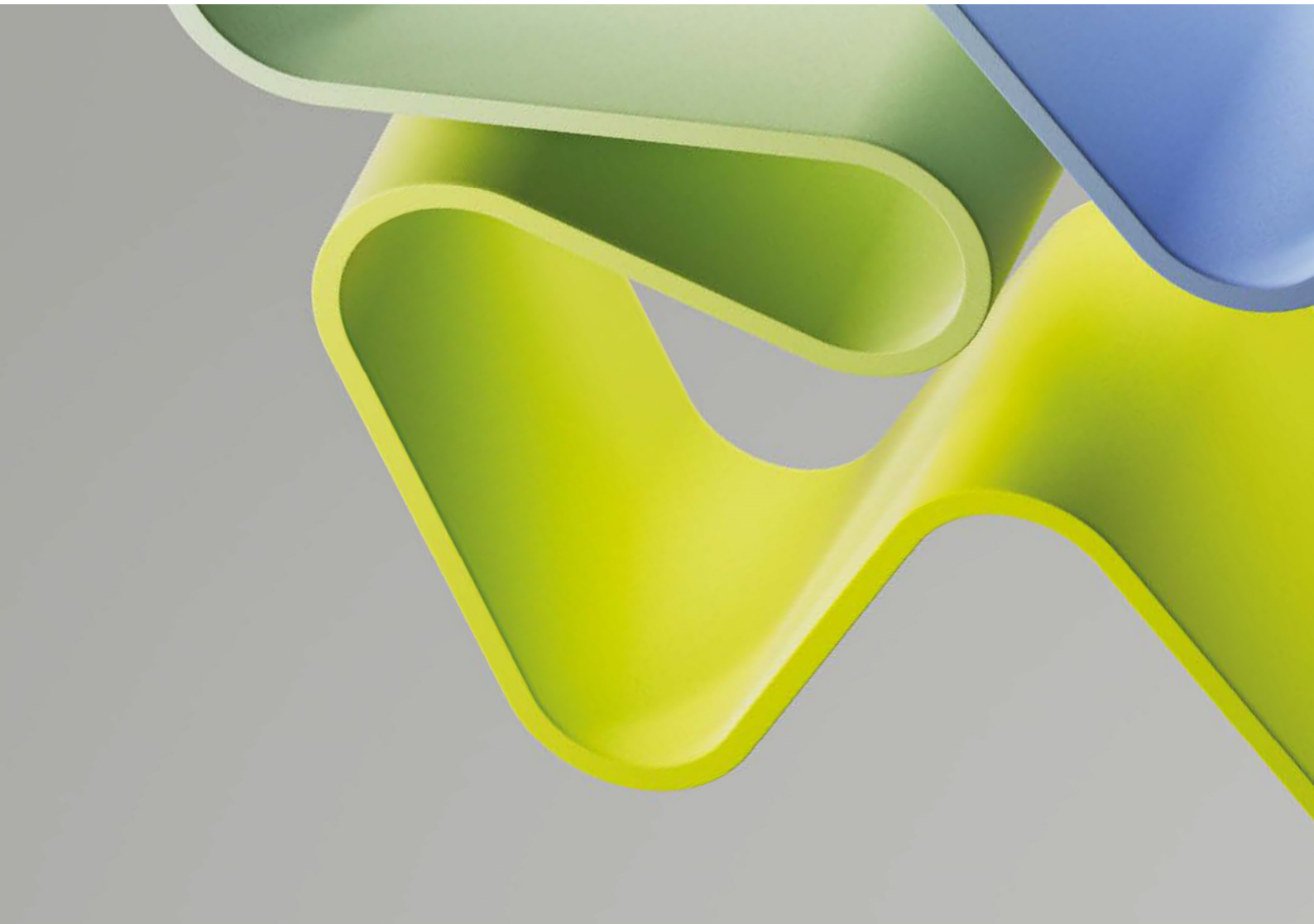
Evaluation of Natural Sciences 2022-2024

