Patterns and emerging trends in Antarctic and Southern Ocean academic publishing 2016-2024

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Executive Summary

- We examined the papers published on Antarctic and Southern Ocean topics over 2016-2024 using the Scopus database.
- The number of these publications varied substantially over 2016-2024, globally and for individual countries.
- The number of Antarctic and Southern Ocean (ASO) publications peaked in 2021 and fell slightly yearly through 2024.
- Based on 2024 data, China has the highest number of publications (by a fractionalised counting method) in quantity and quality (i.e., those published in top-quartile journals).
- China overtook the US in overall publication numbers in 2022, and in top quartile publication numbers in 2024 (according to fractionalised counting method).
- Canada has a relatively high volume of high-quality publications, potentially supporting its application to become a Consultative Party to the Antarctic Treaty.
- Of the top six countries in overall publications, all except China have declined in publication numbers since 2016, including in top quartile publications.
- ASO publications involve collaboration between countries that is greater than the average rate for all fields and topics.
- Russia, India and China have anomalously low rates of ASO collaboration as captured in publications.
- The US produces the highest number of publications with international co-authorship, but a higher proportion is bilateral than in multiple other countries.
- The top five institutions globally, based on total publications (fractionalised) over 2022-24 are the British Antarctic Survey, the Ministry of Natural Resources (China), the Russian Academy of Sciences, the University of Tasmania (Australia), the Chinese Academy of Sciences, and the Consejo Nacional de Investigaciones Científicas y Técnicas (Argentina).
- The top five institutions globally based on top-quartile publication counts (fractionalised) over 2022-24 are the British Antarctic Survey, the Chinese Academy of Sciences, the University of Tasmania (Australia), the Alfred Wegener Institute (Germany) and the Ocean University of China.
- Field-weighted citation impact for ASO research has dropped from well above world average in 2016 to below world average in 2023, likely due to changes outside and inside ASO research.
- The UK is the country with the highest field-weighted citation impact.

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1. Introduction

This report aims to understand recent trends in scientific research related to the Antarctic and Southern Ocean (ASO) region, using peer-reviewed publications as a proxy for scientific output. At a time when the West Antarctic region is rapidly warming and its ice shelves are destabilising, understanding the Antarctic environment is more critical than ever before. However, such research requires investment, both from states and individual institutions. In many disciplines, this research benefits from collaboration across national borders. Here we report on scientific output, quality, degree of international co-authorship and academic impact (in terms of citation), as a whole and by country, subject area and institution, over nine years from 2016-2024.

Information of this kind is essential for gauging the collective effort humans put into understanding the Antarctic region and can play in political decision-making. The 1959 Antarctic Treaty establishes the promotion of "international cooperation in scientific investigation in Antarctica" as one of its key tenets.[1] Decision-making within Antarctic Treaty meetings is made by consensus between the Consultative Parties,[2] which apply for this status based on carrying out "substantial scientific research" in the region.[3] Application for Consultative status requires the submission of evidence of such an achievement, which can include a list of Antarctic-related publications, many of which are often written in collaboration with other countries.[4] Even when Consultative status has been achieved, scientific output remains the "currency of credibility" for states' presence on the continent and in decision-making forums.[5] Such output also reflects (with some lag) a particular state's investment in the Antarctic and Southern Ocean region. The quantity of peer-reviewed publications is widely accepted as a proxy for output.[6] However, the quality of research is also an important consideration, which we examine here using top-quartile journals as our metric.

