Report
2024:12

Mapping Norwegian Polar and Svalbard Research

Bibliometric Indicators and Research Statistics

Dag W. Aksnes

NIFU

Report
2024:12

Mapping Norwegian Polar and Svalbard Research

Bibliometric Indicators and Research Statistics

Dag W. Aksnes

Report 2024:12

Published by Nordic Institute for Studies in Innovation, Research and Education
Addresse P.O. Box 2815 Tøyen, N-0608 Oslo. Visiting Address: Økernveien 9, N-0653 Oslo.

Project No. 21427

Customer Research Council of Norway
Address P.O Box 564 N-1327 Lysaker

Fotomontage / Photo / Illustration: Endre Aas

ISBN 978-82-327-0659-4 (print)
ISBN 978-82-327 0660-0 (online)
ISSN 1892-2597 (online)

www.nifu.no

Preface

This report presents a mapping of Norwegian polar research and research in Svalbard, using bibliometric indicators and statistics on researchers in Svalbard. The purpose is to analyze trends in research activities, scientific output, impact, and collaboration patterns. In addition to the English text, the report includes summaries in both Norwegian and North Sámi. The analysis is carried out on the commission of the Research Council of Norway by Research Professor Dag W. Aksnes at the Nordic Institute for Studies in Innovation, Research and Education (NIFU).

Oslo, 05.09.24

Vibeke Opheim
Director

Espen Solberg
Head of Research

Contents

Summary

Based on the quantitative mappings carried out in the project, the summary below provides an overview of some key figures for Norwegian polar research, and Norwegian and foreign research in Svalbard in 2022, and the development over the past decade (2013–2022).

Norway among the world's largest contributors to polar research

Polar research constitutes 0.32 % of the world's total scientific article production as reflected in the WoS database. Norway is a significant contributor to this polar research, accounting for 5.2 % of the global total scientific knowledge production in the period 2019-2022. Norway ranks as the seventh largest contributor in the world in terms of number of scientific publications. However, Norway has dropped two places compared to the previous mapping, where it ranked as the fifth largest contributor to polar research. This shift is due to China and Russia surpassing Norway in recent years. Both countries have seen a major increase in polar research over the past decade, as measured by scientific publishing. However, Russia's growth has levelled off in recent years. These are general trends which are also seen in other fields. Part of this increase can be attributed to shifting publication patterns, with a greater emphasis on publishing in international rather than national journals.

Norway has a unique position by having territories in the Arctic and territorial claims in Antarctica. In Antarctica, however, Norway is a significantly smaller contributor to research than in the Arctic, ranking as the 19th largest research nation, with a share of 1.6 % of Antarctic research as measured by publication volume. The USA, China, and the UK are the largest contributors to Antarctic research.

Most of the Norwegian polar research output relates to the north, the Arctic, where Svalbard plays a significant role. Only 8 % of Norwegian polar research publications relates specifically to the Antarctic.

The number of publications reflects the research volume but does not indicate the impact or significance of the research, which is often measured by citation indicators. In terms of scientific impact, Norway ranks 10th among the largest polar research nations based on the relative citation index. This index measures

whether a country's publications are cited more or less than the global average. Norwegian publications were cited with an index of 106 or 6 % above this average. Thus, Norwegian polar research performs reasonably well, though it falls below the national average for Norwegian science overall (all fields combined), which is 115.

Declining growth trend in Norway

The study identifies a marked growth in Norway's publication volume during the early years of the past decade. However, in recent years, this growth has plateaued. In fact, compared with the year of the previous mapping (2018), we observe decline. Overall, polar research shows significantly lower relative growth in publication volume compared to other research areas, thereby diminishing its position in the national research landscape. This is related to the fact that the resources allocated to polar research is reduced during the period (cf. Rørstad 2024). Between 2013 and 2022, the number of polar research articles authored by Norwegian researchers grew by 28 %, compared to 46 % for Norwegian research generally.

The Arctic university of Norway (UiT) has the highest output

The Arctic university of Norway (UiT) is the largest institutional contributor to Norwegian polar research measured by publication numbers, followed by the University of Bergen (UiB), the University of Oslo (UiO), the Norwegian Polar Institute (NPI) and the University Centre in Svalbard (UNIS).

There are significant differences in citation frequency among publications from various institutions and institutes. At the top is the Norwegian Institute for Air Research (NILU), with a relative citation index of 161, through the institute is a relatively small unit in terms of the number of polar research articles. The publications of the largest unit, UiT, is cited somewhat below the world average.

International collaboration is the norm in polar research

Norwegian polar researchers extensively collaborate with researchers at institutions in other countries. In 2022, four out of five articles had international contributions. The pandemic and its consequences, such as reduced travel activity, do not appear to have negatively impacted the international collaboration of Norway, as evidenced by co-publications. Most articles involved collaboration between Norwegian and US researchers. Germany was the second largest collaborator with Norway in polar research, followed by the UK, Canada, and the Kingdom of Denmark.

Svalbard research levelling off

Svalbard has a key role in the Norwegian polar research and many Norwegian polar research articles relate to Svalbard. In 2022, Svalbard-related research accounted for 23 % of Norwegian polar research article output.

The report includes two chapters with various indicators on research in Svalbard, encompassing both Norwegian and international research. Based on publication frequencies, research activity appears to have stabilized, with a slight decline observed since 2020. Moreover, the survey of researcher days in Svalbard indicates nearly identical activity levels in 2023 compared to 2018.

Many countries involved

Norway is by far the largest nation in terms of scientific publications related to Svalbard. In 2022, Norway had more than twice as many articles as the second-largest nation, Poland. Following Poland is Russia. Other notable contributors to Svalbard research include Germany, the USA, the UK, and China. Norway's central role is further highlighted by the fact that over 40 % of all Svalbard articles have at least one co-author from Norwegian institutions.

In the past decade, Russia has the most significant growth in Svalbard publications, with a 64 % increase. This might indicate a growing research interest or capabilities in Svalbard research, but the number of researcher days does not show a similar pattern. Apparently, part of this increase can be attributed to shifting publication patterns, with a greater emphasis on publishing in international rather than national journals. During the same period, Norway has a 7 % increase, and Poland a 27 % increase. In 2022, these are the three largest countries in terms of publication output, but many other countries are also involved.

The Svalbard publications are distributed across several disciplines. However, as with polar research in general, geosciences and biosciences dominate.

Svalbard research less cited

Compared to polar research generally, Svalbard research results less often in publications that achieve significant impact and are frequently cited in subsequent scientific literature. This holds for almost all nations that conduct research related to the archipelago. Although Norway has the highest article output, it ranks lower in citation impact. Specifically, Norway ranks seventh in terms of the relative citation index among the countries conducting research in Svalbard. France and the USA rank highest on this indicator, but these countries are not among the main contributors to Svalbard research.

Research activities in Svalbard is not increasing

The mapping of research in Svalbard applies an activity indicator based on number of researcher days. This measure is used as an indicator of the extent of the different countries' research activities on the archipelago.

Compared to the previous mapping, the activity level in terms of researcher days in 2023, was almost identical to that observed in 2018. This indicates that research activity in Svalbard has stabilized.

Researchers from Norwegian institutions accounted for 47 % of the researcher days in 2023, while researchers from foreign institutions accounted for the remaining 53 %. The second largest nation measured in researcher days in 2023 was Poland with a proportion of 17 %, followed by Germany and Russia with 7-8 % per cent. In total, these four countries accounted for approximately three-fourth of the total research efforts in Svalbard measured by researcher days.

The Norwegian share of researcher days in Svalbard is significantly higher than the share of publication output. This is mainly because Norway has a relatively large number of researchers residing in Svalbard, which generates many researcher days, whereas foreign researchers tend to spend shorter periods on the archipelago and process their research material at their home institutions.

Sammendrag

Basert på kartleggingene gjennomført i prosjektet, gir oppsummeringen nedenfor en oversikt over noen nøkkeltall for norsk polarforskning, samt norsk og utenlandsk forskning på Svalbard i 2022, samt utviklingen det siste tiåret (2013-2022).

Norge blant verdens største bidragsytere til polarforskning

Polarforskning utgjør 0,32 % av verdens totale vitenskapelige kunnskapsproduksjon. Norge er en betydelig bidragsyter til denne forskningen, og står for 5,2 % av den globale vitenskapelige artikkelproduksjonen i perioden 2019-2022. Norge rangerer som den syvende største bidragsyteren i verden i antall vitenskapelige publikasjoner, men har falt to plasser sammenlignet med forrige kartlegging, da landet rangerte som den femte største bidragsyteren. Denne endringen skyldes at Kina og Russland har passert Norge de siste årene. Begge landene har hatt en betydelig økning i polarforskning målt ved vitenskapelig publisering. Russlands tall har imidlertid ikke økt de siste årene. Begge utviklingstrekk gjenspeiler generelle trender vi også ser i andre fag. En del av denne økningen kan tilskrives endrede publiseringsmønstre, med større vekt på publisering i internasjonale fremfor nasjonale tidsskrifter.

Norge har en spesiell posisjon med landområder i Arktis og territorialkrav i Antarktis. I Antarktis er imidlertid Norge en betydelig mindre bidragsyter til forskning enn i Arktis, og rangerer som den 19. største nasjonen med en andel på 1,6 % av Antarktis-forskning målt etter publikasjonsvolum. USA, Kina og Storbritannia er de største bidragsyterne til forskningen her.

Det meste av den norske polarforskningen er knyttet til Arktis, der Svalbard spiller en betydelig rolle. Kun 8 % av de norske polarforskningspublikasjonene er spesifikt relatert til Antarktis.

Antall publikasjoner gjenspeiler forskningsvolumet, men sier ingenting om hvilken innflytelse forskningen har hatt, en dimensjon som ofte måles gjennom siteringer. Norge rangerer som nummer 10 blant de største polarforskningsnasjonene målt gjennom relativ siteringsindeks. Denne indeksen viser om et lands publikasjoner blir sitert mer eller mindre enn verdensgjennomsnittet. Med en indeks på 106, ble norske publikasjoner sitert 6 % over dette gjennomsnittet. Dermed

hevder norsk polarforskning seg rimelig bra, selv om nivået ligger under det nasjonale gjennomsnittet for Norge totalt (alle fag inkludert), som er 115.

Nedadgående vekst-trend for Norge

Kartleggingen viser en markert vekst i publiseringsvolumet for Norge i perioden 2013-2017. Imidlertid har denne veksten flatet ut de siste årene. Faktisk ser vi en nedgang sammenlignet med 2018, da forrige kartlegging ble gjennomført. Samlet har polarforskning betydelig lavere relativ vekst i publiseringsvolum enn andre fag. Dermed er den relative posisjonen til polarforskning i det nasjonale forskningslandskapet svekket. Dette henger sammen med at ressursene til polarforskning er redusert i løpet av perioden (jf. Rørstad 2024). Mellom 2013 og 2022 økte antallet polarforskningsartikler skrevet av norske forskere med 28 %, sammenlignet med 46 % for norsk forskning generelt.

Universitetet i Tromsø (UiT) har høyest volum

UiT er den største bidragsyteren til norsk polarforskning målt etter antall publikasjoner, etterfulgt av Universitetet i Bergen (UiB), Universitetet i Oslo (UiO), Norsk Polarinstitutt (NPI) og Universitetssenteret på Svalbard (UNIS).

Det er betydelige forskjeller i siteringsfrekvensen til publikasjoner fra ulike institusjoner og institutter. Øverst på listen finner vi Norsk institutt for luftforskning (NILU), med en relativ siteringsindeks på 161, men instituttet er relativt lite når det gjelder antall polarforskningspublikasjoner. Artiklene fra den største institusjonen, UiT, er sitert noe under verdensgjennomsnittet.

Internasjonalt samarbeid er typisk for polarforskning

Norske polarforskere samarbeider betydelig med forskere ved institusjoner i andre land. I 2022 hadde fire av fem artikler internasjonale bidrag. Pandemien og konsekvensene av den, slik som redusert reiseaktivitet, ser ikke ut til å ha påvirket Norges internasjonale samarbeid negativt, i den grad dette reflekteres gjennom medforfatterskap i publikasjoner. De fleste artiklene involverte samarbeid mellom norske og amerikanske forskere. Tyskland var den nest største samarbeidspartneren med Norge, etterfulgt av Storbritannia, Canada og Kongeriket Danmark.

Forskning på Svalbard

Svalbard spiller en nøkkelrolle i norsk polarforskning, og mange norske polarforskningsartikler er knyttet til Svalbard. I 2022 utgjorde forskning relatert til Svalbard 23 % av den norske polarforskningsproduksjonen. Rapporten inkluderer to kapitler med ulike indikatorer over forskning på Svalbard. Her er både norsk og

forskning fra andre land inkludert. Målt gjennom publikasjonstall ser det ut til at forskningsaktiviteten har stabilisert seg, med en liten nedgang siden 2020.

Mange land er involvert på Svalbard

Norge er klart den største nasjonen når det gjelder vitenskapelig publisering knyttet til Svalbard. I 2022 hadde Norge mer enn dobbelt så mange artikler som den nest største nasjonen, Polen. Etter Polen følger Russland. Andre større bidragsytere til Svalbard-publikasjoner er Tyskland, USA, Storbritannia og Kina. I tillegg til disse landene er mange andre land også involvert. Norges sentrale rolle vises videre gjennom at over 40 % av alle Svalbard-artikler har minst én medforfatter fra norske institusjoner.

I løpet av det siste tiåret har Russland hatt den største veksten i Svalbard-publikasjoner, med en økning på 64 %. Dette kan indikere at landet har økende interesse eller kapasitet til å drive Svalbard-forskning, men forskerdøgnene viser likevel ikke et tilsvarende bilde. En del av denne økningen kan også tilskrives endrede publiseringsmønstre, med større vekt på publisering i internasjonale fremfor nasjonale tidsskrifter. I perioden har Norge hatt en økning på 7 %, og Polen en økning på 27 %.

Publikasjonene fra Svalbard er fordelt på mange disipliner, men som for polarforskning generelt, domineres forskningen av geovitenskap og biovitenskap.

Svalbard-forskning blir mindre sitert

Sammenlignet med polarforskning generelt, resulterer forskning på Svalbard sjeldnere i publikasjoner som oppnår stor vitenskapelig innflytelse i form av å bli hyppig sitert i den påfølgende vitenskapelige litteraturen. Dette gjelder for nesten alle nasjoner som utfører forskning der. Norge har størst antall publikasjoner, men rangerer som land nummer syv når det gjelder relativ siteringsindeks. Frankrike og USA scorer best på denne indikatoren, men disse landene er ikke blant de største bidragsyterne til Svalbard-forskning.

Forskningsaktivitetene på Svalbard øker ikke

Kartleggingen av forskning på Svalbard er basert på en aktivitetsindikator over antall forskerdøgn, som brukes som mål på omfanget av de ulike landenes forskningsaktiviteter på øygruppen.

Sammenlignet med tidligere kartlegging, var aktivitetsnivået målt i forskerdøgn i 2023 nesten identisk med det som ble observert i 2018. Dette indikerer at forskningsaktiviteten på Svalbard har stabilisert seg.

Forskere fra norske institusjoner sto for 47 % av forskerdøgnene på Svalbard i 2023, mens forskere fra utenlandske institusjoner stod for de resterende 53

prosentene. Den nest største nasjonen i 2023 målt i forskerdøgn var Polen med en andel på 17 %, fulgt av Tyskland og Russland med 7-8 % hver. Totalt sett sto disse fire landene for omtrent tre fjerdedeler av den totale forskningsinnsatsen på Svalbard målt i forskerdager.

Den norske andelen målt som forskerdøgn på Svalbard er betydelig høyere enn andelen av publiseringen. Dette skyldes hovedsakelig at Norge har et relativt stort antall forskere som er bosatt på Svalbard, noe som genererer mange forskerdøgn. Utenlandske forskere tilbringer i større grad kortere perioder på øygruppen og hvor forskningsmateriale bearbeides ved hjemmeinstitusjonene.

Čoahkkáigeassu

Daid kvantiiva kártemiid vuođul mat prošeavttas leat dahkkon, addá čoahkkáigeassu muhtun guovddáš loguid Norgga polára dutkamis ja Norgga ja olgoriikka dutkamis Svalbárddas.[1]

Norga lea okta máilmmi stuorámus váikkuheaddjin polárdutkamii

Norga lea okta máilmmi stuorámus váikkuheaddjin polárdutkamii, mii lea 5,2 % ollislaš máilmmi dieđalaš máhtolašvuođa buvttadeamis áigodagas 2019-2022. Norga lea máilmmi čihčče stuorámus juolludeaddji. Norga lea dattetge njiedjan guovtti sadjái ovddit kártema ektui, gos dat oaččui viđat stuorámus váikkuheaddji polárdutkamii. Sivvan dasa lea go Kiinná ja Ruošša leaba dál lihkostuvvan Norgga badjel. Goappašat riikkat leat vásihan stuora lassáneami polárdutkamis vássán logijagis maid dieđalaš almmuhusat leat mihtidan. Ruošša ovdáneapmi lea dásáiduvvan maŋemus jagiid.

Norggas lea erenoamáš sajádat go Norggas leat árktalaš guovllut ja Antárktalaš guovllus báikkálaš gáibádusat. Norga lea mearkkašahtti unnit dutkandoarjja Antárktisis go Arktalaš guovllus, mii lea 19. stuorámus ođđasis ohcan našuvdna, mas lea 1,6 proseanta oassi Antárktisa dutkamis, mihtiduvvon sturrodaga mielde.

Eanas oassi Norgga polára dutkanbohtosiin guoská davviguovlluide, Árktalaš guovlluide, gos Svalbárddas lea stuora mearkkašupmi. Dušše 8 % Norgga polárdutkan publikašuvnnain guoskkahit erenoamážit Antárktisa.

Dieđalaš váikkuhusaid ektui lea Norga 10. sajis stuorámus polára riikkaid gaskkas main ohcet čujuhusaid ođđasit, relatiiva čujuhuslogu vuođul. Dát indeaksadoaibmabijut olles riikka publikašuvnnain namuhuvvojit eanet dahje unnit go gaskamearálaččat máilmmis. Norgga beale publikašuvnnain lea indeaksa 102 dahje 6 % badjelis dán gaskameari. Danin Norgga poláradutkan doaibmá oalle bures, vaikko dat gahčča vuollel riikkagaskameari buot surggiin, mii lea 115.

[1] Dát teaksta lea automáhtalaččat jorgaluvvon Tartu Universitehta Dihtordutkama Instituhta prográmmagálvvu mielde.

Norggas lassáneaddji lassáneapmi

Guorahallamis gávnnahuvvo ahte Norgga almmuhanhivvodat lea mearkkašahtti ollu lassánan, ja ahte dat lea daid maŋemus logi jagiid lassánan. Muhto maŋimuš jagiid lea dát ovdáneapmi vuođđuduvvan. Go buohtastahttá ovddit jagi kártenbargguin (2018), de oaidnit njiedjama. Oppalaččat čájehit polára dutkamat ahte almmuhanmeriid relatiiva lassáneapmi lea mearkkašahtti unnit go eará surggiin, ja dainna lágiin unnida dan sajádaga našunála dutkanbirrasis. Dát čatnasa dasa go áigodagas unniduvvojit dat resurssat mat čujuhuvvojit polárdutkamii (gč. Rørstad 2024).

Norgga árktalaš universitehta (UiT) čájeha buoremus bohtosiid

Norgga árktalaš universitehta (UiT) lea stuorámus institušuvnnalaš váikkuheaddji Norgga polára dutkamii almmuhanloguid ektui, maŋŋil leat Bergen Universitehta (UiB), Oslo Universitehta (UiO), Norgga Polar In-instituhtta (NPI) ja Svalbárdda Universitehtaguovddáš (UNIS).

Iešguđet ásahusaid ja instituuhtaid publikašuvnnain leat mearkkašahtti erohusat bájuhandávjodagas. Bajimusas lea Norgga instituhtta áibmodutkama várás (NILU), mas relatiiva siterenindeaksa lea 161, ja "insti-tute" lea viehka unna ovttadagaš go guoská polárdutkanartihkkaliidda. Almmustahttimat stuorimus sturrodagas, UiT namuhuvvojit veaháš vuolábealde máilmmiviidosaš almmustahttima.

Riikkaidgaskasaš ovttasbargu lea norbman polárdutkamis

Norgga polára dutkit barget viidát ovttas eará riikkaid ásahusaid dutkiiguin. Jahkái 2021 ledje njealjis viđa artihkkalis riikkaidgaskasaš vearut. Pandemiija ja dan váikkuhusat, ovdamearkka dihte mátkkošteami njiedjan, eai oro váikkuhan negatiivvalaččat Norgga riikkaidgaskasaš ovttasbargui, nugo ovttasbargoalmmuheamit čájehit. Eanaš artihkkalat sisttisdollet ovttasbarggu gaskal Norgga ja USA dutkiid. Duiska lei nubbin stuorámus norgalaš kol-laboratoriija polárdutkamis, ja dan maŋŋá bohte Ruoŧta, Canada ja Danmárku.

Svalbárdda dutkan leavvá

Svalbárddas lea guovddáš rolla norgga polárdutkamis ja ollu norgga polárdutkanartihkkaliin lea oktavuohta Svalbárdii. Svalbárd-relaterejuvvon dutkan dagai 2012:s 23 % Norgga polára dutkanbuvttadeamis.

Raporta sisttisdoallá guokte kapihttala main leat iešguđetlágán indikáhtorat dutkama birra Svalbárddas, ja sisttisdoallá sihke norgalaš ja riikkaidgaskasaš dutkamiid. Pub-likerenfrekveanssaid vuođul orrot dutkandoaimmat stáđásmuvvan,

muhto daid lohku lea veaháš njiedjan 2020 rájes. Dutkiid beivviid iskkadeapmi Sval-Bárddas čájeha ahte 2023:s leat sullii seammalágan aktivitehtadássi go 2018:s.

Norga lea stuorámus našuvdna dieđalaš publikašuvnnaid ektui mat gusket Svalbárdii. Jahkái 2021 ledje Norggas eanet go duppal nu ollu artihkkalat go Polskas, mii lea nubbin stuorámus riika. Polskka čuovvu Ruošša. Eará mearkkašahtti váikkuheaddjit Svalbárdda dutkamis lea maiddái Duiska, USA, UK ja Kiinná. Norgga árvosátnečálli rolla nannejuvvo dasto velá dat go badjel 40 % buot Svalbárdda artihkkaliin lea unnimusat okta mielčálli norgga ásahusain.

Vássán logijagis lea Ruošša čájehan eanemus lassáneami Svalbárda guovlluin, gos olmmošlohku lea lassánan 64 %. Dat sáhttá mearkkašit lassáneaddji dutkanberoštumi dahje vejolašvuođaid Svalbárdda dutkamis, muhto dutkiidbeivviid lohku ii čájet seammalágan minstara. Seamma áigodagas lea Norggas olmmošlohku lassánan 7 proseanttain ja Buolbmágis ges lassánan 27 proseanttain. Jagi 2022:s leat dat golbma stuorámus riikka almmustahttima dáfus, muhto ollu eará riikkat leat maid mielde.