Evaluation report

Geophysical Institute

University of Bergen

January 2024



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Statement from Evaluation Committee I

The members of this Evaluation Committee have evaluated the following administrative units at the higher education institutions within natural sciences in 2022-2023 and submitted a report for each administrative unit:

- Geophysical Institute, University of Bergen
- Department of Earth Sciences, University of Bergen
- Department of Physics and Technology, University of Bergen
- Department of Chemistry, University of Bergen
- Department of Theoretical Astrophysics, University of Oslo
- Department of Geosciences, University of Oslo
- Department of Physics, University of Oslo
- Department of Chemistry, University of Oslo

The members of the Evaluation Committee are in collective agreement with the assessments, conclusions and recommendations presented in this report. None of the committee members has declared any conflict of interest.

The Evaluation Committee has consisted of the following members:

Prof. James Kirchner (chair)
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University of Lancaster, United Kingdom

Prof. Nicola Hüsing
University of Salzburg, Austria

Prof. Dieter Schinzer
University of Magdeburg, Germany

Description of the administrative unit

The Geophysical Institute (GFI) of the University of Bergen (UiB) is organised in research groups that together form five academic sections. In 2021, GFI had 126 employees, out of which 16 were professors, 5 associate professors, 19 adjunct positions, 22 researchers, 16 postdocs and 31 PhD fellows.

GFI consists of five research groups: Meteorology, Physical Oceanography, Biogeochemistry, Climate Dynamics, and Renewable Energy.

In recent years, GFI has strategically expanded its research scope from understanding changes in weather, ocean, and climate to include renewable energy and offshore wind. This shift began in 2009 with internal resource reallocation and reached a milestone in 2019 with the creation of the Bergen Offshore Wind Centre (BOW). Their primary strategic goals revolve around sustaining and enhancing research momentum, fostering collaboration, promoting forward-looking recruitment with a focus on gender balance, aligning expertise with funding opportunities, and prioritizing the development of Early Career Scientists (ECS). To support ECSs, senior scientists play a role in providing scientific training, enabling career development and growth within the institute. GFI places particular importance on the continued existence of the Bjerknes Centre and access to high-performance computing and ship time. They also prioritise maintaining a strong public presence to stay relevant in society and attract new students. Regarding renewable energy, GFI acknowledges that they are still in the early stages of establishment, aligning with Norway's broader energy transition efforts. They aim to leverage their expertise while ensuring the sustainable growth of their Renewable Energy group.

In their self-assessment, GFI indicates that Master's projects address real scientific problems and often integrate with ongoing national and international research endeavours. They also highlight the frequent inclusion of PhD student thesis projects within research initiatives, with GFI offering co-supervision to PhD students from various institute sectors. GFI also highlight their role in the national climate research school, CHESS, as it plays a vital role in PhD education in climate sciences. Their status as a prominent national and international research entity is underscored through leadership in collaborative research projects, including partnerships with the Bjerknes Centre and involvement in substantial EU projects.

GFI actively pursues internationalisation efforts by taking central roles in research projects, both nationally and internationally, and collaborating with institutes and the private sector globally. Their partnership with the Bjerknes Centre is seen as contributing to climate research advancement in Norway. GFI also claims leadership in large-scale EU projects, aiming at enhancing their international reputation. They aim to further internationalize Norwegian research in climate, marine, and renewable energy. However, they acknowledge challenges like securing funding, developing a skilled workforce, and adapting to evolving research landscapes. Nonetheless, they are optimistic about expanding private sector collaborations, aligned with growing public interest in their research, which presents opportunities for intersectoral networks and career development.

Overall assessment

The GFI at the UiB is internationally recognized across its diverse portfolio of research. Both the administrative unit as a whole, and its individual research groups, are small compared to their international competitors, but GFI's contributions are substantial relative to its size. However, the small size of the groups creates vulnerabilities in maintaining critical mass, and the risk of "single points of failure" if key staff are lost.