Unsurprisingly, several previous bibliometric analyses have examined the output of Antarctic-related research, some focusing on national contexts,[7] disciplines and topics, and others providing more general analyses.[8] Data sources, temporal coverage, thematic parameters, and counting methods vary between these studies. The most recent general analysis focuses on the

[1] *Antarctic Treaty*, Preamble, Article II, Article III, Article IX,
[2] At the time of writing (May 2025), Antarctic Treaty Consultative Parties comprised Argentina, Australia, Belgium, Brazil, Bulgaria, Chile, China, Czechia, Ecuador, Finland, France, Germany, India, Italy, Japan, Republic of Korea, Netherlands, New Zealand, Norway, Peru, Poland, Russian Federation, South Africa, Spain, Sweden, Ukraine, United Kingdom, United States, Uruguay.
[3] *Antarctic Treaty*, Article IX.2
[4] Hughes et al 2024, p.3. As these authors point out, while the original Treaty text suggests that "the establishment of a scientific station or the dispatch of a scientific expedition" as evidence of "substantial scientific research," stations and expeditions are not necessarily prerequisites, as the example The Netherlands shows.
[5] Quilty 1990.
[6] Muntean 2025, p. 9.
[7] E.g. González-Aravena et al 2023; Stefenon et al 2013; Zhang et al 2023; Liu et al 2017.
[8] Ji et al 2014; Jang et al 2020; Wu et al 2022.

two decades up to 2020.[9] Our report includes insight into the period since then and focuses on the direction of contemporary trends.

As we explain in more detail below, our data source (Scopus) is far better at capturing research outputs within the STEM disciplines than others. Humanities, Arts, and Social Sciences (HASS) disciplines that have been active in Antarctic research for decades, such as international law, political science, and tourism studies, as well as recent emerging interest from disciplines such as environmental history, are only patchily reflected in Scopus's journal coverage and hence our report.[10] Coverage of the humanities – a small but growing area within Antarctic research[11] – is even worse than that of the social sciences in Scopus. The creative arts, in which many publications are non-traditional research outputs, are similarly poorly captured. While this limitation is unlikely to significantly impact the findings of this report, given the dominance of STEM in Antarctic and Southern Ocean research, it is essential to understand that the results reported here do not accurately represent the contribution of the HASS disciplines to this field.

2. Data and methodology

2.1 Data sources

Data sources used in this study are Scopus and SciVal, which are commonly employed in bibliometric and research performance analysis. Scopus is a multidisciplinary bibliographic database that indexes peer-reviewed literature, including journals, conference proceedings, and books, across the sciences, social sciences, and humanities. Its coverage includes about 22,000 titles from approximately 5,000 international publishers. Geographically, Scopus aims for global representation, with approximately 20% of its titles published in languages other than English and coverage extending to journals from all regions. Bibliographic records retrieved from Scopus were exported to SciVal for further analysis. SciVal is a web-based analytics platform that utilises Scopus data to generate bibliometric indicators for research evaluation at the levels of individual researchers, institutions, and countries. The bibliographic information and bibliometric indicators retrieved from SciVal and used in this study include Field-Weighted Citation Impact, Source Normalised Impact per Paper (SNIP), and journal classifications as described below.

It is important to note that Scopus has limitations when representing global scholarly activity. Its coverage is biased toward journals from high-income regions, particularly North America and Europe, while journals from Africa, parts of Asia, and lower-income countries are underrepresented.[12] Additionally, Scopus prioritises journal articles and offers limited coverage of books and conference proceedings, affecting the representation of disciplines

[9] Wu et al 2022.

[10] Re Scopus's journal coverage, see Singh 2021. That study reports that just over 88% of Scopus journal publications are in STEM areas, with the rest in HASS (just over 9% in Social Sciences and less than 3% in Humanities and Creative Arts).

[11] Roberts et al 2016.

[12] Maddi et al 2025.

where these publication types are more common. These factors should be considered when interpreting analyses based on Scopus data.

2.2 Definition of the Antarctic

The Antarctic is defined differently depending on the context. Politically, the Antarctic Treaty defines the region as being to the south of sixty degrees south latitude. The Convention on the Conservation of Antarctic Marine Living Resources takes an ecosystem-based approach. It uses different latitude lines varying from forty-five to sixty degrees south. The Antarctic Polar Front, where cold currents meet warmer northern waters, makes sense as a biophysical boundary, but is an undulating line on a map and is not necessarily reflected in bibliometric classifications. The boundaries of the Southern Ocean (SO) itself are contested, with the International Hydrographic Organisation setting its northerly limit at sixty degrees south,[13] even while some national traditions consider this ocean to reach the southern coastlines of the circumpolar continents.[14] Our approach here is to be as inclusive as possible, incorporating research on the Antarctic continent and islands, the SO, and sub-Antarctic islands.