Svalbárda publikašuvnnat juhkkojuvvojit máŋgga fágasuorggis. Earenoamážiid, nugo polárdutkamis oppalaččat geodiehtaga ja bio-diehtaga oktavuođas, dat mearridit.

Svalbárda dutkan unnit siterejuvvon

Go buohtastahttá polára dutkamiin oppalaččat, de Svalbárdda dutkanbohtosat eai leat nu dávjá almmustahttojuvvon almmuhusain mat vásihit mearkkašahtti váikkuhusaid ja maid dávjá čujuhuvvo ođđa dieđalaš girjjálašvuođas. Dát mearkkaša measta buot riikkaid mat čađahit ohcama ođđasit doppe. Vaikko Norggas lea stuorámus artihkalbuvttadeapmi, de das lea vuolit árvodássi sitáhta váikkuhusa ektui. Norga lea čihčče sajis relatiiva siterenindeavsttas daid riikkaid gaskkas mat čađahit dutkamiid Svalbárddas.

Dutkan doaimmat Svalbárddas eai leat lassáneame

Svalbárdda dutkama kártemis atnit aktivitehtaindikáhtora mii čájeha galle beaivvi dutkis lea. Dát guorahallan čájeha man ollu dutkanbarggut iešguđetge riikkain leat arkiivvain.

Ovddit kártemis lei 2023 dutkiidbeivviid doaibmadássi measta seammá dássi go lei 2018:s. Dát čájeha ahte dutkandoaimmat Svalbárddas leat stáđásmuvvan.

Norgga institušuvnnaid dutkit vástidedje 47 proseantta jahkái 2023, ja olgoriikka institušuvnnaid dutkit fas vástidedje loahppa 53 proseantta. Nubbin stuorámus riika maid dutkiid beaivvit mihtidedje 2023 lei Polen 17 % proseanttain, ja dan maŋŋá bohte Duiska ja Ruošša 7 - 8 proseanttain. Oktiibuot

dagahedje dát njeallje riikka sullii golbma njealjádasa Svalbárddas dutkiidbeivviid ektui.

Norgga dutkiidbeivviid oassi Svalbárddas lea mearkkašahtti eambbo go olggosaddin. Dát lea vuosttažettiin danin go Norggas orrot relatiivalaččat ollu dutkit Svalbárddas, mii dagaha ollu dutkibeaivvi, go fas olgoriikkalaš dutkit lávejit golahit oaneheappot áiggi arkiivvain ja gieđahallat iežaset dutkanávdnasiid ruovttu ásahusain.

1 Introduction

This report is one of two in a series presenting the results of mapping Norwegian polar research, High North research, and research in Svalbard. The present report focuses on bibliometric indicators of polar research and research personnel indicators in Svalbard (researcher days). The other report, which is published by Statistics Norway (Rørstad, 2024), presents the research profile and volume in terms of R&D efforts (R&D work years, full-time equivalents, and expenditures) for Norwegian polar and High North research. Both reports focus mainly on the most recent years for which statistics are available (2022 or 2023) but also include time series and figures from past mappings.

It should be noted that while the Statistics Norway report adopts a dual approach — mapping both polar research and High North research—this report focuses exclusively on polar research, with a dedicated chapter on Svalbard. However, Arctic research on a global scale was recently mapped in a bibliometric study by Aksnes et al. (2023). This study includes additional areas classified as High North research, such as northern Scandinavia.

2 Data and methods

The present chapter contains an overview of the data and methods applied in the study.[2]

2.1 Definition of polar research

Polar research is not a traditional scientific discipline and encompasses a range of disciplines from the humanities to technology and engineering, although the greatest proportion of research is carried out within the natural sciences. Rather than being defined according to thematic focus, it is geographically delimited, even though the criteria for delimitation may be a matter of controversy. The present study is based on the definition of polar research which for a long time has been adopted by the Norwegian government and the Research Council of Norway (cf. Ministry of the Environment 1993) as well as in NIFU's previous mappings of Norwegian polar research:

> *Research carried out on the basis of material from the polar areas (Arctic and Antarctic) or concerning phenomena localized in the polar areas.*
>
> *Arctic: The polar part of the Arctic, including Svalbard, Jan Mayen, the northern part of the Norwegian Sea, the Barents Sea, the Greenland Sea and the Arctic Ocean*
>
> *Antarctic: The area south of the Antarctic Convergence. This encircles Antarctica, and is where cold, northward-flowing Antarctic waters meet and mix with the warmer waters of the sub-Antarctic. Its position varies, but it normally lies between 50°S and 60oS. Also the sub-Antarctic islands such as Bouvet Island and South Georgia, which may at times be north of the Antarctic Convergence are included.*

It should be noted that some other countries and organisations apply a broader definition of polar research. For example, both Arctic and sub-Arctic areas (e.g.

[2] The text in this chapter is based on and adapted from the previous report (Aksnes, 2017), since the methods used previously are still applicable to the current mappings.

northern part of Norway) are included in definition of Arctic developed by AMAP (Arctic Monitoring and Assessment Programme). Applying such a definition would of course significantly increase the volume of Norwegian polar research.

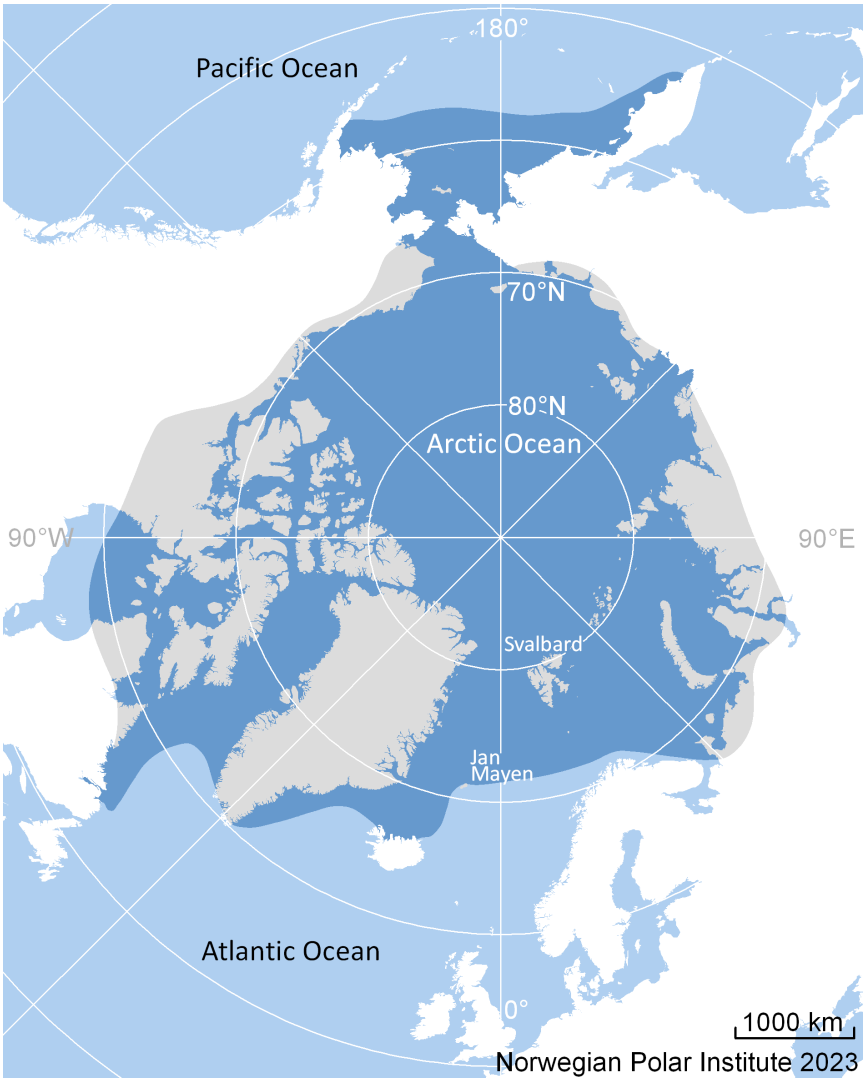

Figure 2.1 Map of Arctic polar areas as delineated in the project*

**) The shaded area indicates the boundary of the Arctic as defined in the survey. It includes areas north of the forest boundary with continuous permafrost and sea areas north of the maximum sea ice extent. In the Norwegian sector, the boundary follows the 72. latitude and not the borders for maximum spread of sea ice.*

Figure 2.2 Map of Antarctica as delineated in the project*

**) The area south of the Antarctic Convergence. This encircles Antarctica, and is where cold, northward-flowing Antarctic waters meet and mix with the warmer waters of the sub-Antarctic. Its position varies, but it normally lies between 50°S and 60°S. Also, the sub-Antarctic islands such as Bouvet Island and South Georgia, which may at times be north of the Antarctic Convergence are included.*

2.2 Bibliometric survey

2.2.1 Identifying polar research publications

In contrast to many other areas of science, it is hard to identify polar research from the scientific outlet or journal. Only a limited portion of research findings are published in specialized journals for polar research (e.g. *Arctic*, *Polar Biology*, *Polar Research* etc.). Most of the articles appear in more general scientific journals and thematic journals. In order to identify publications that should be assigned to the category "polar research", we have used two principles, following the methodology in the previous NIFU-mappings. First, we have included all publications from

the journals that entirely or mainly cover polar research.[3] Second, following the geographical delimitation of polar research, we have applied geographical search terms for identifying the publications. We have done a search through the titles, abstracts and keywords of all the publications in the database, and in total almost 30 million articles were screened for polar research contents. We assumed that the geographical locality in which the research had been performed would generally appear either in the title or in the abstract. Names of geographical areas in the Arctic and the Antarctic were therefore used as an indication of polar research content. With regard to the Arctic, the names of mainland areas, islands and oceans were included, in addition to a few names of indigenous people. With regard to the Antarctic, the name of the entire continent was used (antarc*) in addition to the names of the oceans surrounding it.[4]

We believe the method we have applied is adequate for the purpose of providing a general analysis of efforts within polar research. A previous study (Schild 1996) used field-specific search terms (e.g. "sea-ice", "polar bear" etc.) in addition. We did not consider this necessary, as the geographical locality is usually specified either in the title or in the abstract of the publications. Also, the use of "Arctic" as general search term identifies a large number of publications, although the meaning of the Arctic across the publications does not necessarily correspond with the geographical definition applied in this study. This may be a source of error. Moreover, it might be the case that certain relevant publications have not been identified because the articles do not specify where the research has been carried out, or because other geographical names than those included in the study were mentioned. For instance, certain space-type research based on equipment localized in the polar regions, like research on solar wind or aurora, might not have

[3] *Antarctic Science, Antarctic Journal, Arctic & Alpine Research, Arctic, Arctic science, Arctic Anthropology, Permafrost and Periglacial Processes, Polar Biology, Polar Record, Polar Research, Polish Polar research, Polar geography, Polar science.*

[4] The search included the following names (and spelling variants):
Arctic: Arctic, Svalbard, Spitsbergen, Longyearbyen, Ny-Alesund, Hornsund, Barentsburg, Kongsfjord, Hopen, Bjornoya (Bear Island), Greenland, Baffin Island, Queen Elizabeth Islands , Ellesmere Island, Devon Island, Somerset Island, Prince of Wales Island, Banks Island, Ellef Ringnes Island, Amund Ringnes Island, Bathurst Island, Axel Heiberg Island, Prince Patrick Island, King William Island, Prince Charles Island, Bylot Island, Bathurst Island, Southampton Island, Brooks Range, St Lawrence Island, St Matthew Island, Seward Peninsula, Nunivak Island, Novaya Zemlya, Severnaja Zemlya, Novosibirskije Ostrova, Jan Mayen, Victoria islands, Nunavut, Greenland sea, Fram strait, Beaufort sea, Northpole, Davis Strait, Barents sea, Kara sea, Storfjorden, Baffin, Hudson Bay, Siberian Sea, Laptev Sea, Chukchi Sea, Bering Strait, Bering Sea, Karskoje Sea, Yamal Peninsula, Hudson Strait, Lomonosov Ridge, north polar, north magnetic pole, Amundsen Basin, Amundsen Gulf, Beaufort Gyre, Cambridge Bay, Canada Basin, Cumberland Sound, Denmark Strait, Eurasian Basin, Lancaster Sound, Mendeleev Ridge, Nares Strait, Northwest Passage, Repulse Bay, polynya, Resolute Bay, Taymyr Peninsula, qaanaaq, Tiksi, Chukchi, Wrangel Island, Nunavik, Barents, Ungava, Yupik, Inupiat, Inuit, Eskimo, Greenlander.
Antarctic: *antarc*, South pole, D'Urville Sea Ross sea, Amundsen sea, Pine Island Bay, Weddel Sea, Davis Sea, south polar, south magnetic pole.

geographical names specified, and would be left out by our search strategy. An examination of a subsample of the selected papers using our approach showed high relevance.

Some articles were, however, mistakenly identified and these were removed, for example articles containing the word "subarctic". Furthermore, articles concerning Char (Arctic Charr) were removed if the research was carried out outside the polar regions. The same holds for articles concerning species (primarily) present outside the polar regions.[5]

In a similar previous study (Dastidar 2007), only search terms present in the titles of the publications were used as a basis for identifying Antarctic research. This resulted in a much lower subset of papers, and such a method would accordingly greatly underestimate the size of the production output. Still, there are limitations also with our approach. The boundaries for polar research may sometimes be difficult to draw, particularly this holds for marine research where research cruises sometimes may encompass both polar and non-polar areas. Overall, the sources of errors and uncertainties mean that the study should be regarded as a crude rather than precise quantification of polar research. This needs to be taken into account when interpreting the figures.

2.2.2 Identifying Svalbard research publications

A similar method has been applied in the publication analysis of Svalbard research. To identify articles containing Svalbard research, we searched for relevant terms in the titles and abstracts of the articles. We assumed that research conducted in Svalbard or relating to Svalbard would usually have the geographical locations in Svalbard listed either in the title, keywords or in the abstract of the articles.[6]

The sources of errors attached to the applied method are similar to those for polar research in general. Possibly, some relevant publications are missing because they do not have the geographical names specified in the titles or abstracts. Nevertheless, we believe that the method is adequate for providing an overall analysis of Svalbard research. It should be noted that many of the “Svalbard”-publications report the results of comparative studies that are based on observation/measurements conducted in several different geographical locations

[5] Arctic Bramle, Candida Antarctica, Greenland Halibut, Arctic tern, Gavia arctica, Arctica islandica, E. coli Arctic Express etc. A mutation that causes Alzheimer disease is called "Arctic mutation", and articles concerning this mutation have been removed. Articles referring to a study called Eskimo (Eating Study as a Kiggen Module) have been removed, similar for studies of the Eskimo1 mutant. Articles referring to the polar regions on planets and moons are removed.

[6] The following search terms were used (and spelling variants of these): Svalbard, Spitsbergen, Ny Alesund, Longyearbyen, Barentsburg, Hornsund, Hopen, Bjørnøya (Bear island), Kongsfjord, Vestfonna, Storfjorden.

in the polar regions, where Svalbard is only one of them. This means that Svalbard will have a more peripheral role.

2.2.3 Database

The study is based on the database Web of Science (WoS), more specifically Science Citation Index Expanded, Social Sciences Citation Index, Arts & Humanities Citation Index, Emerging Sources Citation Index, Conference Proceedings citation indexes, and the Book Citation Index. We have applied a replication database of WoS maintained by the Norwegian Agency for Shared Services in Education and Research (Sikt).

The database covers specialized and multidisciplinary scientific journals and books with peer review, including all major international journals in the natural sciences, medicine and technology. Also included are journals and books within the social sciences and humanities, but here the coverage is more limited. This means that the social sciences and humanities will be less well represented in our analysis. At the same time, given the definition of polar research, the research volume within these domains is rather limited. According to the current R&D mapping, the social sciences and humanities account for approximately 4 % of the total Norwegian polar research measured as work years.

2.2.4 Time period and data processing

The analysis covers the period 2013-2022. Only regular articles, review articles proceedings articles, book chapters and books are included (not minor contributions like abstracts, editorials, letters etc.).

Each article contains information about the authors' addresses (institutional affiliations). To assess the publication output for individual institutions and countries, all articles were classified according to the institution and country of the affiliated authors (i.e. the country of their institution addresses). The question arises how these should be credited to individual institutions and countries. The most common approaches are either “whole counting”, where a publication is fully credited to all contributors or “fractionalized counting” where credit is divided proportionally. The Norwegian publication indicator is a compromise, taking publication characteristics of fields into account, and is developed internationally as Modified Fractional Counting (Sivertsen et al., 2019), but where other elements of the Norwegian publication indicator (weighting of journal/publisher level, and international collaboration) are omitted. Modified Fractional Counting has been used in the recent version of RCN’s S&T Indicator report, and is also used in all analyses here, including the citation analyses.

The publication measures reflect the contribution of individual institutions and countries to the international polar research. The indicator can be interpreted as an indirect measure of the size of the countries as polar research nations. However, it should be noted that our study primarily includes English-language journals. Certain countries, particularly Russia and Latin American countries, may publish their research in non-English-language (e.g. Russian or Spanish) scientific journals. Thus, the true extent of these countries' polar research activities may be larger than reflected in the figures of this study. However, the research results published in such journals would generally have less international impact and would not be available to a global scientific audience.

2.2.5 Citation indicators

The Web of Science database also includes information on how many times the articles have been referred to or cited in the subsequent scientific literature. These data have been used to calculate citation indicators. In absolute counts, the countries with the largest number of articles would of course also receive the highest number of citations – these countries have more papers that can be cited. It is, however, common to use a size-independent measure to assess whether a country's articles have been highly or poorly cited. One such indicator is the relative citation index, showing whether a country's scientific publications have been cited above or below the world average (=100). Here, each article is compared with the average paper in the respective area of research and year, and on this basis an overall index is calculated (therefore, the indicator may more precisely be termed the field normalised relative citation index). We have used accumulated citation counts and calculated an overall (total) indicator for the whole period. Articles from the most recent year (2022) are not included in the citation analysis as these have not been available in the literature for a sufficiently long time to be cited.

In addition to the field normalized citation index we have analysed the articles that are among the 10 % most cited in their fields.

2.2.6 Collaboration indicators

The fact that researchers co-author a scientific paper reflects collaboration, and co-authorship may be used as an indicator of such collaboration. By definition a publication is co-authored if it has more than one author, and internationally co-authored if it has authors from more than one country. Compared to other methodologies, bibliometrics provides unique and systematic insight into the extent and structure of scientific collaboration. A main advantage is that the size of the sample that can be analysed with this technique can be very large and render

results that are more reliable than those from case studies. Also, the technique captures non-formalised types of collaboration that can be difficult to identify with other methodologies. In this report, indicators of both international and institutional collaboration have been included.

2.3 Survey of research in Svalbard

2.3.1 Number of researcher days

The project included a separate survey of the research activity in Svalbard. Here, too, we used a similar methodology as in previous studies. The main objective has been to provide a quantitative measure of the extent of the different countries' research activities on the archipelago. Ideally, this would be an indicator of how much financial resources the different countries spend on research in Svalbard. However, obtaining such data is an almost insurmountable task, both because it is difficult to identify all the different actors and because the different actors may not have records of these costs.

In the project we therefore used an alternative indicator as an estimate of the research activity, namely *researcher days* - the number of days researchers spent in Svalbard and near shore waters to conduct research (the purpose of the stay should be to carry out research or to collect data used primarily for research). As researchers, scientists, PhD-students, technicians, research assistants, etc. are included, but not master's and bachelor students.

By counting how many days researchers from different countries and institutions have spent on the archipelago, we are able to provide an indicator of the extent of the countries' research efforts. Researchers who come to Svalbard would normally need a place to stay overnight, and the choice of possible accommodations is limited. At the same time, there are already good accommodation statistics for Ny-Ålesund, compiled by Kings Bay AS.[7]

To be able to obtain a complete statistics of number of researcher days for 2023, we have carried out a survey to other stations and research institutions. In addition, we have used the RiS (Research in Svalbard) database, which is operated by the Svalbard Science Forum (SSF). All project leaders who wish to conduct research activities in Svalbard should register their projects in this database. From RiS we have collected information on individual projects that fall outside the registrations we have received from the individual research stations and institutions.

[7] Still, it should be noted that there may be instances where stays have been counted as researcher days when they were actually for other purposes, such as administrative tasks.

The definition of "research" when calculating researcher days is based on the same principles as for polar research in general. Activities such as topographic mapping and monitoring are not included unless this activity is primarily conducted for research purposes. Teaching activities are not included either. Broadly speaking, the researchers in Svalbard can be divided into the following categories: a) Researchers who are staff or visit the various research stations/installations in Svalbard, b) Staff and other researchers affiliated with the University Centre in Svalbard in Longyearbyen (UNIS), c) Researchers doing field research involving stays in tents or cabins in Svalbard.

In the case of a) we had access to research day statistics for Ny-Ålesund. In addition, we obtained similar information for Kjell Henriksen Observatory at Longyearbyen, EISCAT-Svalbard's facility at Longyearbyen, the Czech research stations in Petuniabukta (Petunia Bay) and Longyearbyen, and the Polish research stations in Hornsund, Kaffiøyra and Billefjorden as well as for the Russian research activity related to Barentsburg. In addition, we received a separate report for the Norwegian Polar Institute's activity in Ny-Ålesund and Longyearbyen. The Norwegian Meteorological Institute did not report any significant research activity related to the stations on Hopen. Concerning SvalSat in Longyearbyen, we have chosen to exclude this installation in the calculation of research days, because SvalSat is primarily operated for commercial, non-scientific purposes.

UNIS (b) represents a special case in relation to the measurement of researcher days. Generally, much of the research in Svalbard is done by researchers being on the archipelago for shorter periods, and where the research material or data is processed and analyzed at the home institutions. For UNIS, this is different since employees stay in Svalbard throughout the year. This situation generates many researcher days. As in the previous surveys, the calculation of researcher days is based on converting the number of R&D work-years by UNIS to number of researcher days (1 work-year is assumed to correspond to 240 days). Note that teaching activity is not included in the statistics. An employee with, for example, 60 % of the working time spent on research will thus have almost 150 researcher days registered (the remaining 40 % spent on teaching and adjacent administration is not registered as researcher days). It should be noted that although all UNIS R&D work-years have been transformed into Svalbard researcher days, some of the research could still include regions other than Svalbard.

For c) we used information from the RiS database. We identified all projects marked as “active/ongoing” or finished but with field research 2023, and which were not likely to have been included by the other parts of the survey. The project leaders of each project were asked to report the number of researcher days in Svalbard in 2023 by geographical area and the country of the institutional affiliations of the project members. An email request was sent to the project leaders of

99 projects. Responses were received for 49 per cent of the projects. For the remaining projects, we did not receive a reply of the or email address was not in use anymore. However, some of the projects did not report field activity in 2023 or were found to be registered through the reports from the stations. In total, about 4,000 researcher days were reported from these projects.

In the prior mapping we also surveyed stays on research vessels in the fjords of Svalbard, but only few days were reported. We noticed that RiS-database also captured this marine activity, and these days are now counted using this method.