The publication rate of GFI is relatively low, with author shares per FTE less than 60% of the average of the 16 administrative units considered by the expert panel. However, GFI's publications tend to be more highly cited than those from most of the other administrative units being assessed.

The fraction of budget that is supported by external funding is quite high, averaging 60% and reaching 75-80% for several groups. This reliance on external funding may make these groups vulnerable to changes in the Norwegian funding system and may endanger their independence if their research agenda is shaped by the priorities of external funding sources.

GFI's global position in climate and ocean research means it has played an important societal role in understanding the challenge of climate change, and it has contributed substantially to other public policy debates. However, GFI clearly expresses its aim to pursue disciplinary basic research, with little ambition to engage more fully with communicating research or collaborating on commercial climate solutions. This may optimise its basic research output, but may limit its future social utility.

Where possible, the Evaluation Committee has commented on issues identified in the terms of reference. In some cases this may not be possible, for example due to limitations in the information that was available to the Evaluation Committee.

Recommendations

1. The institute needs a strategy. The current strategy document mostly just describes the institute's research areas. What is needed instead is a clear-eyed view of the challenges and opportunities that the institute is likely to face in the coming years, and a plan for handling them. The SWOT analysis may provide a good place to start but should be complemented with concrete initiatives to address the issues that are raised there. The truly strategic part of a strategy involves figuring out how it will be implemented.
2. Most of the research groups are small enough that the expert panel assessments consider them to be vulnerable to losing critical mass. The institute should weigh the costs and benefits of consolidating effort through reorganisation.
3. The Bjerknes Centre has been a vital "force multiplier" for Earth sciences at Bergen, and the ongoing and future relationship between the institute and the Bjerknes Centre deserves some strategic thought.
4. Likewise, some strategic thinking about the relationship between the institute and the Earth Sciences department at Bergen would be helpful. However, the Evaluation Committee does not see a strong case for merging with the geophysics group in Earth Science, despite the similar name, due to the difference in focus (solid earth vs. ocean and atmosphere).
5. Initiatives to encourage collaboration among the research groups would be welcome.
6. Research in many of the groups is very dependent on external funding. The institute should have contingency plans for how they would handle possible changes in the Norwegian research funding system.
7. Succession planning for the Biogeochemistry group is urgently needed.

8. Gender equity needs ongoing attention, particularly at the advanced career stages where gender ratios are very strongly skewed.
9. A relatively small amount of focused attention on communicating with the wider society could magnify the real-world impact of the institute's research findings.

1. Strategy, resources and organisation of research

The GFI is focused on fundamental research, guided by the vision and research interests of its established professors. This approach has enabled it to conduct globally important research, but may not be sufficient to maximize future success. Strategic documents largely state present research foci, rather than outlining future research challenges the administrative unit will address, nor providing plans for future appointments, partnerships, funding, and infrastructure needs.

Although relatively small, the administrative unit is set up in 5 Research Groups, each of which is correspondingly small. This structure makes the groups vulnerable to loss of people or funding and appears to limit collaborative working within the administrative unit. Strategic consideration of departmental structures and governance, involving staff at all levels across the administrative unit, would be beneficial.

The administrative unit is established as the lead Norwegian institute for physical oceanography and is a leading player in other areas of its research. Their leadership position delivers excellent science, but it would be wise to guard against complacency regarding these leading positions, given the increasing interest in climate and ocean science nationally (including within UiB, where Physics is setting up a new programme in ocean physics).

The administrative unit appears to receive a good level of base funding and is also successful at bidding for competitive research funding. Computational and ship-related infrastructure are extensively used by the administrative unit and are critical to its future success, requiring engagement in national and international conversations on future infrastructure need and funding. There are some similarities in this regard with UiB’s Earth Sciences, which makes partnership with that administrative unit important.

There are close relationships with the Bjerknes Centre, which will be important to build on as research develops in the future. The administrative unit is also important to the overall UiB strategy, particularly with respect to climate and oceans, making engagement with the wider university important.