In addition to the total number of research days and distribution per country (national institutional affiliation), overviews of the geographical distribution were obtained. The following categories were used (see the map, Figure 2.3) – but in the survey, Zone 3-5 were aggregated:

- Zone 1: Management area 10a, includes Longyearbyen, Barentsburg, Pyramiden, Isfjorden and Svea.
- Zone 2: Management area 10b includes Ny-Ålesund and Kongsfjorden
- Zone 3: North West Svalbard, includes Prins Karls Forland
- Zone 4: East Svalbard, includes East Spitsbergen, Nord Austlandet, Kong Karls land, Hopen and Edgeøya
- Zone 5: South Svalbard, includes Hornsund and Bjørnøya

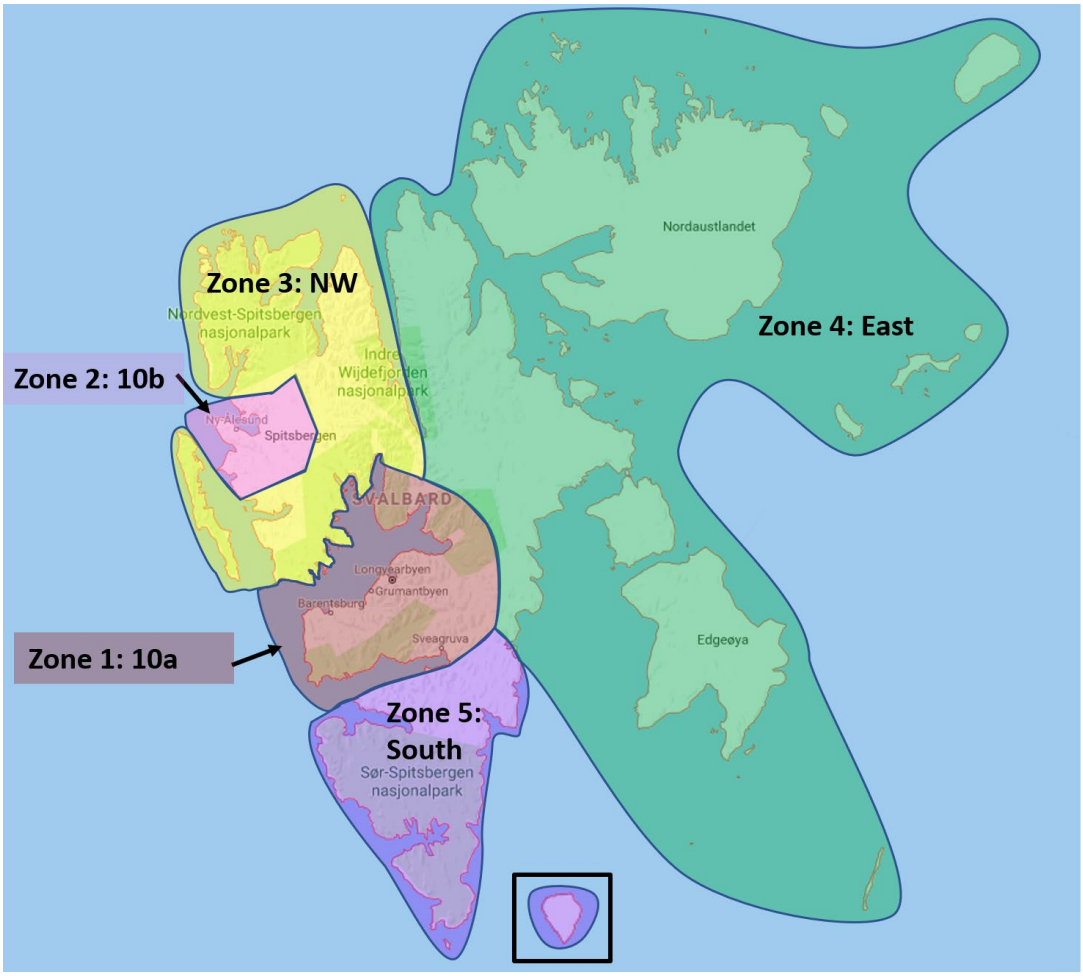

Figure 2.3 Map of Svalbard and zones used in the project.

Source: Svalbard Science Forum

It should be emphasized that the statistics of researcher days has different sources of errors. These can be divided into three categories:

1. *Lack of coverage.* This concerns the question whether the survey is complete, that is, whether there are research activities in Svalbard which are not captured by the survey. Here, we find it reasonable to believe that the survey has a good and satisfactorily coverage. We have obtained reports of number of researcher days for almost all the research stations and installations, and most of the research in Svalbard is affiliated with these stations. Concerning the individual projects, however, we may not have been able to capture all the relevant projects, either because of lack of response or missing information in the RiS database. However, the importance of this source of error is probably small compared with the total number of researcher days already registered.

2. *Double counting.* The survey involves various approaches to identify number of researcher days. This might potentially lead to cases of double counting if one and the same person is included in the statistics from multiple sites (e.g. if a researcher from UNIS has been involved in research in Hornsund and then would be included in the figures from both UNIS and Hornsund). It is likely there might be such cases. However, the importance of this factor is probably minor with little influence on the overall patterns.
3. *Reliability of the answers.* As for the R&D statistical survey, the statistics of researcher days is based on discretionary assessments made by the institutions and project leaders. NIFU does not have background information to verify whether the figures reported are accurate or reasonable, and we have to trust the assessments made by the respondents. For Ny-Ålesund, detailed statistics is available by Kings Bay. Other institutions/stations do not systematically register researcher days, and the figures reported should be considered as rough estimates. Compared with the previous surveys we in some cases find large variations in the reports for some institutions/stations, particularly this has been noted for the research activities in Barentsburg. We believe that some of these variations relate to uncertainty/reliability issues. Overall, this source of error is considered to have the largest impact on the results.

In conclusion, it should be emphasized that the statistics of researcher days aresubject to uncertainty. This means that the survey should be regarded as a rough rather than precise quantification of the volume of research in Svalbard measured through researcher days.

3 Polar research – a global view

As background for the analyses of Norwegian polar research, this chapter presents a bibliometric analysis of polar research at the global level. It examines the scientific publication output and scientific impact of the major contributors to polar research.

3.1 Trends in the global article production

During the period 2013-2022, more than 102,000 polar research articles were published. The study shows that the global scientific production in polar research increased significantly during this period, from 6,800 articles in 2013 to nearly 9,400 articles in 2022, a 38 % increase. By comparison, the total global knowledge production across all fields increased by 44 % (to approximately 3,020,000 articles in 2022). Thus, polar research has a lower growth compared with the global average for all fields. This is likely due to the fact that China and some other Asian countries account for a significant proportion of the overall global growth during the period, and these countries are less specialised in polar research. Polar research constitutes 0.32 % of the world's total scientific article production as reflected in the WoS database.

As described in Chapter 2, the articles were identified using geographic search terms, allowing differentiation between articles about research related to Antarctica and the Arctic. Figure 3.1 shows the development of the total number of articles relating specifically to the Arctic and Antarctica. Some articles cover, or are based on, research conducted in both the Arctic and Antarctica, and these articles are included in a “bipolar” category. A larger proportion of the article production concerns the Arctic compared to Antarctica (60 % and 35 %, respectively). During the period 2013-2022, there has been a much stronger relative increase in the number of articles relating to Arctic than Antarctic, 43 % and 33 %, respectively. However, for both categories we see a decline from 2021 to 2022, possibly related to the effect of the COVID-19 pandemic.

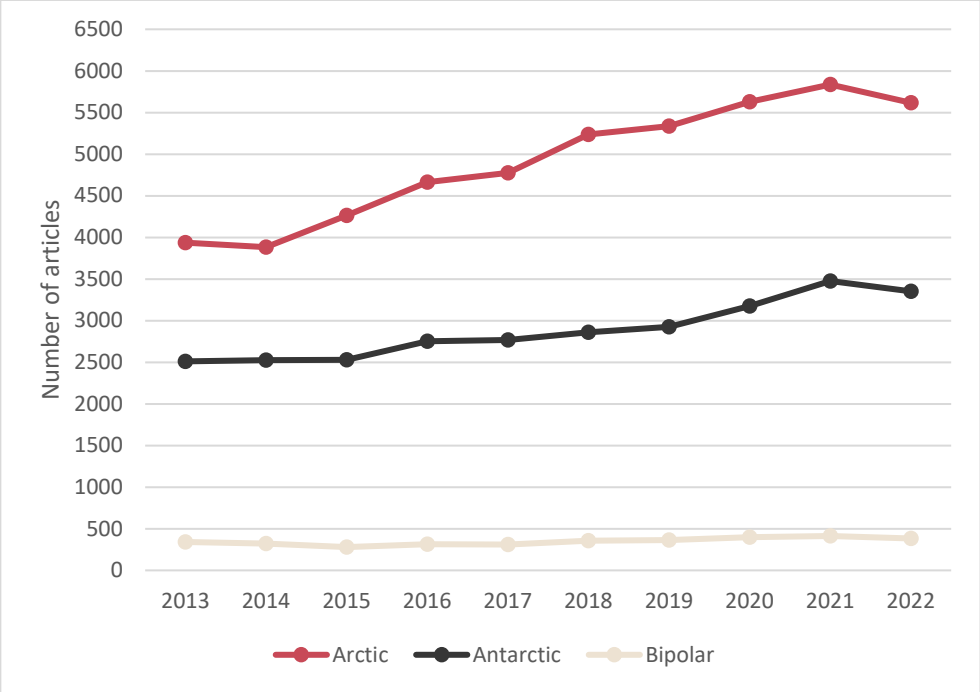

Figure 3.1 Global scientific article production in polar research, number of articles from 2013 to 2022, Arctic and Antarctic.

The USA is by far the largest contributor in terms of publications on both the Arctic and the Antarctic. Figure 3.2 shows the distribution by country for the 2019-2022 period, limited to the nations with the highest number of publications. Following the US, Russia and China are the next largest contributors.

Norway ranks as the seventh largest contributor, with 2,350 fractionalized articles. This corresponds to a share of 5.2 % of the total global polar research output. In other words, polar research is a field in which Norway is a relatively significant contributor. This is notable, as Norway is otherwise known as a small research nation in an international context, accounting for 0.52 % of the world's total scientific knowledge production (2022 figures). However, Norway has dropped two places compared to the previous mapping, where it ranked as the fifth largest contributor to polar science globally. This shift is due to China and Russia surpassing Norway in recent years (see below).

There are significant differences among the countries in their geographical profile. Some countries primarily concentrate their research on the Arctic, such as Canada, Norway, Russia, and the Kingdom of Denmark.[8] Others mainly focus on the Antarctic, such as Australia and Brazil, and for several nations the research output is more evenly distributed between the two regions, such as the USA and China.

[8] Denmark, Greenland and the Faroe Islands.

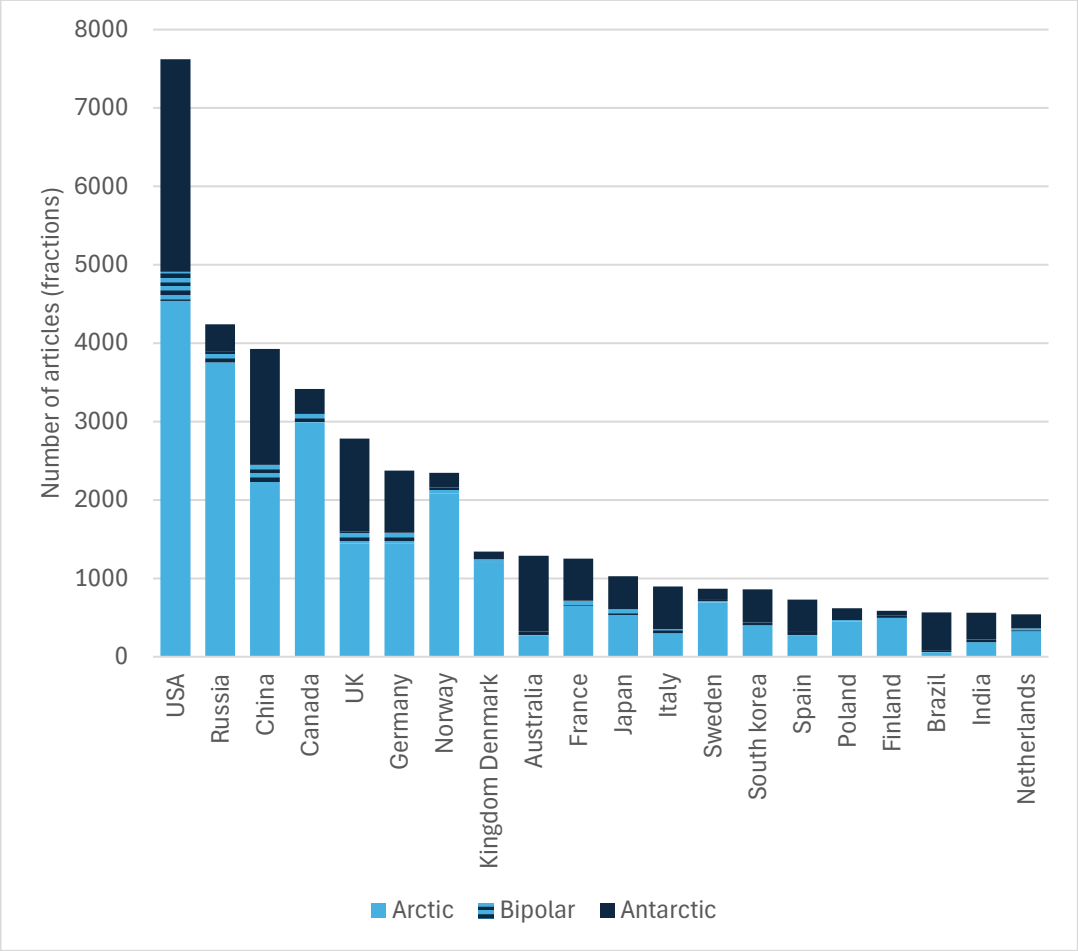

Figure 3.2 Number of polar research articles (fractions) per country, 2019-2022 total, Arctic and Antarctic

Figure 3.3 shows the development in the number of polar research articles for the largest nations from 2013 to 2022. All countries have a growth in scientific publishing. The USA increased its fractionalized article count from 1,620 in 2013 to 1,900 in 2022, representing a growth of 17 %. The by far largest absolute increase is seen for China with a 294 % growth. While China ranked as the seventh largest polar nation in 2013, it rose to the second largest by 2022. China's strong growth is not unique to polar research and is observed across most research fields. China is now the world's largest research nation measured by publication volume. The growth can generally be explained by the expansion of the country's research resources, incentives to publish in international scientific journals, and increased coverage of Asian scientific journals in the database.

Russia also has a tremendous increase with 165 %, moving from the sixth to the third largest contributor. As with China, part of this increase can be attributed to shifting publication patterns, with a greater emphasis on publishing in international rather than national journals. Other nations had more modest relative growth: Canada (8 %), UK (7 %), Norway (28 %) and Germany (19 %).

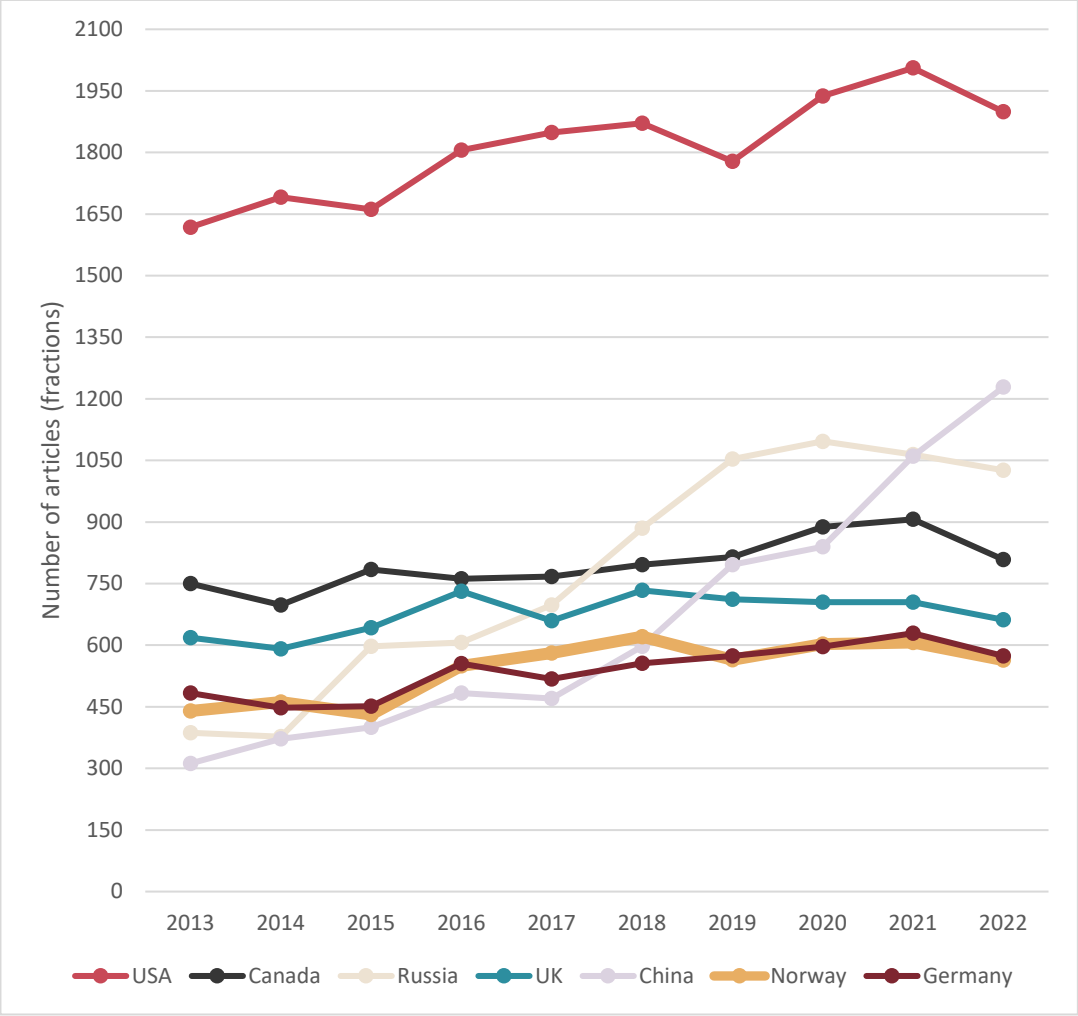

Figure 3.3 Number of polar research articles (fractions) per country and year, 2013-2022.

In terms of Arctic polar research, Norway is the world's fifth largest nation by publication volume, with the USA, Russia, Canada and China having higher numbers (see Table 3.1 and Figure 3.4). Norway's share was 7.6 % during the period 2019-2022.

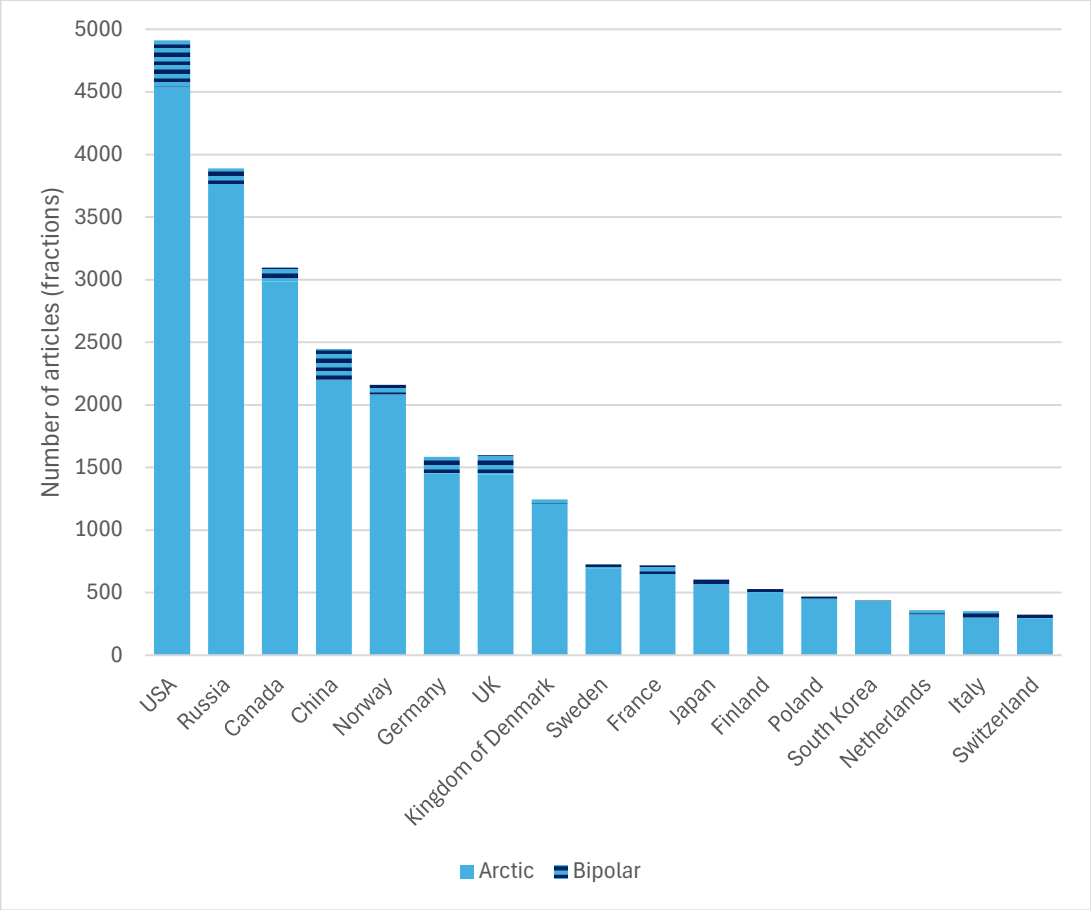

Figure 3.4 Number of Arctic polar research articles (fractions) per country, 2019-2022 total.

Norway holds a unique position by having territories in the Arctic and territorial claims in Antarctica. In Antarctica, however, Norway is a significantly smaller contributor than in the Arctic, ranking as the nineteenth largest research nation, with a share of 1.6 % of Antarctic research measured by publication volume in 2019-2022 (see Table 3.1). The USA, China, and the UK are the largest contributors to Antarctic research.

Table 3.1 Number of Arctic and Antarctic polar research articles (fractions) 2019-2022 per country. Proportion of world total.

ARCTIC*			ANTARCTIC*		
Country	No articles (fractions)	Proportion of world total	Country	No articles (fractions)	Proportion of world total
USA	4 912	17.4 %	USA	3 081	18.2 %
Russia	3 890	13.8 %	China	1 723	10.2 %
Canada	3 095	11.0 %	UK	1 340	7.9 %
China	2 447	8.7 %	Australia	1 019	6.0 %
Norway	2 151	7.6 %	Germany	924	5.5 %
UK	1 597	5.6 %	France	602	3.6 %
Germany	1 584	5.6 %	Italy	594	3.5 %
Kingdom Denmark	1 245	4.4 %	Brazil	513	3.0 %
Sweden	726	2.6 %	Chile	508	3.0 %
France	718	2.5 %	Japan	494	2.9 %
Japan	606	2.1 %	Russia	483	2.9 %
Finland	527	1.9 %	Argentina	480	2.8 %
Poland	469	1.7 %	South Korea	458	2.7 %
South Korea	436	1.5 %	Spain	454	2.7 %
Netherlands	360	1.3 %	Canada	433	2.6 %
Italy	353	1.3 %	New Zealand	414	2.4 %
Switzerland	325	1.2 %	India	378	2.2 %
Australia	320	1.1 %	South Africa	275	1.6 %
Spain	317	1.1 %	**Norway**	262	1.6 %
India	218	0.8 %	Netherlands	216	1.3 %

**) Bipolar articles are included in both categories.*

3.2 Citation impact

In absolute numbers, the countries with the highest production of scientific articles generally also receive the most citations. However, it is common to use size-independent metrics to assess whether a country's articles are highly cited or not. One such indicator is the relative citation index, which is a measure of the average number of citations per publication. This index indicates whether a country's publications are cited more or less than the global average, which is normalised to 100.

In Figure 3.5, we have calculated the relative citation index for the largest polar research nations for the years 2019-2021 (articles from 2022 require a longer observation period to be included). The analysis is based on all articles published during this period. We see that Norway ranked tenth among the countries included in this comparison, with a citation index of 106. This means that Norwegian articles were cited 6 % above the global average.

The Netherlands and UK achieved the highest scientific impact measured by the number of citations during this period. Articles from these countries were cited 51 % and 33 % more than the global average, respectively. The lowest citation frequencies among the countries in the figure belong to Russia with index value of 56. Thus, these articles on average received approximately half as many citations as the global average.

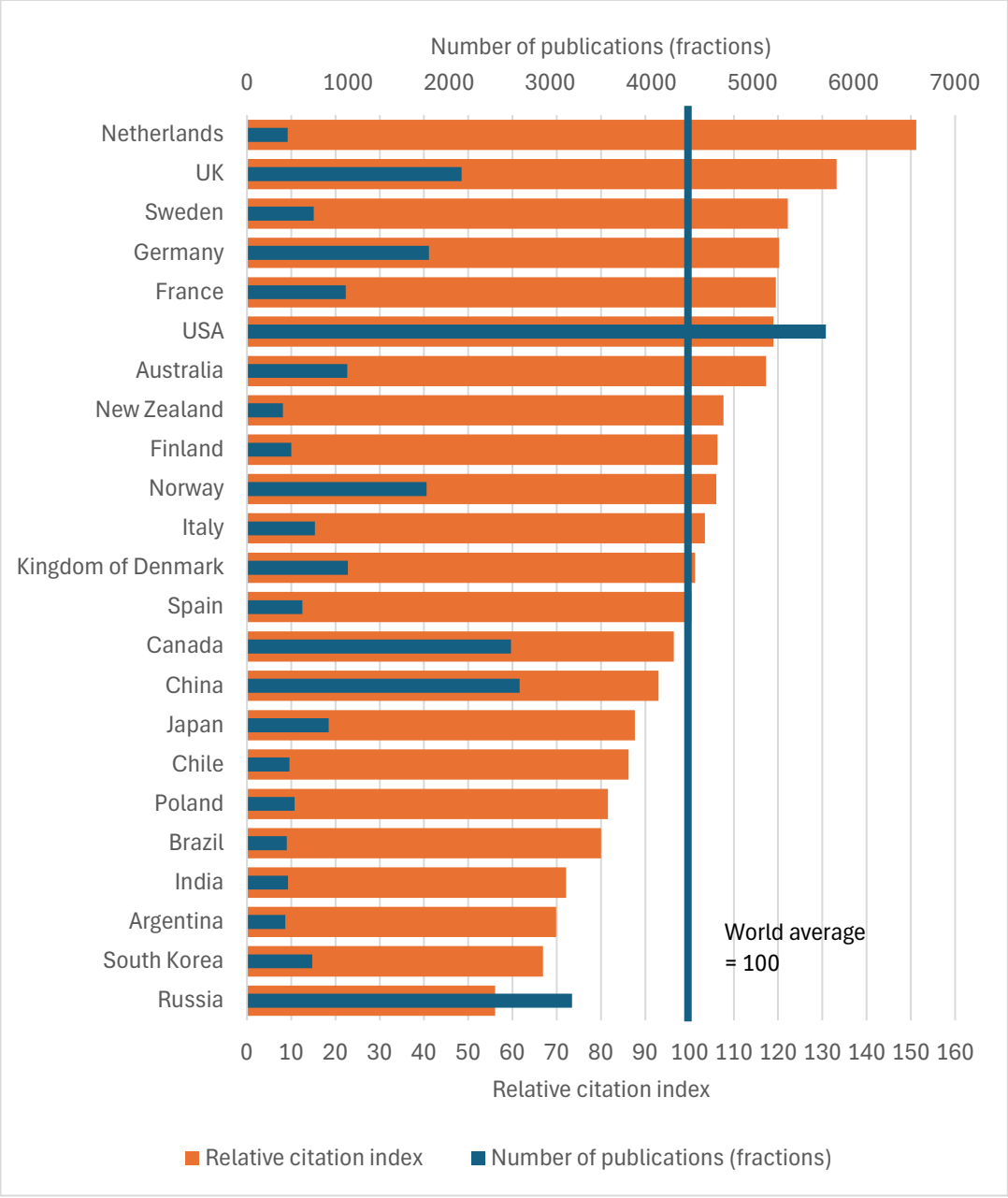

Figure 3.5 Relative citation index per country and number of polar research articles (fractions), 2019-2021.

4 Norwegian polar research

In this chapter, we present statistics and indicators of the outcomes of Norwegian polar research through scientific publications, focusing on the period from 2013 to 2022. In some cases, statistics is presented for individual years, with 2022 being the most recent year for which figures are available and often emphasized in the chapter. In other cases, a period is analysed, typically the 2019-2022 period. Using a longer period instead of individual years is preferred when data may show larger annual variations, often due to random fluctuations in publication frequencies. This is particularly relevant when considering the publication output of smaller units and when calculating citation indexes.

4.1 Development and profile

From 2013 to 2022, the number of polar research articles authored by Norwegian researchers increased from 590 to 870. Measured by publication fractions, the numbers were 440 to 564, corresponding to a 28 % growth. By comparison, the corresponding overall growth for Norwegian research across all fields was 46 % during this period. Therefore, polar research showed a significantly lower relative growth in publishing compared to other research areas, weakening its relative position in the national research landscape. We observe a decrease from 2021 to 2022. However, this specific decrease is evident also at the national level and is likely an effect of the pandemic.

Figure 4.1 shows the development in the number of polar research articles from Norway, both in total and for the Arctic and Antarctic regions specifically. As noted in the previous chapter, most Norwegian research is related to the Arctic, which is reflected in the publication numbers. In relative terms, the increase in article production related to the Artic and Antarctica has been quite similar during the 2013-2022 period.

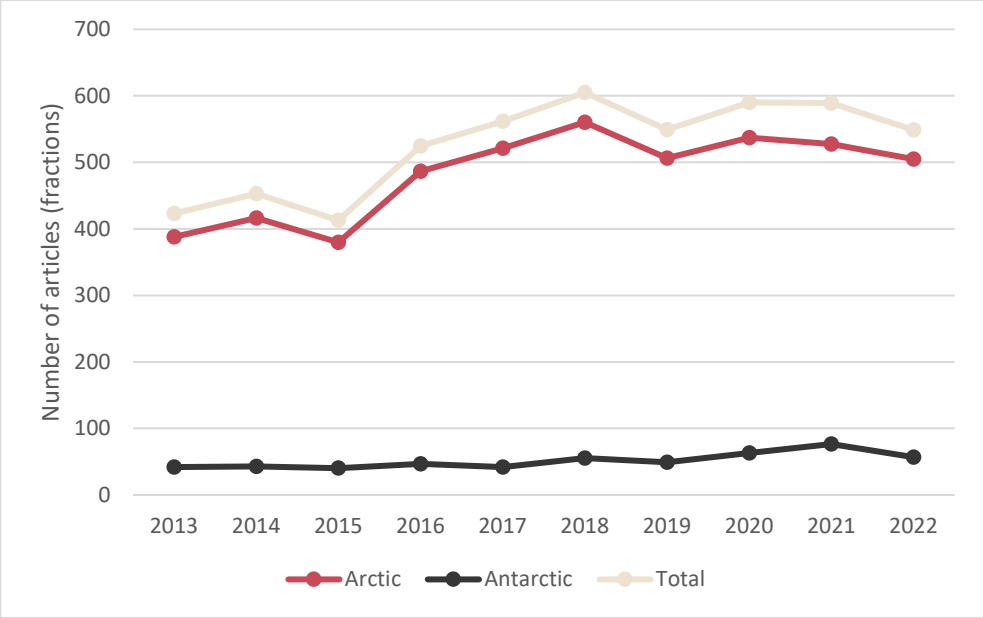

Figure 4.1 Number of Norwegian polar research articles total and per geographic area, 2013-2022.*

**) Some articles deal with, or are based on, research conducted in both the Arctic and Antarctica (bipolar articles), and these articles are included in both categories.*

Figure 4.2 provides additional details on the research focused on Antarctica. In 2022, there were 57 articles (fractions) related to Antarctica, representing 10.2 % of Norwegian polar research output. Some of these articles were bipolar, also including the Arctic. Excluding the bipolar articles, the proportion of purely Antarctic-focused research would be 7.8 %. We observe some annual fluctuations in this proportion during the period.

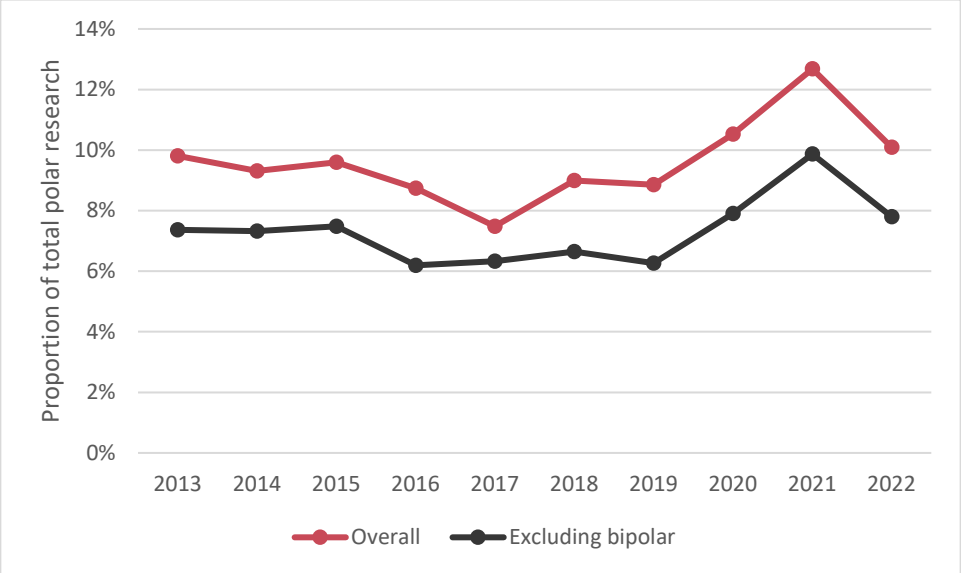

Figure 4.2 Antarctic proportion of Norwegian polar research output, total and when excluding bipolar (dual Arctic and Antarctic) articles, 2013-2022.

Figure 4.3 shows the distribution of the Norwegian publication output across different fields of research. The figure is based on publications from 2022. Norwegian article production in polar research is dominated by geosciences and biology, with approximately 350 and 200 fractionalised articles respectively. Geosciences here represent a broad category that includes disciplines such as geophysics, oceanography, geology, and atmospheric research. Article production in other fields like physics and chemistry, technology, medicine, social sciences, and humanities is much more limited.

The figure also shows the proportion of the world's production of polar research that Norway contributed to. Here, the proportions are highest for social sciences with 7.4 %. Norway also contributes a relatively high proportion to the world's production in biology (6.6 %). The proportion is lowest for biomedicine, humanities and physics and chemistry at 2.7-3.6 %.

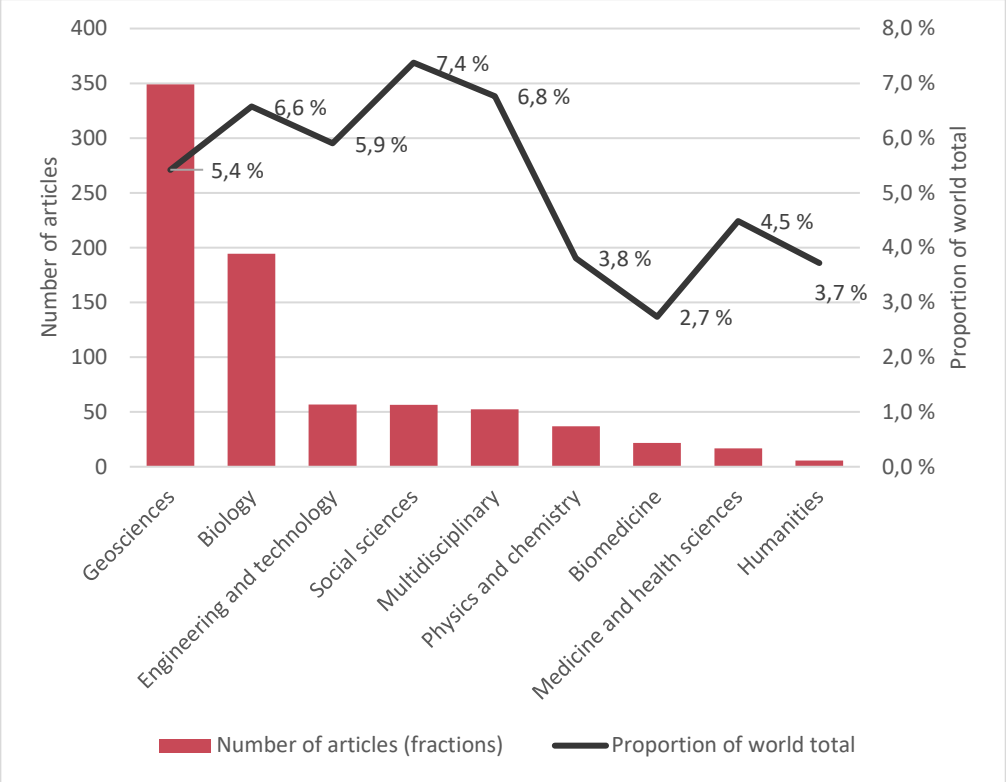

Figure 4.3 Number of Norwegian polar research articles (fractions) by field and proportion of world total of polar research, 2022.

Based on Web of Science categories, the articles are further classified into more than 100 different fields and sub-disciplines. Within the scope of this report, it is not possible to provide a complete overview of publications at this level of detail. However, Figure 4.4 shows Norway's contribution to the world's production in some selected fields. Using the proportion of the world as yardstick, Norway is a particularly significant contributor to polar research in Leisure, sport and tourism,

Fisheries, Energy & Fuels, International relations, and Political Science. In these fields, Norway contributes to 12-23 % of the world total. It should be noted, however, that in some fields, there are just a few publications.

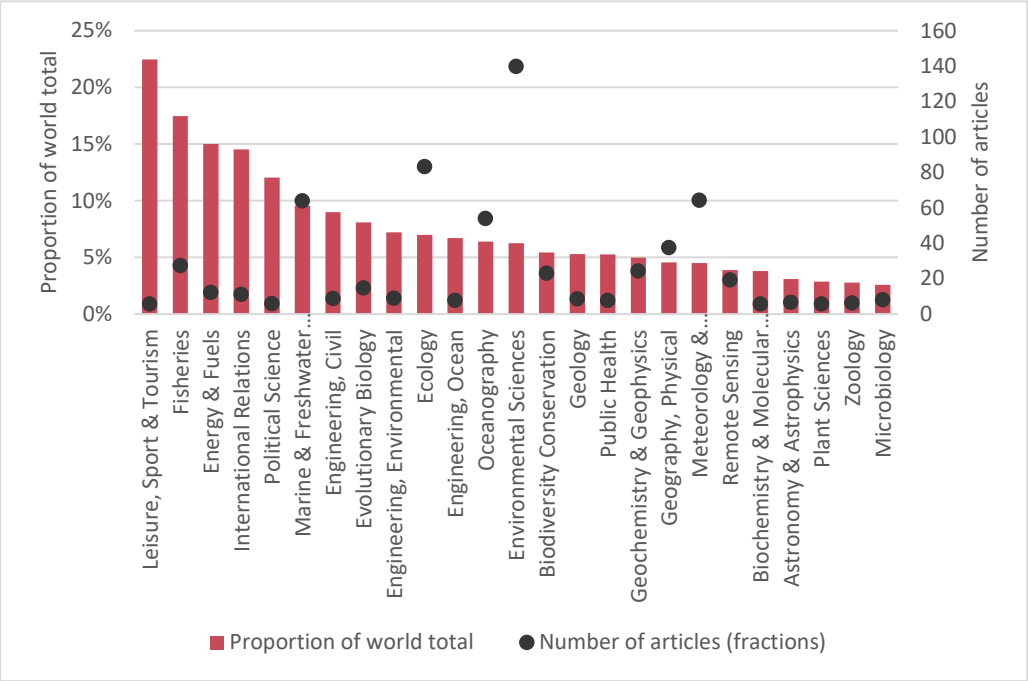

Figure 4.4 Number of Norwegian polar research articles by selected WoS-subfield and proportion of world total, 2022.

In Table 4.1, we have analyzed the distribution of Norwegian article production across disciplines for the period 2013-2022, measured as a percentage of the total Norwegian polar research output. We observed some annual fluctuations, so we presented the figures for three-year periods. There has been growth in the number of articles over the period, but overall, the relative profile has been fairly stable, though there are some notable changes. Geosciences account for nearly half of the Norwegian polar research output during all periods and have remained stable. Social sciences have strengthened their relative position by two percentage points. Conversely, engineering and technology saw a reduction of 3 percentage points.

Table 4.1 Distribution of Norwegian polar research articles by field and periods 2013-2022, proportion of national total.

	2013-2016	2017-2019	2020-2022
Geosciences	46.1 %	45.6 %	45.8 %
Biology	25.1 %	22.9 %	23.9 %
Social sciences	6.3 %	9.2 %	8.3 %
Engineering and technology	11.7 %	10.3 %	8.8 %
Multidisciplinary	2.1 %	3.2 %	3.8 %
Physics and chemistry	2.0 %	2.1 %	3.3 %
Biomedicine	4.0 %	3.4 %	3.0 %
Medicine and health sciences	1.9 %	2.2 %	1.9 %
Humanities	0.7 %	1.2 %	1.1 %
Total	100.0 %	100.0 %	100.0 %

4.2 Citation impact

We have also calculated the citation impact of Norwegian polar research articles. In Figure 4.5, we present the relative citation index by fields for the periods 2013-2015, 2016-2018, and 2019-2022. The index is based on publications from the three respective periods. In the most recent period (2019-2021), the citation index is above the world average for geosciences and the multidisciplinary field, with index values of 111 and 148, respectively. Geosciences is also the largest field in terms of the number of articles. The multidisciplinary category consists of publications in multidisciplinary journals like PlosOne, Science and Nature, which publish articles across a range of disciplines. However, the articles themselves are not necessarily multidisciplinary. The citation rate is on par with the world average in physics and chemistry (102) and biology (98). Engineering and technology have the lowest citation index at 81.

Some fields show an improvement in the relative citation index over time, while others show the opposite pattern. Geosciences, and the multidisciplinary field consistently perform above the world average, but for geosciences we see a declining trend. Medicine and health sciences, biomedicine and molecular biosciences, engineering and technology, and social sciences are generally below the world average. These fields have room for improvement to reach or exceed the world average. Overall, the citation rate is declining for Norwegian polar research during this period, from an index at 115 to an index at 106.

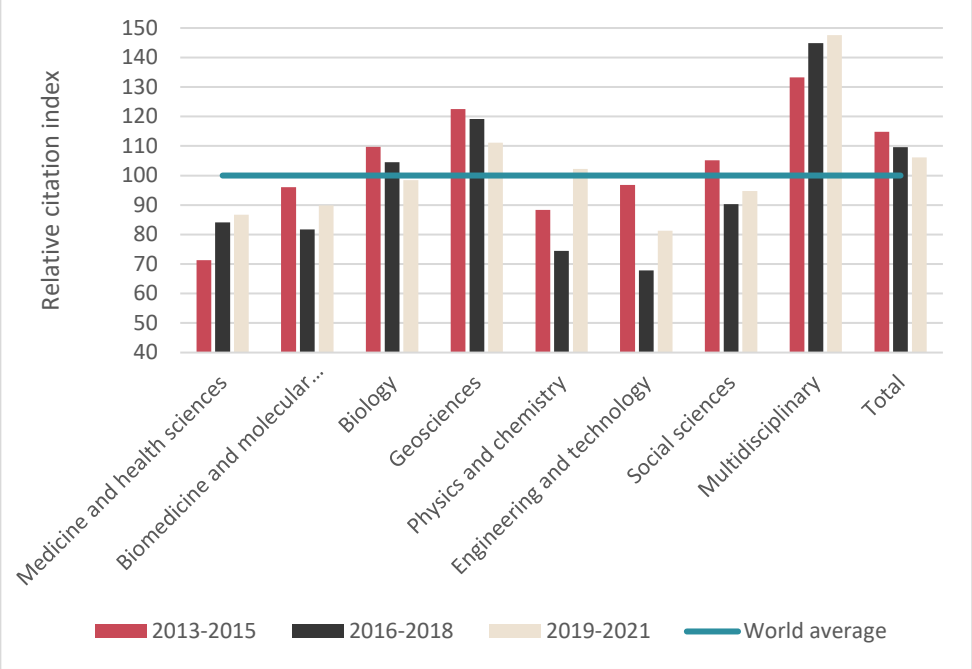

Figure 4.5 Relative citation index of Norwegian polar research articles by discipline, 2013-2015, 2016-2018 and 2019-2021.

Figure 4.6 shows the similar indicator, but with articles classified according to the geographical area they relate to. Across all three analysed periods, articles on Antarctica are the most highly cited, while those on Svalbard receive the fewest citations. However, the citation counts for Svalbard articles do not differ much from the average for articles on other Arctic regions. In the most recent period (2019-2021), the citation index stands at 127 for Antarctic articles, 108 for Arctic articles, and 102 for Svalbard articles.