1.1 Research Strategy

The Geophysical Institute's strategy document does not really outline a strategy, but instead describes the areas in which the institute works and makes some generic statements about desire to conduct research and collaboration. What does the institute want to achieve in the future, besides more of the same? Where are opportunities for improvement? In what ways would it be smart to change direction? There is possibly an intention to disavow strategy in the administrative unit's self-assessment document, but more attention to future direction is recommended by the expert panel.

A more positive example is the strategic vision in the initiation of the new (2019) research group on renewable energy, as presented in the Research Group report.

The SWOT analysis is insightful, identifying several key issues, including critical mass (dependence on key individuals), gender balance, and stability/reliability of funding in the shifting Norwegian research landscape. What are needed (and missing) are concrete action plans to deal with these issues. The SWOT analysis also points to unexploited potential for high-impact research results, beyond what has already been achieved (although it does not outline ways that this potential could be realized).

There is also no stated plan on innovation or commercialisation; instead, there appears to be a deliberate focus on scientific research alone.

This downplaying of strategy and innovation may allow the GFI to conduct high-quality research at present, but it is questionable whether the administrative unit will be able to continue to tackle important issues and conduct excellent science without wider engagement and strategic planning.

1.2 Organisation of research

GFI is a small administrative unit and has a correspondingly small management structure, with a head of department sitting directly above five small research groups, each enjoying an apparently high degree of autonomy. This gives faculty members significant freedom, but also leaves them responsible for delivery of much of the people-facing components of the administrative unit and offers limited institutional resilience.

Most of the five Research Groups are sufficiently small that they are considered vulnerable in research group reports. There are also frequent comments about the potential for greater collaborative working in these reports. It would be good for the administrative unit to give some come consideration to consolidating effort through group reorganisation (or at least through establishment of new approaches to working between groups).

The institute appears confident about its place in the Norwegian research landscape, perhaps complacently so with an expectation of continued core-support funding for activities such as physical oceanography, where its national leadership position makes it hard to challenge.

1.3 Research funding

The administrative unit appears to enjoy a good degree of base funding for its work and is successful at obtaining competitive funding from national and EU programmes. There may be concern that faculty members are reaching saturation in the amount of public research funding they can realistically be expected to bring in and manage.

There is some indication of funding from private sources, particularly for student positions, but there is significantly more potential in this regard.

1.4 Use of infrastructures

Computational infrastructure and ship time are critical to several of the research groups, and they appear to be well supported by the university (It is unclear whether the value of this support is included when assessing the fraction of external funding in the total budget, but one suspects that it is not). Continued access to ship time and other costly infrastructure is essential to GFI's future.

GFI hosts an appropriate range and number of national infrastructure facilities, including the marine component of ICOS and others in climate and environment. The OBLO facility is particularly well suited for GFI research and expertise and is a valuable facility for Norway.

1.5 National and international collaboration

The institute has extensive collaborations, both nationally and internationally. These have led to many publications: 79 per cent of the administrative unit's publications between 2019 and 2021 were co-authored with international collaborators, which is above the average for Norwegian universities in the natural sciences.

The relationship today and in the future with the Bjerknes Centre is not well elucidated in the self-assessment but seems of critical importance to the future success of GFI. The Bjerknes Centre has been very important in raising the profile and international visibility of the Earth sciences at Bergen. Strategic planning to develop and utilise this relationship is merited.

1.6 Research staff

Staff numbers (particularly permanent staff) are limited. The low staffing numbers lead to vulnerability in maintaining critical mass, and the risk of "single points of failure" if key staff are lost through retirement or otherwise. The issue is recognized by the administrative unit, but it is unclear whether the administrative unit has a strategic approach for handling it.

Women are under-represented at the researcher and professor levels. It is unclear how much of this skew is due to demographics (age structure) at these higher levels, or due to societal expectations. The self-assessment recognizes the issue but lacks concrete strategies for addressing it. The institute is participating in a gender action plan for the math/natural sciences faculty of UiB, as well as action plans for diversity, inclusion, etc. The effectiveness of these plans will depend on their translation into practice.