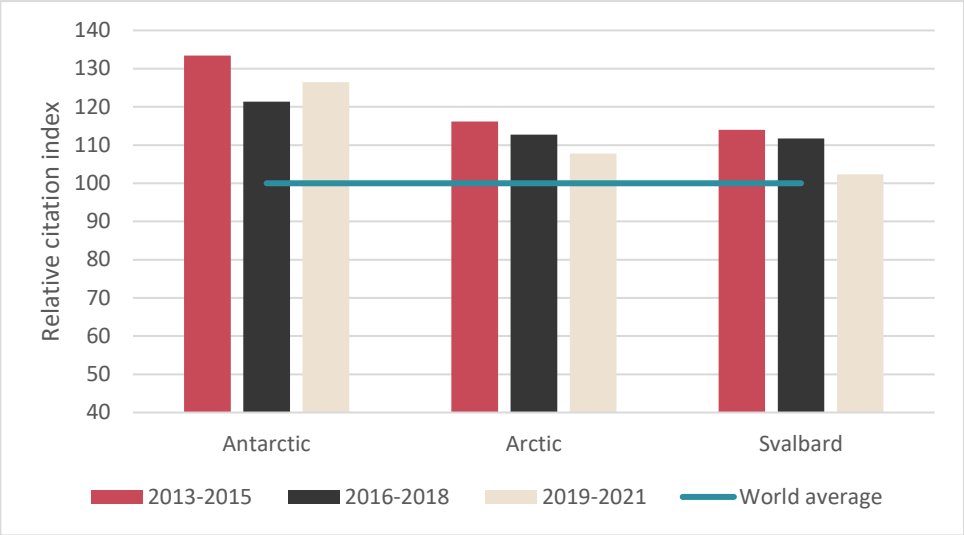

Figure 4.6 Relative citation index of Norwegian polar research articles by geographical area, 2013-2015, 2016-2018 and 2019-2021.

4.3 The national research landscape

A large number of Norwegian universities, university colleges, institutes, and businesses contribute to polar research. Figure 4.7 displays the relative distribution of publications among research-performing sectors based on figures from the 2019-2022 period. The higher education institutions account for 58 % of the national publication output. The institute sector contributes 32 %, while the business enterprise sector adds 4 %. The remaining 6 % comes from other public organisations.

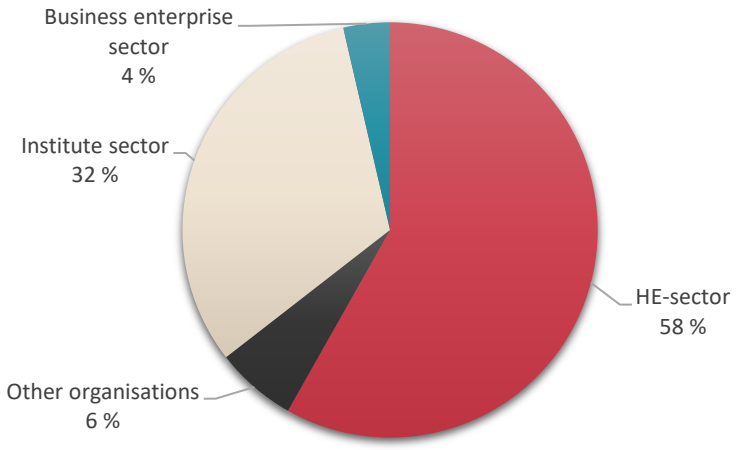

Figure 4.7 Contributions to Norwegian polar research publication output by sector, proportion of national total, 2019-2022.

UiT, The Arctic University of Norway, is the largest contributor to scientific publishing, with just over 550 fractionalised articles during the four-year period from 2019 to 2022 (Table 4.2). Following UiT are the University of Bergen (UiB), the University of Oslo (UiO), and the Norwegian Polar Institute, each with between 225 and 297 article fractions. The University Centre in Svalbard (UNIS), Institute of Marine Research and the Norwegian University of Science and Technology (NTNU) each have about 180-190 fractions each.

Other entities in the HE-sector and institute sector were significantly smaller contributors to polar research, each with 80 or fewer article fractions each. Among these, the largest contributors are NORCE Norwegian Research Centre AS, the Norwegian Institute for Nature Research (NINA), the Meteorological Institute, and the Nansen Environmental and Remote Sensing Center as the largest. For a full overview see Table 4.2.

Table 4.2 Number of polar research articles (fractions) and proportion of national total by institution/institute,* 2019-2022.

Institution/institute	Number of articles (fractions)	Proportion of national total
UiT - the Arctic University of Norway	558.7	17.9 %
University of Bergen	292.0	9.4 %
University of Oslo	278.3	8.9 %
Norwegian Polar Institute	224.5	7.2 %
University Centre in Svalbard	190.5	6.1 %
Institute of Marine Research	186.2	6.0 %
Norwegian University of Science and Technology	183.9	5.9 %
NORCE Norwegian Research Centre AS	81.5	2.6 %
Norwegian Institute for Nature Research	79.1	2.5 %
Norwegian Meteorological Institute	63.5	2.0 %
The Nansen Center	60.3	1.9 %
Norwegian University of Life Sciences	59.6	1.9 %
Akvaplan Niva	56.9	1.8 %
SINTEF group	43.4	1.4 %
Geological Survey of Norway	41.4	1.3 %
Norwegian Institute for Air Research	40.6	1.3 %
Business enterprise sector	112.9	3.6 %
Other research institutes	194.3	6.2 %
Other HE-institutions	169.5	5.4 %
Other organisations	196.6	6.3 %
TOTAL	3113.6	100 %

**) Only the largest units shown separately.*

Table 4.3 provides the citation index for the largest Norwegian institutions and institutes in Norwegian polar research (i.e., those with the most articles). Generally, the units in the institute sector rank above the higher education institutions, contributing more to high-impact research. At the top is the Norwegian Institute for Air Research (NILU), with a relative citation index of 161. This means its publications are cited 61 % more than the corresponding world average. However, NILU is a relatively small institute in terms of the number of polar research articles. Following NILU is the Meteorological Institute, with a citation index of 155.

Among the larger contributors, the University of Oslo and the Norwegian Polar Institute have the highest citation rates, both with approximately 130. The largest Norwegian contributor, UiT, has a citation index slightly below the world average at 94. Publications from other HE-institutions (than the ones shown in the table) and Akvaplan Niva have the lowest citation rates, with index values of 84-86.

The analysis of the Norwegian citation index shows that geosciences and the multidisciplinary field achieved the highest impact. There are greater differences in the citation index at the level of individual institutions than at the level of fields. Furthermore, an examination that combines both field and institutional variables indicates that the citation patterns observed at the field level do not always hold true at the institutional/institute level. This suggests that certain institutions excel

in specific fields, leading to higher citation impacts, while others may not perform as well despite conducting research in high-impact field.

Table 4.3 Citation indicators of polar research articles by institution/institute,* 2019-2021.

Institution/institute	Number of articles (fractions)	Relative citation index	Number of accumulated citations
UiT - the Arctic University of Norway	400.2	94	8253
University of Bergen	221.6	111	5725
University of Oslo	207.0	131	7140
Norwegian Polar Institute	165.2	130	5248
Institute of Marine Research	141.3	118	3194
University Centre in Svalbard	139.4	101	4214
Norwegian University of Science and Technology	136.8	96	2673
Norwegian Institute for Nature Research	61.5	136	2746
NORCE Norwegian Research Centre AS	60.6	140	2733
Akvaplan Niva	47.4	84	1117
Norwegian Meteorological Institute	47.0	155	2279
The Nansen Center	44.2	143	1954
Norwegian University of Life Sciences	42.8	110	1263
SINTEF group	36.7	118	708
Geological Survey of Norway	32.8	101	837
Norwegian Institute for Air Research	30.3	161	1425
Business enterprise sector	76.7	101	1358
Other HE-institutions	124.9	86	2927
Other research institutes	149.3	96	3262
Other organisations	140.2	123	4475

**) Only the largest units shown separately.*

4.4 International collaboration

Norwegian polar researchers collaborate extensively with researchers from other countries. Over the ten-year period from 2013 to 2022, the proportion of Norwegian polar research publications with international co-authorship increased from 71 % to 79 % (Figure 4.8). In other words, four out of five articles had contributions from institutions in other countries. Despite the pandemic and its consequences, such as reduced travel activity, this does not appear to have negatively affected international collaboration patterns as evident in publication patterns.

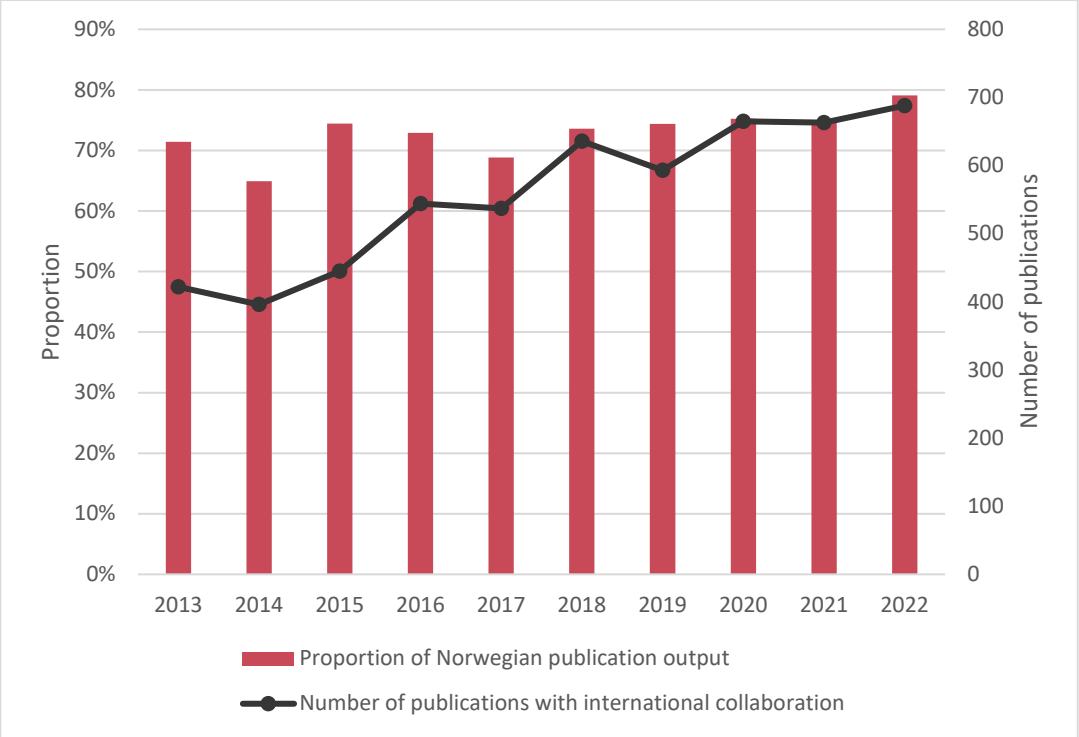

Figure 4.8 Number and proportion of Norwegian polar research articles with international collaboration.

The internationally co-authored publications result from various types of collaborative projects, ranging from small bilateral projects between a Norwegian and a foreign researcher to large multilateral projects involving numerous researchers across multiple countries.

Figure 4.9 shows the distribution of publications across different types of collaboration projects in 2013-2022. There has been an increase particularly for the multilateral articles during the period, where the annual number has more than doubled. In total, 21 % of the Norwegian publications did not have co-authors from institutions in other countries than Norway in 2022, 30 % involved collaboration with one other country (bilateral collaboration), 19 % involved two other countries (trilateral collaboration), and 31 % involved three or more other countries (multilateral collaboration).

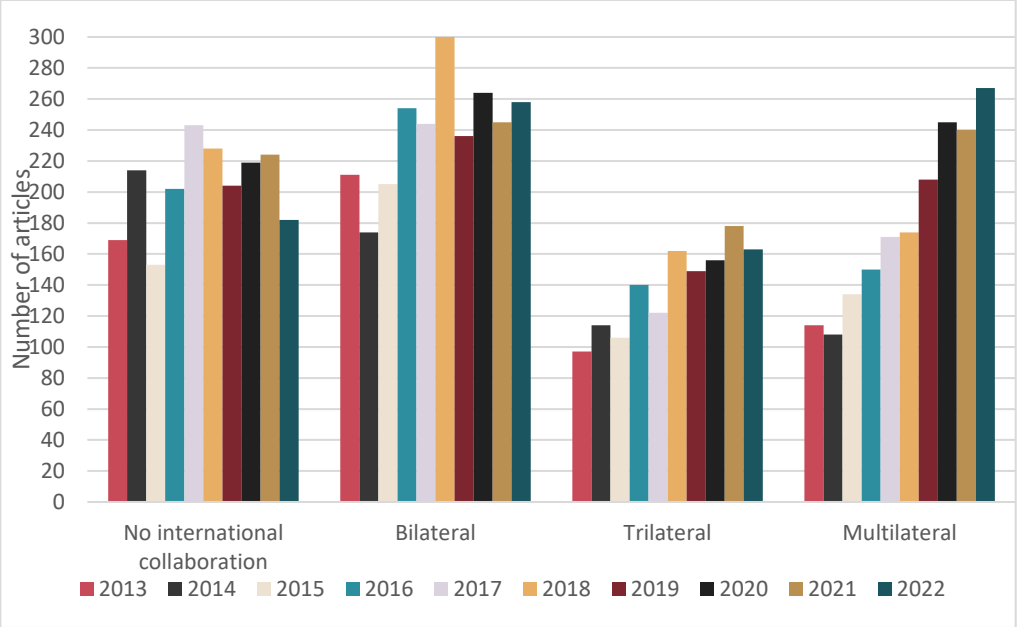

Figure 4.9 Number of Norwegian polar research articles by collaboration type, 2013-2022

In Table 4.4, we present the 2022 collaboration figures for the countries with which Norwegian researchers most frequently collaborate. Most articles involved collaboration with US researchers, in total just over 230 articles. This means that about one in four Norwegian polar research articles had co-authors from the USA. Germany was the second largest collaborator, with nearly 190 articles, or 21 % of Norwegian article production, involving German researchers. Following Germany, the UK, Canada, and Kingdom of Denmark were the most significant collaborative nations for Norwegian polar research.

Table 4.4 also shows the combined bi- and trilateral collaboration ratio, representing the proportion of articles with each country that involved bilateral or trilateral collaboration. For example, this ratio is 0.47 for China and 0.14 for Spain. This indicates that bilateral and trilateral collaborations are much more common when Norwegian scientists collaborate with China. Collaborations with Spain typically occur within multilateral projects involving many other participants.

Table 4.4 International collaboration with Norway 2022, number of articles with co-authorship.

Country	Number of articles with collaboration	Proportion of in Norwegian publication output	Bilateral and trilateral collaboration ratio
USA	231	27 %	0.35
Germany	184	21 %	0.33
UK	171	20 %	0.36
Canada	154	18 %	0.21
Kingdom of Denmark	139	16 %	0.25
Sweden	106	12 %	0.25
Russia	95	11 %	0.39
Finland	90	10 %	0.23
France	87	10 %	0.31
China	64	7 %	0.47
Australia	52	6 %	0.27
Netherlands	51	6 %	0.18
Switzerland	51	6 %	0.20
Italy	43	5 %	0.21
Iceland	43	5 %	0.26
Poland	42	5 %	0.40
Spain	42	5 %	0.14
Japan	39	4 %	0.26

The volume of international collaboration, measured as co-authorship, has increased with most countries during the 2013-2022 period, although there are quite large annual fluctuations, as seen in Figure 4.10. The USA and China show the most consistent growth over the period with increased collaboration with Norway. Norwegian-Russian collaboration has also increased overall, but there was a notable decrease from 2021 to 2022, possibly related to the impact of sanctions.

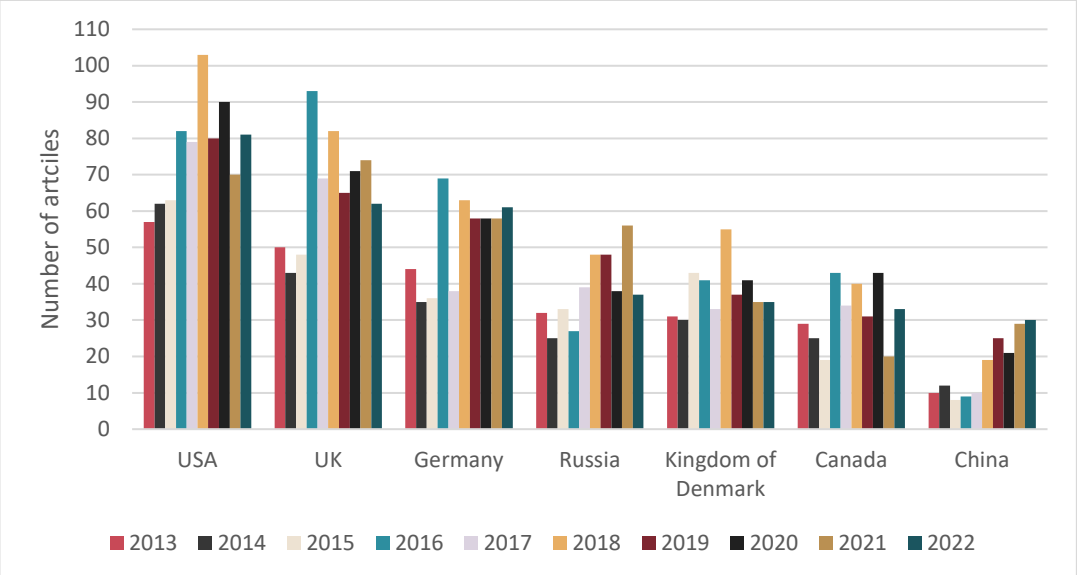

Figure 4.10 Number of articles with bilateral/trilateral collaboration by country, 2013-2022.

Figure 4.11 illustrates collaboration between Norway and the main international partners for the year 2022. The size of the circles represents the total number of polar research articles from each country. For example, while Canada has more than twice as many polar research articles as the Kingdom of Denmark overall, both countries have nearly equal numbers of collaborative articles with Norway.

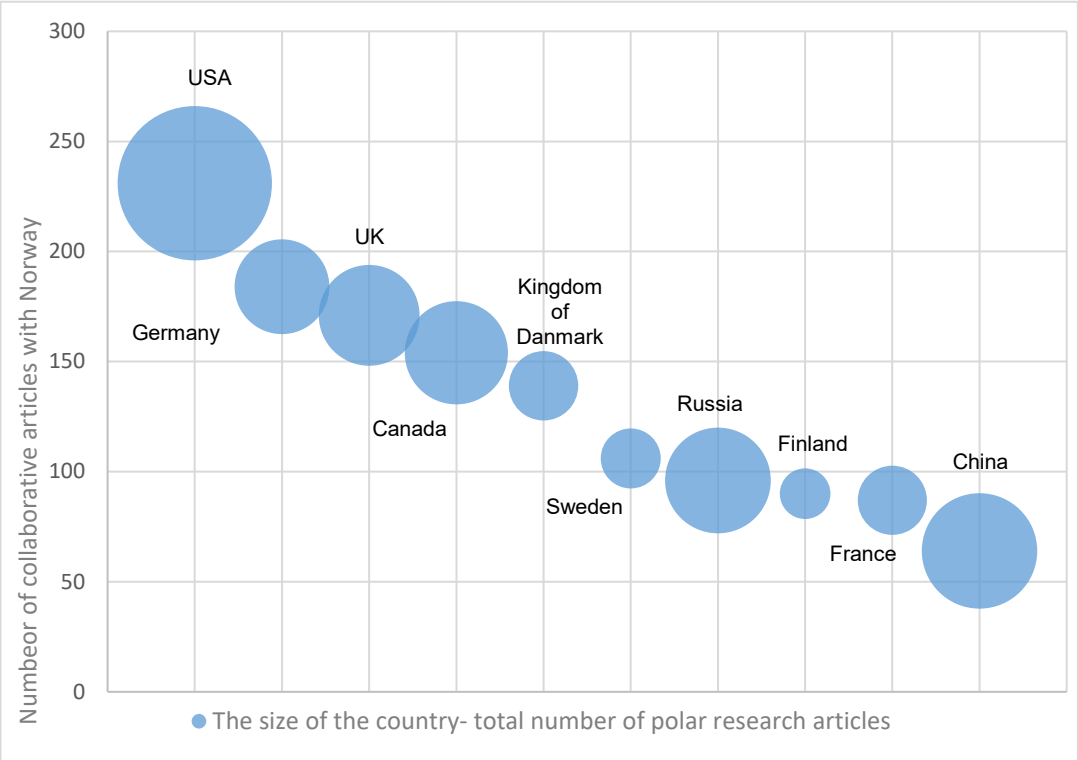

Figure 4.11 International collaboration with Norway in polar research. The number of collaborative articles 2022 and the country's size (total number of polar research articles)

At an aggregate level, the citation frequency of articles involving international collaboration is higher than for those with authors from a single country. This general trend is also evident in Norway's polar research.

Figure 4.12 shows the citation index of articles authored solely by Norwegian researchers compared to those with international co-authors. The latter group is categorized by the type of collaboration: bilateral, trilateral, and multilateral

Articles without international collaboration had a relative citation index of 87 for the period 2019-2021. Articles with bilateral collaboration, meaning between researchers in Norway and one other country, had a citation index of 92. Trilateral collaboration articles achieved an index value of 101, while multilateral collaboration articles were cited far above the world average with a citation index of 182.

In other words, there is a positive correlation between international collaboration and citation frequency. The numbers suggest that Norwegian research clearly

benefits from participating in such collaborative projects by increasing the international influence. Large multinational collaborative projects will consist of contributions from many researchers often with funding from multiple countries. Such projects can result in research that is particularly significant and scientifically important, leading to higher citation rates.

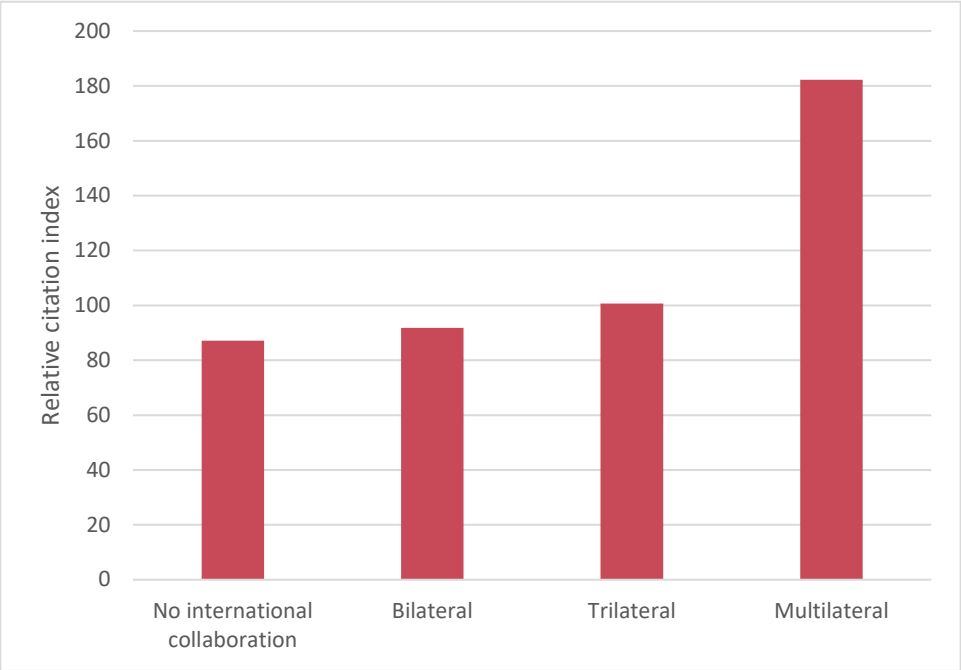

Figure 4.12 Relative citation index for articles with different types of international collaboration with Norway in polar research, 2019-2021.

4.5 National collaboration

In addition to international collaboration, national collaboration within Norwegian polar research is also significant. This can include collaboration between individuals within the same institutes, between individuals at different departments within the same institution, and between individuals at different institutions in Norway.

National collaboration can also be analysed through bibliometric indicators. Here we focus on external national collaboration, meaning collaboration where authors are affiliated with different Norwegian institutions, institutes (in the institute sector), organizations, or companies. Co-publishing that occurs, for example, between researchers affiliated with two departments at the same university is not considered national collaboration in this context.[9]

[9] It should be noted, however, that individuals holding positions at multiple organizations (e.g. adjunct positions) may list two or more addresses on their publications. These publications will also be counted as collaborative in the analysis.

We have calculated the proportion of joint publications for the largest institutions/institutes, based on data from the period 2019-2022. This indicator reflects the intensity of collaboration between the institutions/institutes.

Table 5.5 shows the results of the analysis, using a colour scale to illustrate the intensity of the collaboration. The table should be read at the column level. For example, we see that UiT the Arctic University of Norway (column 15) published 994 polar research articles during the period 2019-2022 (N). Of these, 14 % included co-authors from the Norwegian Polar Institute (NP), and 15 % included co-authors from UNIS. These are UiT's two most important collaborators as measured by co-authorship.

Similarly, NP (column 11) had 461 polar articles from the period, of which 30 % involved co-authorship with researchers from UiT. The lower percentage for UiT compared to NP is because UiT has the most publications overall (cf. N), while the number of collaboration publications from which the percentage is calculated is the same. This difference is particularly large when the institutions differ significantly in size. For example, 58 % of Akvaplan Niva's articles (column 1) involved collaboration with UiT, while the reverse ratio was 7 %.

Table 4.5. National collaboration in polar research by institution/institute. Proportion of publications with co-authorship 2019-2022.

	Akvaplan Niva	IMR	MET	Nansen Center	NILU	NORCE	NGU	NTNU	NINA	NP	SINTEF	UiB	UiO	UiT	UMB	UNIS	Other HE	Other inst	Business sector	Other
Akvaplan Niva		6 %	4 %		13 %	2 %	1 %	6 %	5 %	8 %	9 %	1 %	2 %	7 %	4 %	11 %	4 %	4 %	3 %	3 %
IMR	15 %		6 %	5 %	2 %	4 %	4 %	4 %	9 %	13 %	23 %	11 %	6 %	10 %	5 %	6 %	5 %	7 %	5 %	7 %
MET	4 %	2 %		5 %	8 %	5 %		1 %	2 %	3 %		4 %	5 %	2 %	1 %	2 %	1 %	3 %	3 %	3 %
Nansen		2 %	5 %		6 %	6 %				0 %		7 %	1 %	1 %		1 %	2 %	1 %		2 %
NILU	10 %	1 %	6 %	5 %		1 %		3 %	6 %	6 %	1 %	2 %	2 %	2 %	5 %	1 %	0 %	3 %	1 %	2 %
NORCE	2 %	2 %	8 %	10 %	2 %			2 %	5 %	2 %		11 %	5 %	4 %		3 %	2 %	3 %	5 %	5 %
NGU	1 %	1 %						5 %		1 %		1 %	1 %	4 %	1 %	2 %	2 %	1 %	4 %	4 %
NTNU	16 %	4 %	3 %		11 %	4 %	19 %		26 %	11 %	29 %	6 %	7 %	8 %	15 %	18 %	7 %	7 %	11 %	13 %
NINA	7 %	5 %	2 %		11 %	5 %		14 %		12 %		4 %	5 %	6 %	18 %	5 %	7 %	4 %	3 %	10 %
NP	29 %	18 %	10 %	2 %	25 %	5 %	7 %	14 %	30 %			8 %	8 %	14 %	9 %	14 %	8 %	7 %	2 %	9 %
SINTEF	5 %	5 %			1 %			6 %				1 %	0 %	3 %	1 %	2 %	0 %	1 %	1 %	2 %
UiB	6 %	19 %	16 %	33 %	13 %	34 %	5 %	9 %	11 %	10 %	7 %		13 %	8 %	11 %	22 %	6 %	8 %	15 %	14 %
UiO	7 %	11 %	21 %	4 %	12 %	13 %	9 %	11 %	14 %	9 %	1 %	13 %		7 %	15 %	21 %	10 %	22 %	24 %	23 %
UiT	58 %	31 %	17 %	4 %	19 %	19 %	38 %	23 %	34 %	30 %	41 %	14 %	13 %		21 %	36 %	21 %	19 %	15 %	28 %
UMB	4 %	2 %	1 %		6 %		1 %	5 %	13 %	3 %	1 %	2 %	3 %	3 %		5 %	4 %	7 %	7 %	5 %
UNIS	37 %	8 %	6 %	3 %	6 %	7 %	8 %	21 %	11 %	13 %	11 %	16 %	16 %	15 %	15 %		15 %	8 %	12 %	9 %
Other HE	10 %	5 %	3 %	4 %	1 %	3 %	5 %	6 %	12 %	5 %	1 %	4 %	6 %	6 %	8 %	12 %		10 %	10 %	10 %
Other inst	11 %	8 %	9 %	2 %	10 %	6 %	5 %	7 %	8 %	5 %	4 %	5 %	15 %	7 %	20 %	7 %	11 %		10 %	13 %
Business	4 %	3 %	4 %		1 %	5 %	8 %	5 %	3 %	1 %	3 %	5 %	8 %	3 %	10 %	5 %	5 %	5 %		7 %
Other	7 %	7 %	8 %	6 %	8 %	9 %	13 %	13 %	19 %	7 %	9 %	8 %	15 %	10 %	12 %	7 %	11 %	13 %	14 %	
N	125	324	126	123	104	188	91	357	188	461	70	568	544	994	130	411	310	356	176	342

N: Total number of publications (with and without national collaboration). Note that some publications will have co-authors from more than one institution or institute and will therefore be included in several categories.

5 Svalbard research

Research in Svalbard has a long-standing tradition.[10] Systematic exploration began in the 19th century and continued into the 20th century (Arlov 1996). Today, there is considerable research activity in Svalbard, with research and higher education playing an important role in maintaining a permanent settlement on the archipelago. Svalbard is unique in offering modern research facilities and infrastructure, along with a geographically advantageous location for studying various issues relating to the Arctic and polar areas. The presence of researchers from many different countries also offers great opportunities for international collaboration.

There are two main research centres in Svalbard: Longyearbyen and Ny-Ålesund. In addition, there are significant research activities in Barentsburg and Hornsund.

Longyearbyen is the largest settlement in Svalbard and is also important when it comes to research. Several research installations are located in the area. The University Centre in Svalbard (UNIS), the world's northernmost higher education institution, was established in Longyearbyen in 1994. The educational program has an international profile, with courses taught in English due to a large number of international students. UNIS has four departments: Arctic biology, Arctic geology, Arctic geophysics and Arctic technology.

The Svalbard Science Forum (SSF) serves as an information and coordination hub for research in Svalbard. The SFF, which is coordinated by the Research Council of Norway, is located in Longyearbyen. The secretariat's main tasks include providing information about research infrastructure and activities, coordinating research efforts, facilitating data sharing among researchers, and offering advisory services.

The Norwegian authorities have established Ny-Ålesund as a research station dedicated to international cooperation. This site offers diverse terrestrial and marine environments, making it ideal for research across many disciplines. Currently, institutions from 10 countries (Norway, Germany, the UK, Italy, France, Japan,

[10] This introduction is an updated version of the text which appeared in the previous report (Aksnes & Rørstad, 2019).

South Korea, China, the Netherlands, and India) maintain a permanent presence in Ny-Ålesund. Additionally, several other institutions and nations regularly visit Ny-Ålesund for research purposes, transforming the town into an international "scientific village."

Kings Bay AS owns the land and facilities in Ny-Ålesund and is responsible for the on-site infrastructure. Originally a coal company, Kings Bay AS is now a state-owned limited company. Its mandate focuses on providing services, promoting research and scientific activities, and contributing to the development of Ny-Ålesund as an international Arctic research station.

Research in Ny-Ålesund is coordinated by the Ny-Ålesund Science Managers Committee (NySMAC), which comprises representatives from institutions with significant interests in Ny-Ålesund. NySMAC provides advice on research projects, planning and coordination, infrastructure development, and environmental protection.

The Norwegian Polar Institute has extensive activities in Svalbard, including research, environmental monitoring, topographical and geological mapping, logistics services, operation of research station and lighthouse maintenance. It also provides expert and strategic advice concerning polar issues for Norwegian and local authorities. In addition to office in Longyearbyen, the institute fulfills Norway's host role in Ny-Ålesund and operates the Sverdrup and the Zeppelin Observatory

The Institute of Geophysics at the Polish Academy of Sciences established a research station in Hornsund, located at the Hornsund fjord in West Spitsbergen. The station's history dates back to the late 1950s, with permanent staffing since 1978. It also hosts guest researchers from various, primarily Polish, institutions. Besides the station in Hornsund, Poland institutions have established smaller research stations in Petunia Bay and Kaffiøyra.

Russian research is primarily conducted in and around the mining village of Barentsburg, with some activity in Pyramiden. Research in Barentsburg has been ongoing since 1962 and encompasses various disciplines, including archaeology, biology, geology, cryospheric research, hydrology, atmospheric research, oceanography, and geophysics. Several Russian institutions are involved in this research.

Other stations with research facilities in Svalbard include the University of South Bohemia from the Czech Republic. The institution has a research station and laboratories in Longyearbyen and a field station in the Petunia Bay, which is located together with the Polish station.

We refer to the previous report for a further description of the research sites and installations in Svalbard (Aksnes & Rørstad, 2019).

5.1 Bibliometric indicators

This chapter presents publication indicators for research in Svalbard. We refer to Chapter 2 for a description of the methods applied for identifying the Svalbard publications. The analysis encompasses publications from all countries, although the main focus is on the publications from Norway.

5.1.1 Development over time

Figure 5.1 shows the trend in the total number of articles related to Svalbard from 2013 to 2022. During this period, there has been an overall increase in the number of articles, although the number has decreased from 2020 to 2022. In 2022, the total was 430 articles. As noted previously, the decline from 2021 to 2022 is likely related to the impact of the pandemic.

The figure also shows the proportion of global Arctic polar research related to Svalbard, but it should be noted that some "Svalbard publications" may simultaneously relate to other Arctic areas as well (when data and observations are from multiple locations).[11] In 2013, almost 10 % of all Arctic polar research globally was related to Svalbard. This proportion decreased to 7.7 % in 2022. In other words, the relative position and role of Svalbard in international polar research has declined over this period.

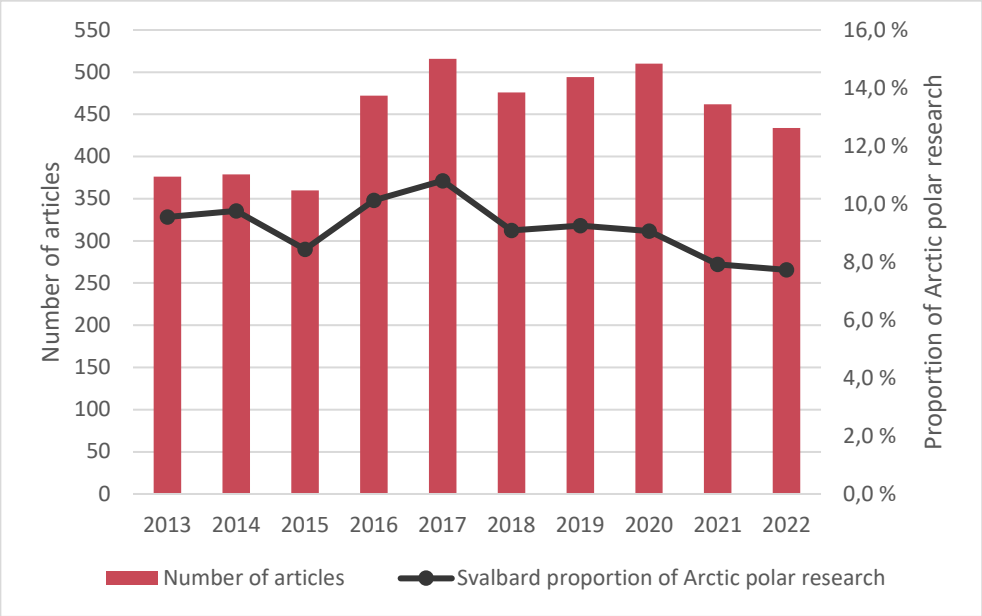

Figure 5.1 Number of Svalbard-articles and Svalbard proportion of Arctic polar research in the world 2013-2022

[11] As an example, this article title illustrates this point: Chlorinated hydrocarbon contaminants and metabolites in polar bears (Ursus maritimus) from Alaska, Canada, East Greenland, and Svalbard.

Norway is by far the largest nation in terms of scientific publications related to Svalbard. Svalbard also represents a major part of Norwegian polar research, with a proportion of 23 % in 2022 measured by publication output.

Figure 5.2 shows the number of articles (fractions) in 2022 for the largest countries in terms of article production. Norway has more than twice as many articles as the second-largest nation, Poland. Following Poland is Russia. Other notable contributors include Germany, the USA, the UK, and China. Norway's central role is further highlighted by the fact that over 40 % of all Svalbard articles have at least one co-author from Norwegian institutions (see Figure 5.3).

Generally, Arctic rim-states are the major contributors to Arctic polar research, in addition to China (cf. Figure 3.4). This pattern does not apply to Svalbard. According to publication output, some Arctic rim-states, notably Canada and Denmark, are hardly or only to a small extent involved in research relating to the archipelago.

Figure 5.2 also shows the relative change in publication numbers by country from 2013 to 2022 (black line). Among the largest Svalbard-publishing nations, Russia has the most significant growth, with a 64 % increase over the 10-year period, indicating a growing research interest or capabilities in Svalbard research. However, as for polar research generally, part of this increase can be attributed to shifting publication patterns, with a greater emphasis on publishing in international rather than national journals. Norway has seen a 7 % increase, and Poland 27 %. Countries like the Czech Republic, South Korea, China, and India are rapidly increasing their contributions to Svalbard-publishing, with each more than doubling their production, though they were very small contributors in 2013. Conversely, some countries, notably Japan, the Netherlands, France, and Sweden, show reductions in their contributions to Svalbard research.

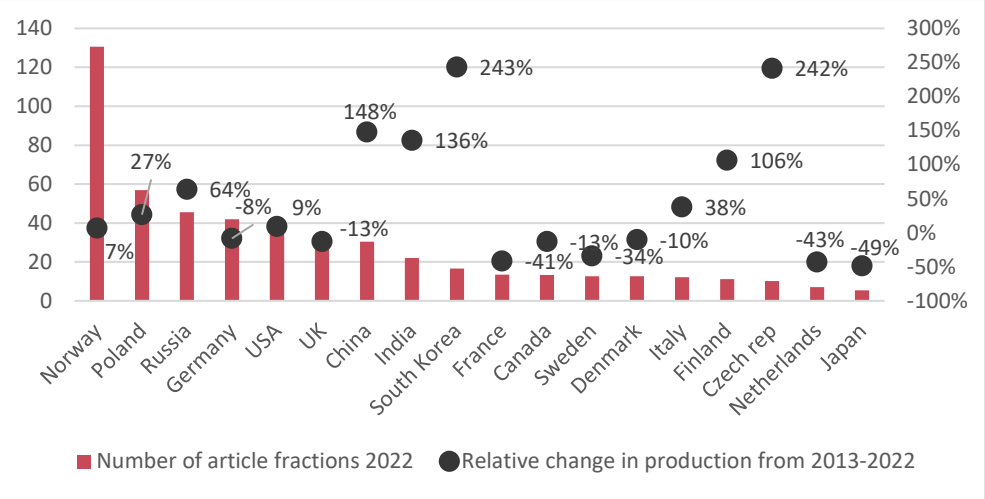

Figure 5.2 Number of Svalbard articles (fractions) 2022 by country and relative change from 2013 to 2022

Figure 5.3 provides further details on the development of Norwegian article production from 2013 to 2022. The Norwegian output increased from approximately 160 fractional articles in 2013 to 180 in 2022. However, similar to Svalbard research overall, there was a decline from 2020 to 2022. As noted above, the relative increase over the entire 10-year period is 7.0 %.

In 2022, 44 % of Svalbard articles had at least one contributor from a Norwegian institution. However, when measured by fractional counts, this proportion was significantly lower at 23 %. Both figures have remained relatively stable throughout the period. In other words, Norway has maintained its relative position in Svalbard research when considering scientific publishing.

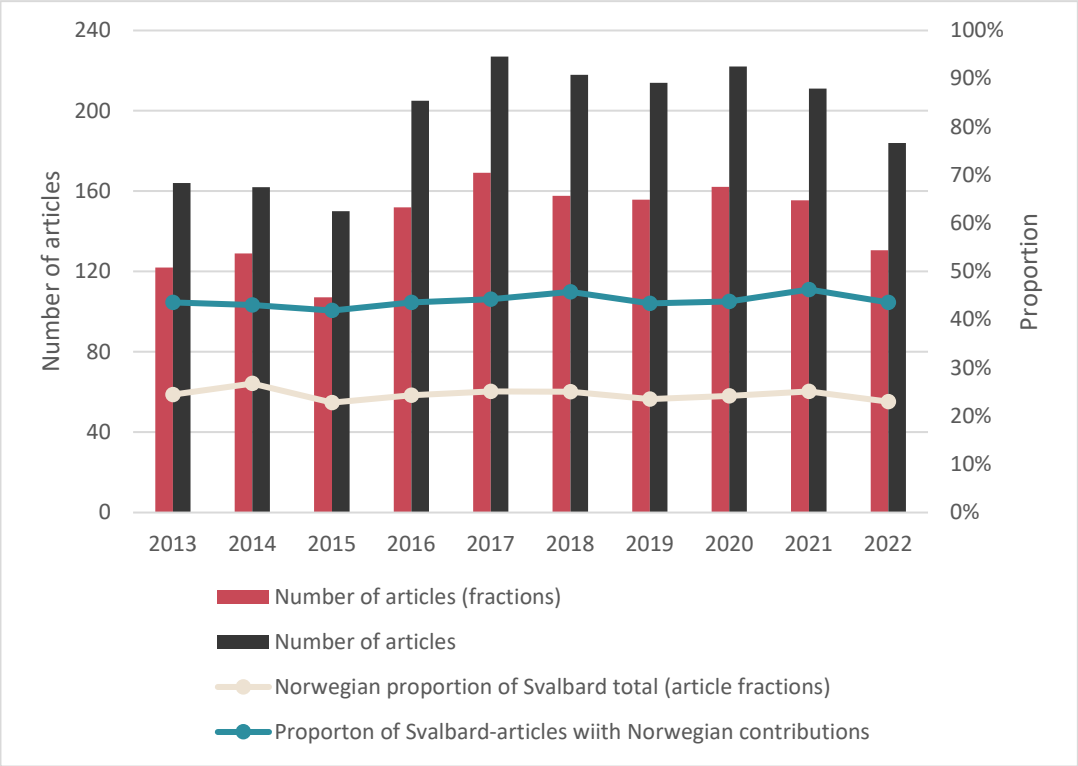

Figure 5.3 Norwegian contribution to Svalbard-articles, number and proportions, 2013-2022

The Svalbard publications are distributed across several disciplines. However, as with polar research in general, geosciences and biosciences dominate. Figure 5.4 provides a breakdown of Svalbard-related publications by subject area for various countries. Overall, the research profiles of the countries do not differ significantly.

Geosciences is the predominant field for Svalbard research across all countries. Contributions in physics and chemistry, engineering, and social sciences and humanities are more varied, with certain countries showing higher relative activity in specific fields.

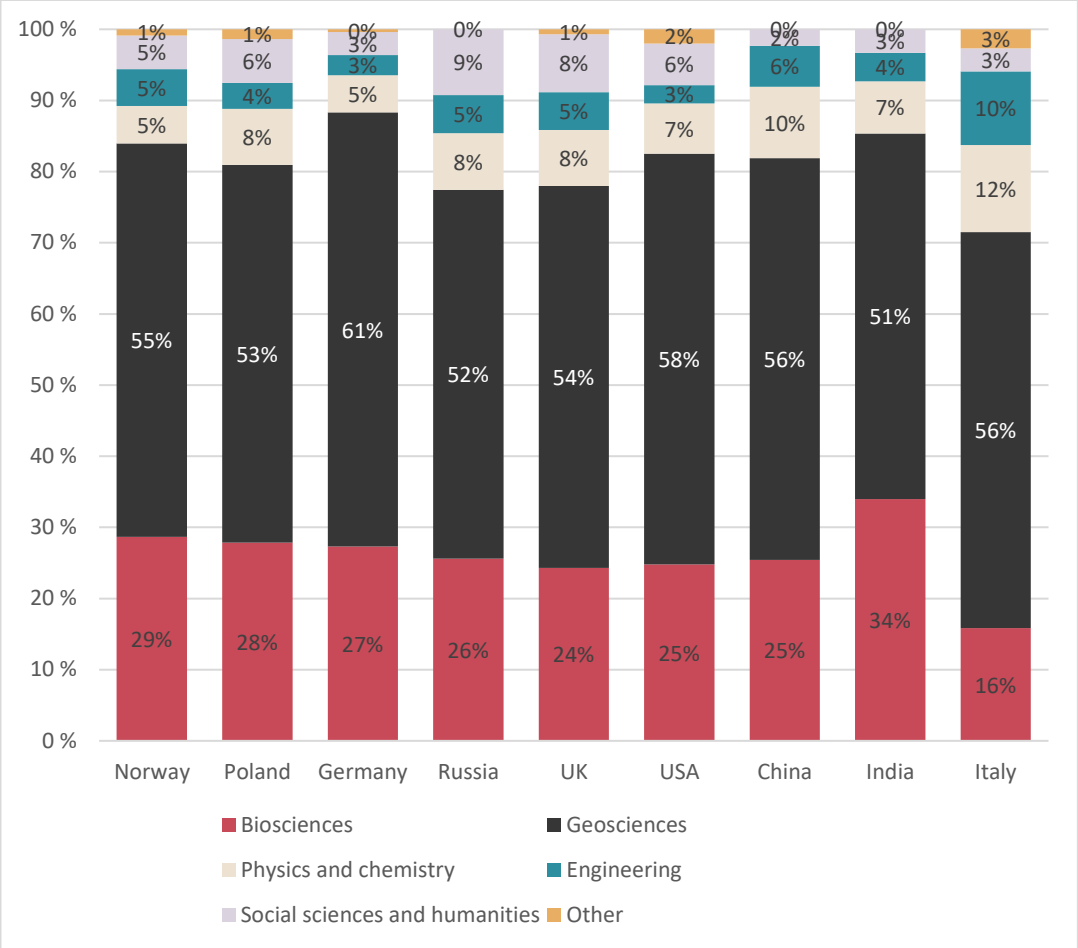

Figure 5.4 Relative distribution by scientific field and country, based on Svalbard articles (fractions) 2019-2022.