2. Research production, quality and integrity

The institute is internationally recognized, and its research meets high international standards. Its contributions are substantial, particularly relative to its size. Its work has contributed substantially to important public policy debates, as detailed in the impact cases.

GFI has the lowest number of author shares per FTE of any of the 16 administrative units considered by the expert panel (<60% that of the average). The citation impact of these publications is high, however, and GFI is ranked 2nd for both share of 10% most highly cited papers, and for mean normalised citation score.

Among the 5 research groups, research quality scores from the expert panels were generally 4's (3 out of 5 groups), with one 5 and one 3. In all cases, however, the groups were assessed as being internationally recognized. One of the groups is very new (Renewable Energy) and still small, with a quite narrow research focus. The fraction of budget that is supported through external funding ranges from 35% (for this new group) to 75-80% for several other groups. This very high level of external funding may make these groups vulnerable to shifts in Norwegian funding priorities. It also carries the risk that the research agenda will be largely shaped by external funders rather than the groups themselves.

Overall, the quality of the research conducted is high, with particular strength in climate dynamics.

The Biogeochemistry research group is compared favourably with the best in the world and has a global position for its work on ocean carbon uptake. This group is critically small however, without adequate provision of training or succession planning, and is vulnerable for the future.

The Renewable Energy group was only established in 2019 but has rapidly built a strong reputation and a good research record. This group has developed good PhD training and is clearly focused on bringing research to face modern climate challenges. A good example of more strategic future-facing research and something to be built on and learned from.

The Meteorology group is producing excellent research and being rewarded with important funding successes (e.g. 2 ERCs). It is again small, with four faculty, but has an excellent ratio of 3.5 PhD students per faculty members and a good range of other members. The group does a good job of combining research and training excellence and is focusing research on important problems.

The Climate Dynamics group is rated very highly for pure research and clearly delivers excellent work (with a logical regional focus on mid/high latitudes). It makes good use of HPC resources. It is only disappointing that this disciplinary excellence comes at the expense of active engagement with other groups and pursuit of more societally relevant questions.

The Physical Oceanography group does good research, focused on observations, and is the largest PO group in Scandinavia. There is some danger that this group relies on their unique position in Norway and on generous core funding to be insular, complacent, and lacking in strategy. The Research Group report makes valuable suggestions about the need for a strategic refresh for this group’s plans. Information received from the GFI subsequent to the interview describes the PO group's activities and guiding questions in more detail, along with the group's outreach efforts (primarily directed toward education in the broader society).

Awards and recognitions earned by staff (such as ERC grants) are mentioned in the expert panel reports but unfortunately are barely mentioned in the institute's self-assessment.

The institute follows the University of Bergen policies in the area of research ethics/integrity.

2.1 Research quality and integrity

Research group Biogeochemistry overall assessment

There is clear evidence of international leadership in the senior management part of the group, and there is an outstanding track record of funding. It is evident that the group is highly regarded nationally and internationally, building strong, lasting, and productive networks. There are high-quality outputs and some excellent research outputs, all together demonstrating the importance of the research.

This group is critically small, however, and there is a lack of succession planning and of training of future biogeochemists. This makes the group vulnerable in the future which, given the group’s expertise and international standing, is particularly regretful. The expert panel felt that the potential for societal impact from the group’s research is very strong, but that a more innovative and direct approach to partners might bear more fruit.

Research group Climate Dynamics overall assessment

The group's activities are of a high quality by international standards, and they make important contributions to the international research environment. The group attracts a high level of external funding and turns that into international quality research.

In particular, the group's expertise in improving understanding of the coupled climate system and how this is modelled is excellent. The group contributes to climate prediction and projection activities at the highest level.

The group could do more focused outreach/impact work if this is deemed appropriate and tangential to their research efforts.

The expert panel felt this was a strong group and worthy of being highlighted in the national assessment.

Research group Meteorology overall assessment

The Meteorology research group is a strong and internationally visible group working on processes in the atmosphere related to weather, comprising observations, modelling, and theory. The mixture of earlier and more recent recruitment of professors with their complementary fields give prospects for a very positive development. The group is producing excellent research and being rewarded with important funding successes (e.g. 2 ERCs).