5.1.2 Citation impact

In Figure 5.5, we show the relative citation index for the largest nations during the period 2019-2021, i.e., for publications published within this period. The figure also shows the share of highly cited publications for each nation. We note that for several of the countries, the citation index and proportion of highly cited publications are lower than the world average. This pattern is particularly pronounced for the latter indicator. Thus, Svalbard research results less often in publications that achieve significant impact and are frequently cited in subsequent scientific literature.

This pattern has persisted for several years and was further investigated by Aksnes (2017). The study found that research conducted in Svalbard is more frequently published in low-impact journals. Moreover, a large majority of the Svalbard articles were single-location studies, meaning they were based solely on research carried out in specific geographical locations within Svalbard. The

proportion of such papers was much higher in the set of Svalbard publications compared to polar articles in general. Single-location studies were, on average, cited less frequently than studies incorporating data from multiple Arctic locations.

The citation index varies significantly between countries. France and the USA rank highest with a citation index of approximately 120, but these countries are not among the main contributors to Svalbard research. The USA and UK also have a high share of their articles in the top 10 percentile. Russia and India score the lowest in terms of citation frequency, with index values between 45 and 55. With a citation index of 102, Norwegian Svalbard articles were cited approximately in line with the world average. Norway ranks as number seven in terms of relative citation index and number five in terms of highly cited papers among the countries shown in Figure 5.5.

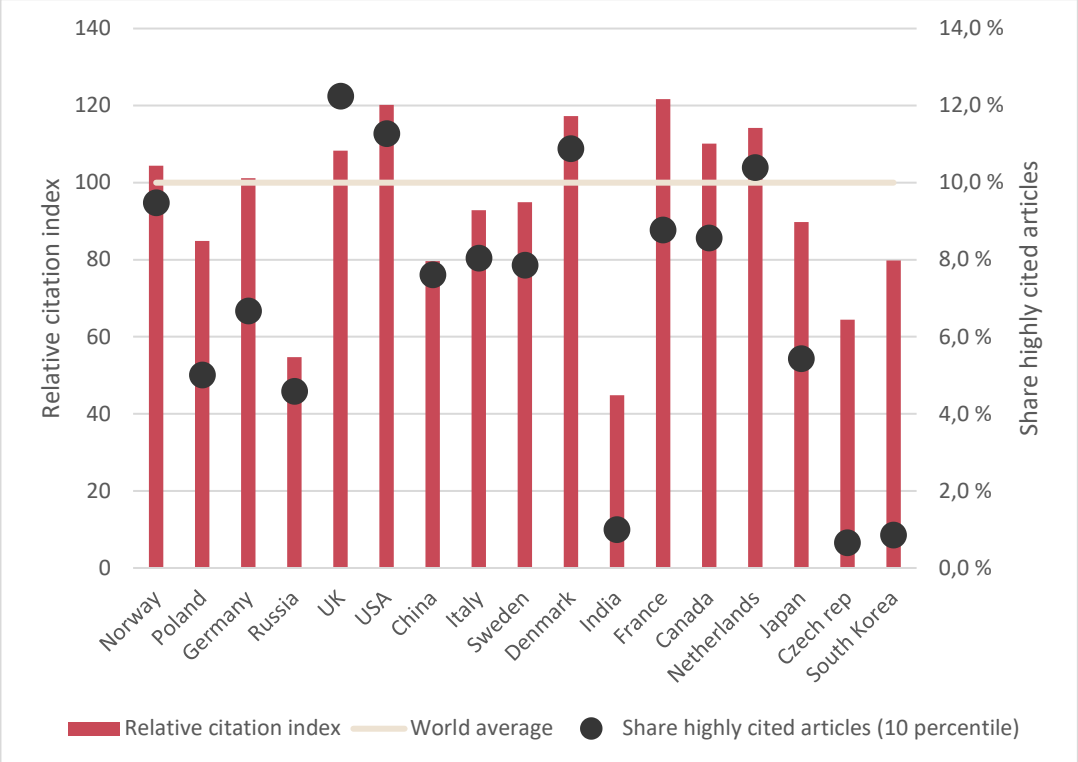

Figure 5.5 Relative citation index per country and proportion of highly cited articles (10 percentile), 2019-2021.

5.1.3 Norwegian contributors

Many Norwegian institutions, institutes, and companies actively participate in Svalbard research. Table 5.1 presents the distribution of Norwegian Svalbard publications for the 4-year period from 2019 to 2022. The highest number of publications originates from UiT, The Arctic University of Norway, in total nearly 160 fractionalised article contributions. This represents approximately 18 % of Norway's output. Moreover, the University Centre in Svalbard (UNIS) and the Norwegian Polar Institute (NPI) are significant contributors, accounting for 14 % and 12 % of the national total, respectively. Together, these three organizations contribute 44 % of Norway's Svalbard research output.

The other three major universities—UiO, UiB, and NTNU—contribute between 5.5 % and 9.2 %, with UiO being the largest among them. Next to the Norwegian Polar Institute, Institute of Marine Research, Norwegian Institute for Nature Research and Akvaplan Niva, are the single largest contributors in the institute sector, with proportion in the range of 2 to 4 %.

Table 5.1 also shows the "Svalbard profile" for each organization, measured as the proportion of their polar research publications related to Svalbard (right column). UNIS stands out with 63 % of its polar research publications focusing on Svalbard, according to the methodology applied in the report. Not surprising, UNIS has a much stronger focus on Svalbard than the other units. In contrast, UiT had 28 % of its polar publications related to Svalbard. Also the NPI has a strong Svalbard focus, with 48 % of its publications dedicated to the archipelago.

Table 5.1 Number of Svalbard articles (fractions) and proportion of national total by institution/institute,* 2019-2022

Institution/institute	Number of articles (fractions)	Proportion of national total	Svalbard profile (proportion of polar research related to Svalbard)
UiT - the Arctic University of Norway	157.9	17.9 %	28.3 %
University Centre in Svalbard	120.3	13.6 %	63.1 %
Norwegian Polar Institute	107.9	12.2 %	48.0 %
University of Oslo	81.4	9.2 %	29.2 %
University of Bergen	58.9	6.7 %	20.2 %
Norwegian University of Science and Tech	48.4	5.5 %	26.3 %
Institute of Marine Research	31.5	3.6 %	16.9 %
Norwegian Institute for Nature Research	22.8	2.6 %	28.8 %
Akvaplan Niva	20.5	2.3 %	36.0 %
Geological Survey of Norway	17.8	2.0 %	43.0 %
Norwegian Institute for Air Research	17.2	2.0 %	42.4 %
Norwegian University of Life Sciences	16.1	1.8 %	26.9 %
Norwegian Meteorological Institute	14.7	1.7 %	23.2 %
NORCE Norwegian Research Centre AS	11.7	1.3 %	14.4 %
SINTEF group	9.8	1.1 %	22.6 %
Other HE-institutions	30.1	3.4 %	11.8 %
Other research institutes	50.9	5.8 %	30.0 %
Business enterprise sector	18.5	2.1 %	16.4 %
Other organisations	46.5	5.3 %	23.6 %
TOTAL	882.8	100.0 %	28.4 %

**) Only the largest units shown separately.*

5.1.4 International collaboration

Many of the Svalbard articles involved international collaboration. Out of the over 1,800 Svalbard articles published during the period 2019-2022, 54 % involved authors affiliated with institutions from more than one country. Note that these figures include all Svalbard publications and are not limited to the Norwegian subset.

In total, 28 % of the Svalbard publications involved collaboration among two different countries (bilateral collaboration), 13 % involved three countries (trilateral collaboration), and 13 % involved four or more countries (multilateral collaboration), see Figure 5.6. These percentages illustrate the extent and diversity of international collaboration in research related to Svalbard, from purely domestic studies to extensive multinational projects involving numerous countries.

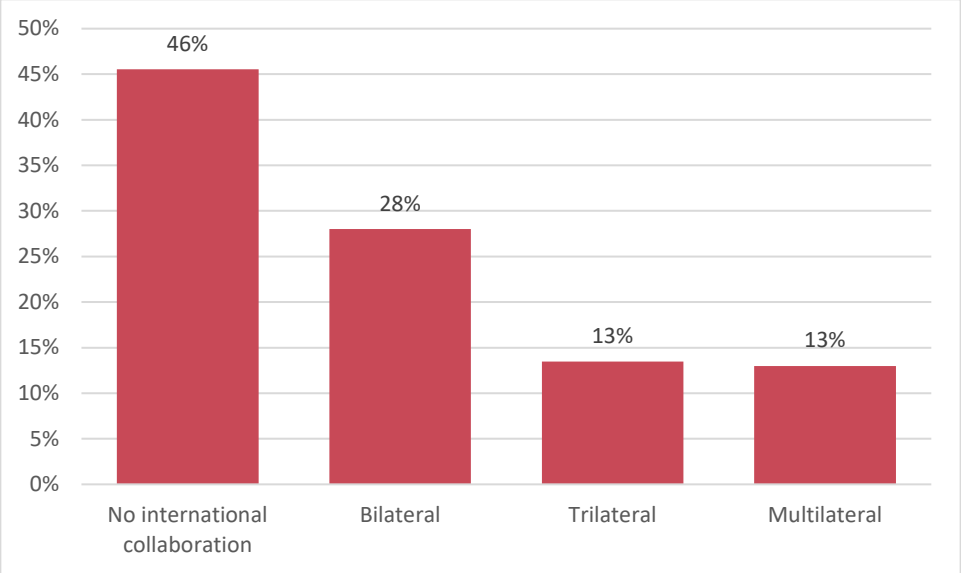

Figure 5.6 Proportion of Svalbard articles by collaboration type, 2019-2022.

However, there is significant variation in the extent to which each country is engaged in international collaboration. Some countries rarely conduct research in Svalbard purely on their own and are almost always involved in international cooperation. This is shown in Figure 5.7. Here we see that 98 % of Denmark's articles involve international collaboration. On the other hand, Russia and India are at the lower end with 35-43 % international collaboration. Norway falls in the middle with 75 %.

As is evident, the proportion of articles with international collaboration appears higher when analyzed at the country level compared to for Svalbard overall. This is due to the calculation procedure where articles with international collaboration are counted multiple times, once for each contributing country, whereas they are counted only once in the total for Svalbard.

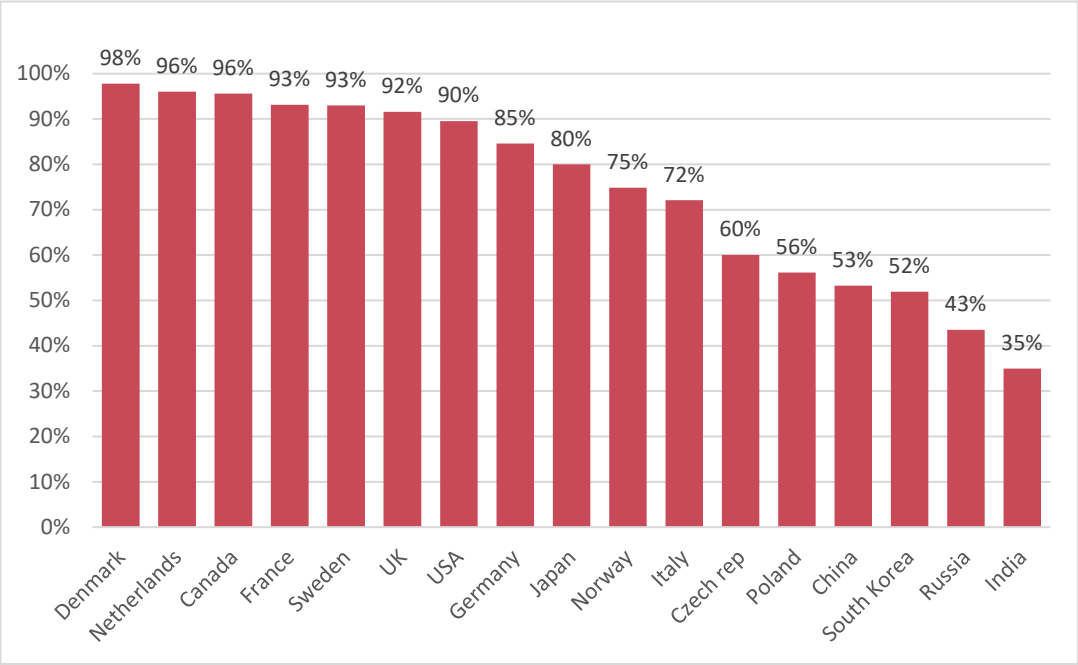

Figure 5.7 Proportion of Svalbard articles with international collaboration, by country 2019-2022.

Figure 5.8 provides a graphical illustration of collaboration patterns in Svalbard research based on the extent of international co-authorship during the period 2019-2022. Only the largest countries in terms of the number of Svalbard articles are separately depicted in the figure. The size of the circles represents the respective countries' size in terms of the number of Svalbard articles, while the width of the lines indicates the extent (number of articles) of collaboration between these countries. The distance between the circles gives an indication of the relative intensity of the collaboration, so that nations with relatively many joint publications are grouped together (clusters).

Norway emerges as the main collaborator for many countries in the figure, which is unsurprising given Norway's status as a leading research nation in Svalbard. In the diagram, we can identify three clusters, each marked by different colours. In one of them, Germany has a central role.

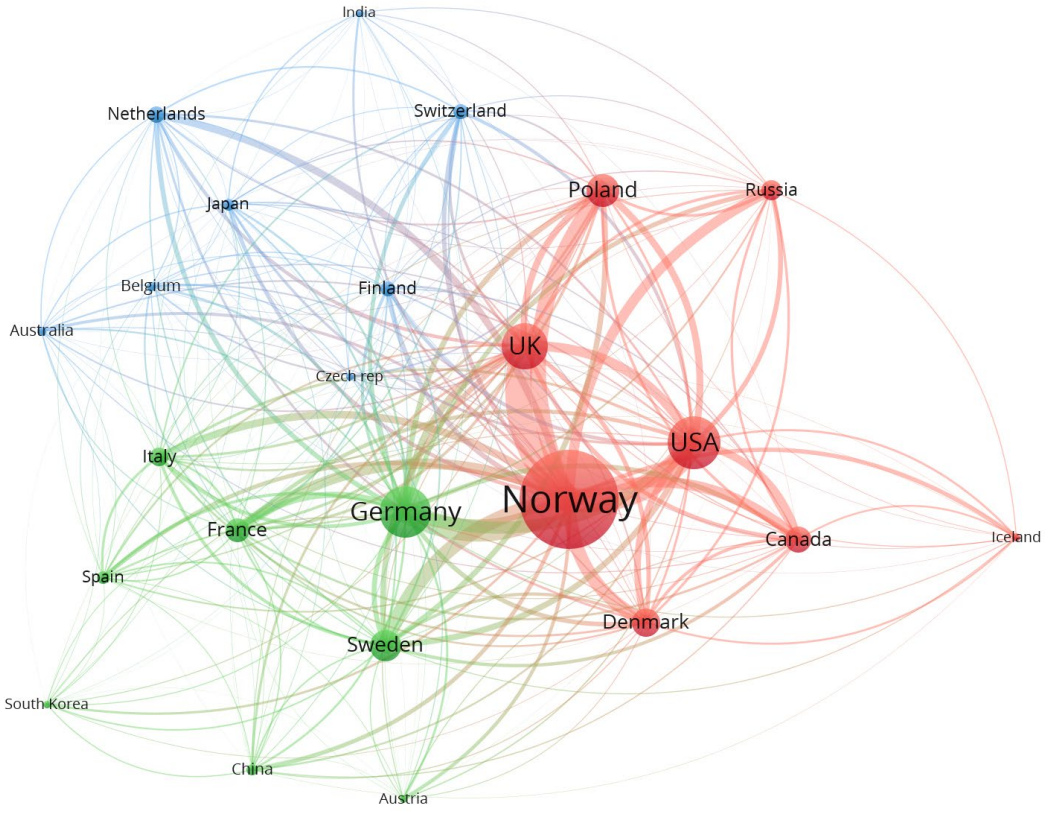

Figure 5.8 Graphical illustration of international research collaboration in Svalbard, 2019-2022.

5.2 Researcher days in Svalbard

In order to provide a quantitative measure of the extent of the different countries' research activities on the archipelago, *researcher days* have been used as an indicator (see Chapter 2). The indicator includes the number of days that researchers spend on Svalbard to conduct research (researcher days in this context also include PhD-students, technicians, research assistants etc., but not master's and bachelor students). By counting how many days researchers from different countries and institutions have spent on the archipelago, we are able to provide an indicator of the extent of the countries' research efforts.

The indicator reflects physical presence on Svalbard, but not the extent of "Svalbard research" carried out at the home institutions in the various countries. For Norway, however, we also have figures for the latter activity, and this is presented in the other report from the mapping (Rørstad, 2024). When presenting figures of researcher days below, it is important to emphasize that these only will include days spent in Svalbard.

5.2.1 Total figures

The survey showed that researchers from Norway and other countries spent a total of 39,900 days for research in Svalbard in 2023. If this figure is converted to full time equivalent work-years, using a proxy where 1 full-time equivalents = 240 days, this corresponds to about 166 work years. These figures thus include the time that researchers spend on Svalbard to perform research, corrected for teaching and other activities that fall outside the research (for example, for UNIS teaching activities are not included).

To a large extent, the research stays will provide data and observations that are further processed at the home institutions. This means that the overall research related to Svalbard would be much higher. For example, fully or semi-automatic measurement stations can provide large amounts of data and thus form the basis for much research, but would contribute to few researcher days. For Norway, we have calculated that the number of researcher days at Svalbard converted to full-time equivalents would amount to about 78 R&D work-years. In contrast the R&D survey showed that to the total research related to Svalbard amounted to 175 work-years (Rørstad, 2024). Thus, only, 45 % of this activity was actually conducted in Svalbard. Similar patterns, perhaps to an even larger extent, would probably apply for other countries as well.

Researchers from Norwegian institutions accounted for 47 % of the researcher days in 2023, while researchers from foreign institutions accounted for the remaining 53 %. The figures include UNIS for Norway, both field activity and presence in the offices in Longyearbyen (corrected for teaching and other activities). If UNIS had been included, which would correspond to a situation where mainly field activity count, the Norwegian share would have dropped to 24 %.

Based on data from the similar surveys previously carried out by NIFU, Figure 5.9 shows the development in number of researcher days for the period 2002-2023 and the Norwegian and foreign proportions of the researcher days. During the period 2002-2014 the number of researcher days increased significantly, this holds for both Norway and other countries. In 2018, we for the first time observed a decrease in the research activity measured by researcher days. By 2023, the activity level was almost identical to the one observed in 2018, indicating that the research activity has stabilized.

The proportion of Norwegian research conducted in Svalbard, as measured by researcher days, has varied over the years. For most of the observed years, it has ranged between 40 % and 50 %. It peaked at 60 % in 2010 before declining to 42 % in 2018. In 2023, it began to rise again, reaching 47 %.

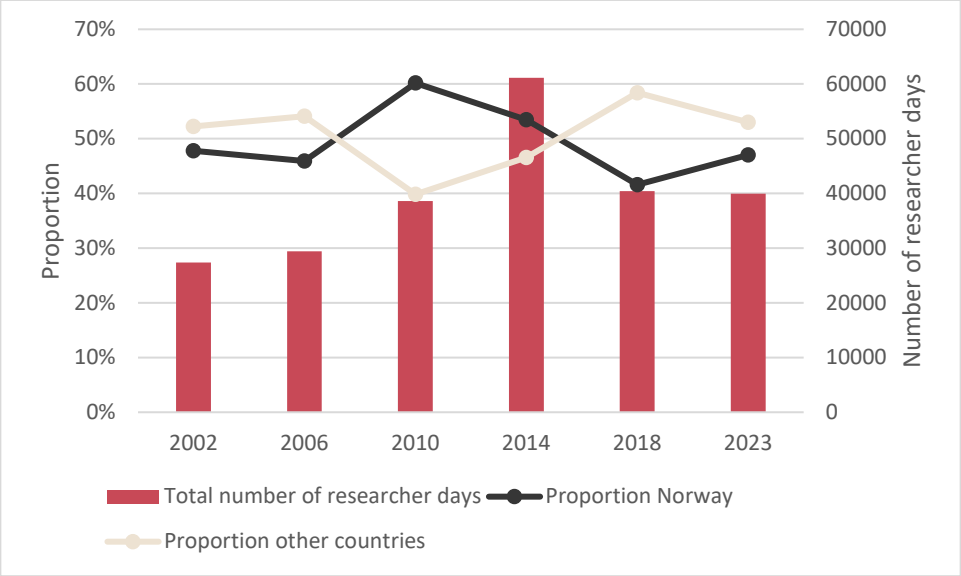

Figure 5.9 Number and proportion of researcher days in Svalbard, 2002-2023, Norway and other countries.

As is evident, the Norwegian share of researcher days in Svalbard is significantly higher than the share of scientific publication output. This is mainly because Norway has a relatively large number of researchers residing in Svalbard, which generates many researcher days, whereas foreign researchers tend to spend shorter periods on the archipelago and process their research material at their home institutions.

For Norway, the presence of UNIS and the Norwegian Polar Institute significantly increases the number of researcher days. Additionally, some of the Norwegian research conducted in Svalbard is related to nature conservation and management, which likely contributes less to scientific journal publications compared to other types of research.

5.2.2 Distribution by country

As described above researchers from Norwegian institutions accounted for 47 % of the researcher days in Svalbard in 2023. The second largest nation was Poland with a proportion of 18 % (Figure 5.10). The Hornsund station accounts for the majority of the researcher days for Poland, but Polish institutions also have research facilities in Petunia Bay and Kaffiøyra. Researchers from German institutions do also have extensive research activities in Svalbard. Germany is the third largest nation with a proportion of 8.1 % of the researcher days in Svalbard in 2023. Much of this activity is related to the French-German AWIPEV facilities in Ny-Ålesund. Russia is also a major contributor with 6.5 %. er cent (Figure 5.8). Most of the Russian research is carried out in Barentsburg. In total, these four

countries accounted for approximately three-fourth of the total research efforts in Svalbard measured by researcher days.

Then follow six countries with proportions in the order of 2-4 per cent: Italy (3.6 %), UK (2.7 %), India (2.6 %), France (2.5 %), and China (1.7 %). In addition, researchers from institutions in a number of other countries have been involved in research activities on the archipelago in 2023. According to our registrations, these other researchers are affiliated with institutions in 19 different countries.