Based on its strengths in observations and process analyses, the group contributes to improve numerical weather prediction models for forecasting and many related applications. Close cooperation with universities like Oslo, being more model-oriented, and Met Service is underway for this purpose. The group managed to develop project-based collaborations with the wind-energy and natural risks communities which cause a significant societal impact. The group does a good job of combining research and training excellence and is focusing research on important problems.

Research group Physical Oceanography overall assessment

This is a solid physical oceanography group that makes important and original contributions to the field. They publish in the top journals. They are well funded and contribute significantly to the training of students and young scientists. Furthermore, they are largest group of physical oceanographers in Scandinavia, and as such they are a critical piece of infrastructure for a coastal nation like Norway.

Despite their obvious qualities they appear rather insular in their thinking and activities. There is little evidence for them being driven by an overarching research question, or for them contributing to larger international science goals. For example, one could envision that their excellent work on observing turbulence could contribute greatly to the theoretical or numerical advancement of mixing physics. Similarly, there is little evidence of their work being influenced by society's needs. There is some danger that this group relies on their unique position in Norway and on generous core funding to be insular, complacent, and lacking in strategy. There is a need for a strategic refresh of this group's plans.

Research group Renewable Energy overall assessment

The group is prioritised by the University and is doing high quality work since its formation in 2019. The marks take account of the early stage of development. To continue to be assessed at this level

the group will need to broaden their expertise to fulfil their stated aims and strengthen collaboration with outside stakeholders, e.g. to provide industry facing reports.

They are meeting their benchmarking objectives to a greater or lesser extent commensurate with their size. Examples where they could develop in addition to the points raised above include improved collaboration (e.g. with Met Norway), reaching even wider groups of stakeholders through reports and projects, and further research publications core to the group.

With regard to opportunities, the ongoing and planned energy transition provides a wealth of new research opportunities. Their high level of ambition and innovation are the driving forces in the energy group to attract external investments. They highlight the excellent support at GFI for proposal planning and realization help to use new chances effectively. The initiative on new teaching and learning methods contributes to attract more students to the group, and into this important area. This research group is a good example of more strategic future-facing research and something to be built on and learned from.

2.2 Open Science

There is a strong statement on open science, and an impressive 98.4% of publications are published OA. Open science training is provided, and the UiB open science strategy is taken seriously. This is a commendable feature of GFI's practise.

The statement on FAIR data is concrete and convincing, supported by frequent mention of FAIR principles related to data elsewhere in the SA. This is one of many areas where the work of GFI and the Bjerknes Centre are closely and positively linked.

3. Diversity and equality

The statement on EDI is strong, with explicit recognition of key groups for possible bias, reference to the UiB strategy, and recognition of the need to address what are rather poor gender statistics.

The gender imbalance issue is described as entering its operational phase with concrete actions to be taken, but no details are provided about these actions, making this unconvincing.

Gender statistics are unusual, with a healthy 40% fraction of female associate profs and adjuncts (better than norm) but a poor 24% female fraction at researcher levels and very poor 12% at full professor. Gender equity needs attention, particularly in climate and ocean science where gender ratios in the wider discipline are not as bad as in some other subjects.

The productivity of women and men within the administrative unit, measured as the average number of author shares by FTE, differs slightly: in the period 2019-21, female members of the administrative unit have an average author share of .52, whereas their male colleagues have an average of .68. Compared to some other administrative units in the evaluation, there is room for improvement.

4. Relevance to institutional and sectorial purposes

The institute's work contributes in clearly identifiable ways toward elements of the Norwegian long-term plan and the SDG's. The overall impact in this area is (unsurprisingly) difficult to assess in concrete terms.

The administrative unit seeks and achieves sector-based influence through increased understanding of the climate system. The strength of the research provides this influence, but the administrative unit makes rather little effort to actively communicate its findings to broader stakeholder groups, relying largely on academic publications and education. This is an area where a relatively small amount of focused attention could lead to big reward in terms of the traction achieved for the research findings. Societal benefit could be much enhanced.

There is little or no attempt to commercialise the research of GFI, and this appears to be a deliberate strategy. To commercialise is positioned by the administrative unit, incorrectly, as though it would be a distraction from 'disciplinary basis research'. The statement that 'our output is more scientific than commercial' suggests a lack of comprehension that scientific knowledge can be commercially valuable. Science and commerce are complementary, not in competition. The importance of climate change to all businesses suggests that a change of mindset for GFI in this regard could reap substantial rewards in funding and in the societal influence of their important research.

5. Relevance to society

The administrative unit's global position in climate and ocean research means it has played an important societal role in understanding the challenge of climate change.

The lack of ambition of the administrative unit in engaging more fully with communicating research or collaborating on commercial climate solutions may limit its future social utility.

Comments to impact case 1: Scientific basis underpinning the Paris Agreement
This impact case outlines the institute's roles in the IPCC process over nearly two decades. Many researchers from leading Earth Science departments have contributed to IPCC's series of assessment reports. Bergen's major contributions are in the area of coupled climate modelling. Although, as the impact case states, "The isolated impact of the institutes contribution to the now worldwide understanding of the threats of climate change is undoubtedly small and impossible to quantify," it would be unrealistic to expect otherwise, given the scope of the global effort in this area.

Comments to impact case 2: The Barents Sea "ice edge" and the management plan
This impact case reports on the institute's contributions to the public debate on possible revisions to the Barents Sea management plan. The main role of the institute appears to have been to communicate long-term sea ice forecasts to the public and the legislature. The approach of publishing linked op-ed and research papers is interesting, and a useful coupling of novel research to public communication. The end result in parliament was at odds with the scientific advice, suggesting that economic and political factors had greater influence on the outcome, but it remains important to have ensured scientific evidence was considered in the process and the administrative unit is to be congratulated in this regard.

List of administrative unit´s research groups

Institution	Administrative Unit	Research Groups
University of Bergen - Faculty of Mathematics and Natural Sciences	Department of Geophysics	Meteorology
		Physical Oceanography
		Biogeochemistry
		Climate Dynamics
		Renewable Energy

Methods and limitations

Methods

The evaluation is based on documentary evidence and online interviews with the representatives of administrative unit.

The documentary inputs to the evaluation were:

- Evaluation Protocol (see appendix 3 Evaluation Protocol) that guided the process
- Terms of Reference
- Administrative unit's self-assessment report
- Administrative unit's impact cases
- Administrative unit's research groups evaluation reports
- Bibliometric data
- Personnel and funding data
- Data from Norwegian student and teacher surveys

After the documentary review, the Evaluation Committee held a meeting and discussed an initial assessment against the assessment criteria and defined questions for the interview with the administrative unit. The Evaluation Committee shared the interview questions with the administrative unit two weeks before the interview.

Following the documentary review, the Evaluation Committee interviewed the administrative unit in an hour-long virtual meeting to fact-check the Evaluation Committee's understanding and refine perceptions. The administrative unit presented answers to the Evaluation Committee's questions and addressed other follow-up questions.

After the online interview, the Evaluation Committee attended the final meeting to review the initial assessment in light of the interview and make any final adjustments.

A one-page summary of the administrative unit was developed based on the information from the self-assessment, the research group assessment, and the interview. The administrative unit had the opportunity to fact-check this summary. The administrative unit approved the summary virtually without adjustments.

Limitations

(1) The Evaluation Committee judged the information received through documentary inputs and the interview with the administrative unit generally sufficient to complete the evaluation.

Appendices

1. Description of the evaluation of EVALNAT
2. Invitation to the evaluation including address list
3. Evaluation protocol
4. Self-assessment administrative units
5. Grading scale for research groups

Website: https://www.fors**kningsradet.n**o/tall-analyse/evalueringer/fag-tema/naturvitenskap/

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