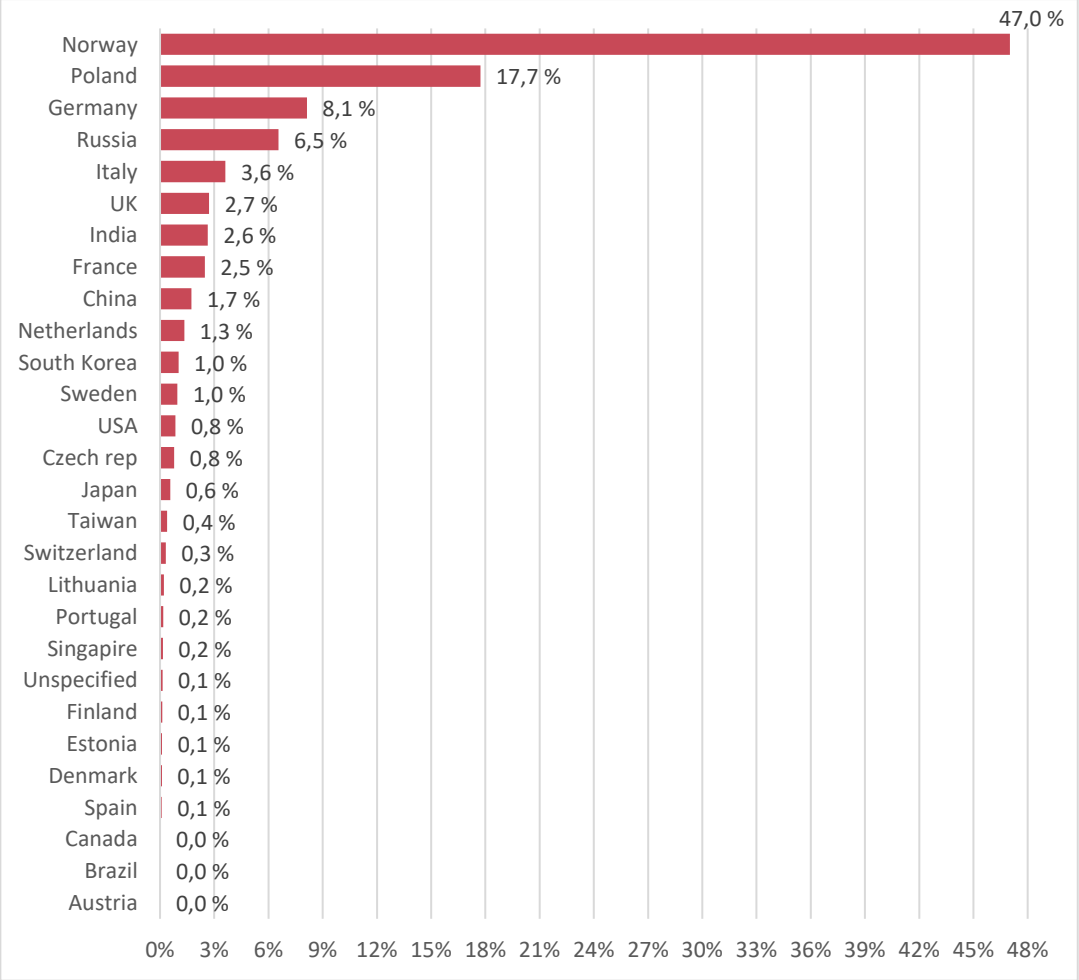

Figure 5.10 Researcher days in Svalbard 2023, relative distribution by country.

Based on data from the previous NIFU mapping, Figure 5.11 shows the development over time for selected countries. As can be seen, there are significant variations in the numbers for some countries. While some have increased their activities, others have reduced them. These variations may result from random annual fluctuations influenced by the implementation of large research programs. Other changes may reflect more long-term trends in activity.

For Poland, the largest country after Norway, there has been a 14 % increase in the number of researcher days over this period. In contrast, there has been a very

large reduction for Russia. It should be noted that the Russian figures for all years are more uncertain due to challenges in obtaining complete statistics. Nevertheless, the data indicates a substantial decrease in Russian scientific activities in Svalbard.

Germany, on the other hand, has an increase in numbers from 2018 to 2023, while for USA there is a significant reduction.

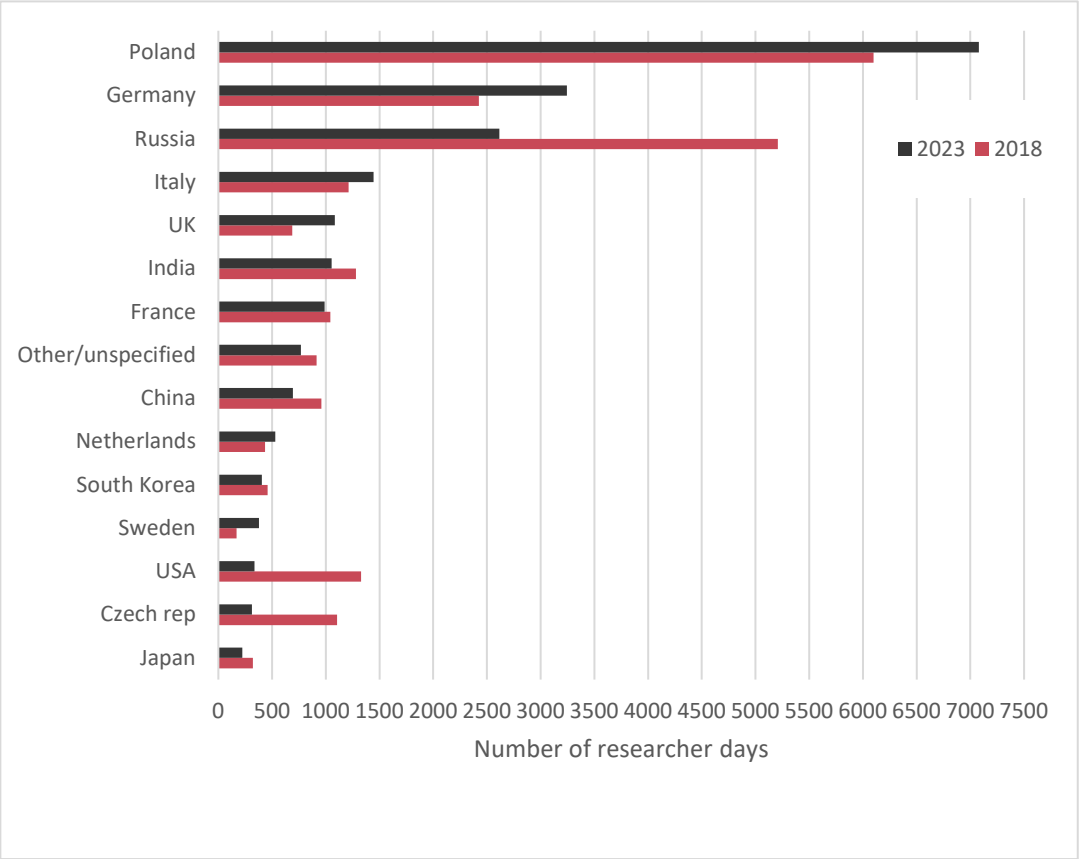

Figure 5.11 Number of researcher days in Svalbard 2018 and 2023 for selected countries

5.2.3 Distribution by geographical area

In the analyses, researcher days have been distributed according to geographical zones in Svalbard, as shown in Figure 5.12. Zone 1, which includes Longyearbyen, Barentsburg, Pyramiden, Isfjorden, and Svea, accounts for the largest number of researcher days, approximately 17,000, or 44 % of the total. An important factor here is the presence of UNIS in Longyearbyen. Excluding UNIS' days in Longyearbyen (highlighted in hatched colour), the number and proportion would drop significantly.

Research activity in Zone 2 (Ny-Ålesund, Kongsfjorden, and adjacent areas) accounted for over 14,600 days, or 37 % of the total activity in Svalbard in 2023. Approximately 6,700 researcher days were spent in Zones 3-5 (17 %), with the Hornsund base being a major contributor.

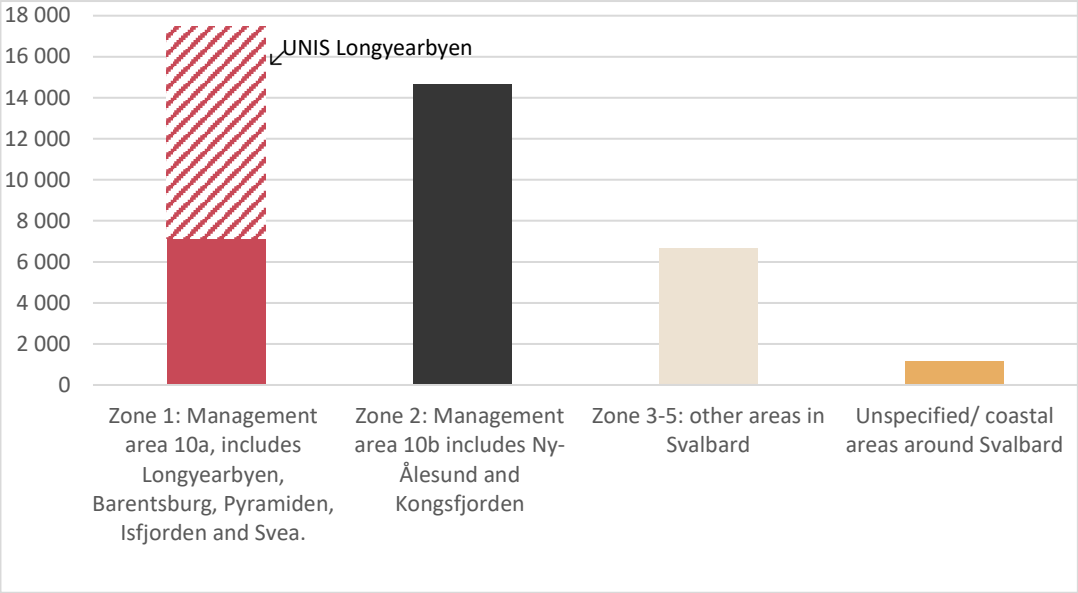

Figure 5.12 Number of researcher days in Svalbard 2023 by geographical zones.*

UNIS in Longyearbyen is shown in hatched colour. See Figure 2.3 for a map of the zones.

In Figure 5.13, we have included the 2018 figures for comparison. Overall, the geographical profile of Svalbard research has remained very stable during this period, with only minor changes in each of the geographical zones.

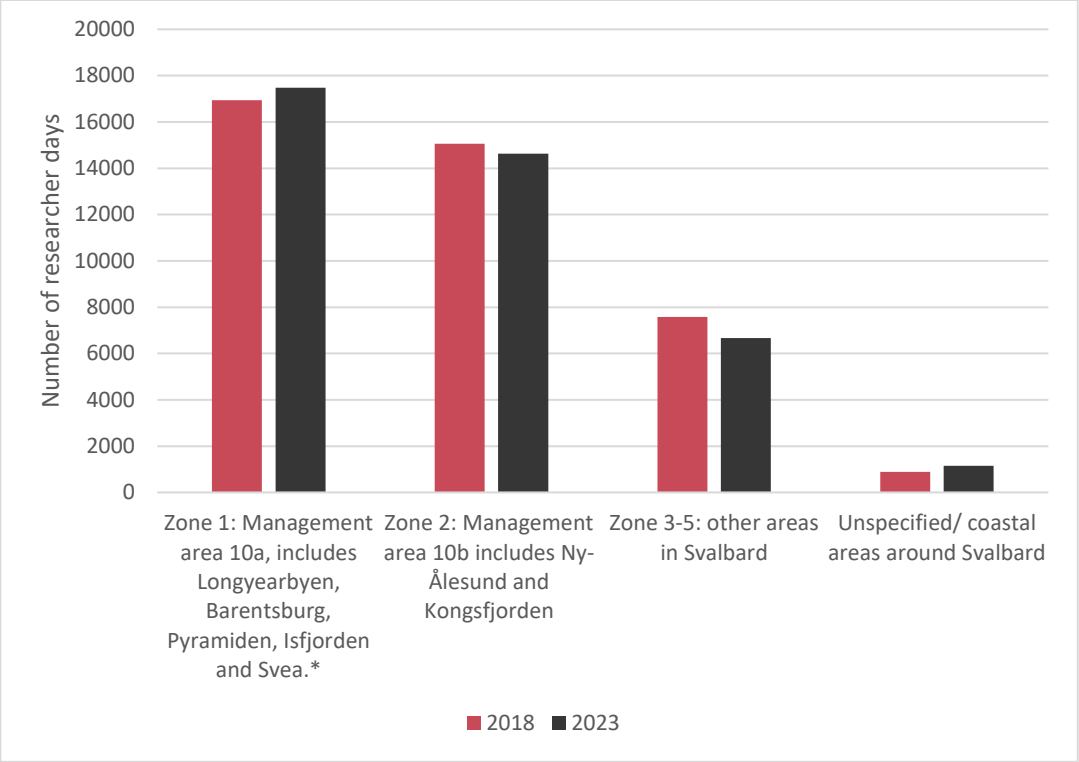

Figure 5.13 Number of researcher days in Svalbard in 2018 and 2023 by geographical zones.*

**) Including UNIS in Longyearbyen. See Figure 2.3 for a map of the zones.*

5.2.4 Ny-Ålesund

In 2023, Kings Bay registered 13,500 researcher days in Ny-Ålesund. Figure 5.14 shows the number of researcher days in Ny-Ålesund, dating all the way back to 1996. The number increased significantly from 2006 to 2009, possibly due to the International Polar Year (IPY). Afterward, the volume dropped somewhat but saw marked growth from 2013 to 2014. From 2014 to 2019, the number stabilized around 13,000 to 15,000 days annually. In 2020, the number dropped significantly to 8,000 due to the pandemic. However, already by 2021, the activity had almost returned to “normal” levels, as reflected in researcher days.

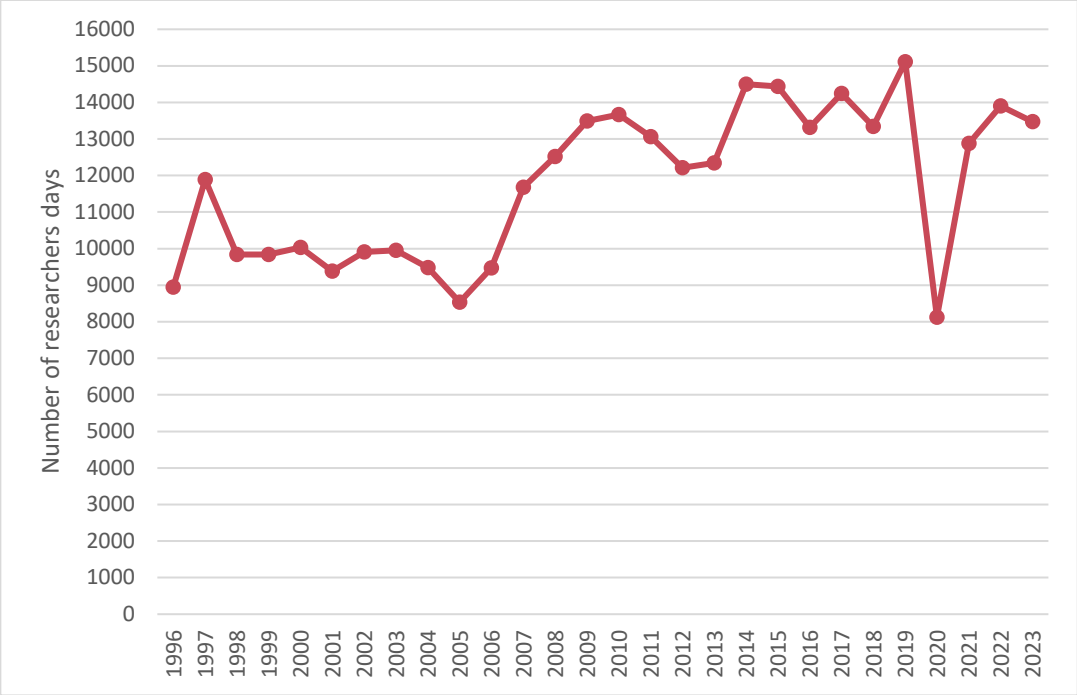

Figure 5.14 Number of researcher days in Ny-Ålesund, 1996-2023.

Source: Kings Bay AS.

Figure 5.15 displays how the research activity in 2018 and 2023 was distributed throughout the year. The number of researcher days is clearly highest in the summer season (June-August), with particularly high numbers in July and August. There is much less activity during the winter when the polar night precludes most research activities.

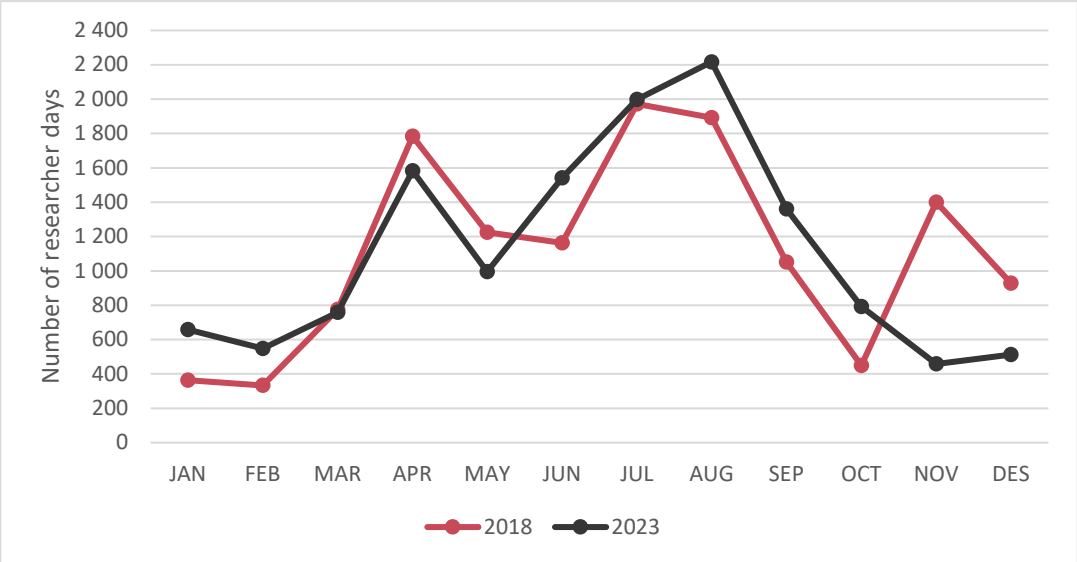

Figure 5.15 Number of researcher days in Ny-Ålesund per month, 2014, 2018 and 2023.

Source: Kings Bay AS.

The Sverdrup building, managed by the Norwegian Polar Institute (NPI), accounted for the highest number of researcher days in Ny-Ålesund, with approximately 4,400 days in 2023 (including those by institutions hosted by NPI), see Figure 5.16. AWIPEV had the next largest activity, with just over 3,300 researcher days. AWIPEV is the joint research infrastructure by the German Alfred Wegener Institute for Polar and Marine Research (AWI) and the French Polar Institute Paul Emile Victor (IPEV). Together, Sverdrup and AWIPEV accounted for 57 % of the total researcher days in Ny-Ålesund.

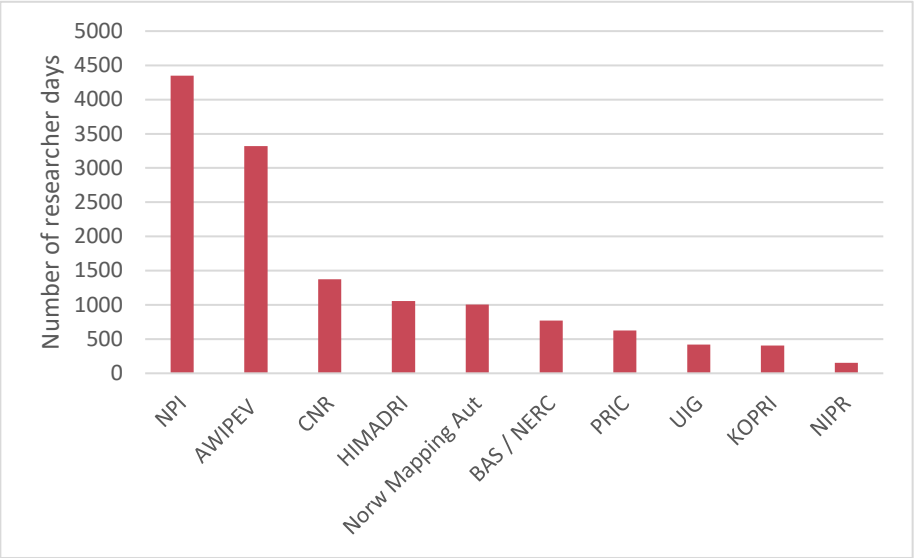

Figure 5.16 Number of researcher days in Ny-Ålesund per institution 2023.

Source: Kings Bay AS. Legends: NPI: Norwegian polar research institute; AWIPEV: The German Alfred Wegener Institute for Polar and Marine Research (AWI) and the French Polar Institute Paul Emile Victor (IPEV); CNT: The National Research Council of Italy; HIMADRI: The Indian National Centre for Polar and Ocean Research; BAS/NERC: British Antarctic Survey/National Environment Research Council; PRIC: The Polar Research Institute of China; UIG: The Arctic Center at the University of Groningen; KOPRI: The Korean Polar Research Institute: NIPR: National Institute for Polar Research, Japan.

References

Aksnes, Dag W. & Kirsten Wille Maus (2003). Norsk polarforskning – forskning på Svalbard. Ressursomfang og vitenskapelig publisering – indikatorer 2002. Norsk institutt for studier av forskning og utdanning (NIFU), Rapport 8/2003.

Aksnes, Dag W. & Kristoffer Rørstad (2008). Norsk polarforskning - forskning på Svalbard. Ressursinnsats og vitenskapelig publisering - indikatorer 2006. NIFU STEP, Rapport 8 / 2008.

Aksnes, Dag W., Kristoffer Rørstad & Trude Røsdal (2012). Norsk polarforskning – forskning på Svalbard. Ressursomfang og vitenskapelig publisering – indikatorer 2010. NIFU, Rapport 3/2012.

Aksnes, Dag W. & Kristoffer Rørstad (2015). Norsk polarforskning – forskning på Svalbard. Ressursomfang og vitenskapelig publisering – indikatorer 2014. NIFU, Rapport 37/2015.

Aksnes, Dag W. (2017). Norwegian Polar Research & Svalbard Research. Publication Analysis. NIFU, Rapport 6/2017.

Aksnes, Dag W. & Kristoffer Rørstad (2019). Norwegian polar research, High North research and research in Svalbard. A mapping survey 2018. NIFU, Rapport 24/2019.

Aksnes, Dag W., Christopher Blöcker, Cristian Colliander & Lena M. Nilsson (2023). Arctic Research Trends: Bibliometrics 2016-2022. Umeå universitet. https://www.diva-portal.org/smash/get/diva2:1787024/FULLTEXT01.pdf

Arlov, Thor B. (1996). Svalbards historie. Aschehoug, Oslo

Dastidar, P.G. (2007. National and institutional productivity and collaboration in Antarctic science: an analysis of 25 years of journal publications (1980-2004). *Polar Research* 26: 175-180.

Ministry of Environment (1993). St.meld. nr. 42 (1992-93). Norsk polarforskning. Miljøverndepartementet, Oslo.

Rørstad, Kristoffer (2024). Norwegian polar research, High North research and research in Svalbard. A mapping survey 2022. Statistics Norway.

Schild, Ingrid (1996). The politics of international collaboration in polar research. PhD dissertation, University of Sussex.

Sivertsen, Gunnar, Ronald Rousseau & Lin Zhang (2019). Measuring scientific contributions with modified fractional counting. Journal of Informetrics, 13 679-694

List of tables

List of figures

Nordisk institutt for studier av
innovasjon, forskning og utdanning

Nordic institute for Studies in
Innovation, Research and Education

www.nifu.no