To reflect this breadth, while avoiding false positives to the greatest extent, we adopted the following search team:

Topic Search (TS) = ((antarc* NOT (candida OR ‘except antarctica’ OR ‘not antarctica’ OR ‘other than Antarctica’)) OR ‘transantarctic’ OR ‘ross sea’ OR ‘amundsen sea’ OR ‘weddell sea’ OR ‘southern ocean’)

This was the search term recommended in a study of polar bibliometrics and subsequently deployed in an analysis of the Antarctic Treaty parties' attainment of consultative status.[15]

2.3 Methodology

Counting methods

Counting methods are essential in bibliometrics, as most publications have multiple authors. The main question is how to credit individuals, institutions, or countries. Two common approaches are full counting (i.e., full and equal credit for publication to all contributors) and fractional counting (i.e., the credit for each author is divided by the number of authors).[16] Fractional counting ensures that the total adds up to the actual number of publications.

This report primarily uses fractional counting. However, some figures also present full counts for complementary purposes. For articles involving multiple institutions or countries, fractional credit is assigned based on the number of participating entities.[17] Analyses of international collaboration are based on full counting. This approach is consistent with standard practices such as those used in the National Science Foundation’s (NSF’s) Science and Engineering

[13] International Hydrographic Organization 2023.
[14] McCann 2018.
[15] Gray 2019; Hughes et al 2024.
[16] Gauffriau 2017.
[17] When a publication has multiple country affiliations, each country receives a fractional contribution equal to one divided by the number of countries. The same method applies to institutions: each institution receives one divided by the total number of affiliated institutions.

Indicators report.[18] A limitation of the Scopus database is that a non-duplicative list of institutions or countries is reported for each publication rather than the institution or country for each author. Hence, the fractionalised counting reported here would differ in many cases from a counting based on individual author affiliations or countries.

Institutions

Figures for individual institutions are based on Scopus Affiliation Profiles created by standardising author affiliation data. Over 20,000 institutions are defined in the database. While Scopus's disambiguation system is precise in assigning publications to institutions, it may not capture all publications from an institution. Therefore, institutional-level statistics should be interpreted with this limitation in mind.[19]

Field Classification

This study uses two field classification systems: the Australian and New Zealand Standard Research Classification (ANZSRC) and the All Science Journal Classification (ASJC). The ASJC system is more fine-grained and has more subject categories than ANZSRC, which has 27 top-level fields. Elsevier experts use ASJC classifications based on a journal's aims, scope, and published content.

2.4 The dataset

Scopus was searched using the above query, targeting document titles, abstracts, or keywords. The search was limited to publication years 2016 to 2024 2024 and the following publication types: Article, Book, Chapter, Conference Paper, Letter, Note, and Review. The search resulted in 29,831 documents, of which 91% were journal publications, 5% were conference papers, and 4% were books or book chapters.

We tested the precision of the query by having three expert raters evaluate the relevance of 300 randomly selected documents. The raters were instructed to classify each document into one of four categories: 'Not Relevant', 'Relevant Term'[20], 'Partly Relevant Subject', and 'Relevant Subject'. These categories range from documents unrelated to Antarctica to those where Antarctica is the main subject. The raters' judgments showed some variation, particularly in the proportion of documents classified as relevant under stricter versus more inclusive criteria. On average, 3.9% of documents were judged Not Relevant, 20.7% as Relevant Term, 26.8% as Partly Relevant Subject, and 48.7% as Relevant Subject. Fleiss' Kappa statistic was used to assess inter-rater reliability across the four categories, resulting in a value of 0.638, which indicates substantial agreement among the raters. A majority principle was used to summarise the results: the judgment of at least two raters determined a document's classification. This approach yielded a precision of 97% (±1%).

[18] National Science Board, National Science Foundation 2021.
[19] Donner et al 2020.
[20] 'Relevant term' meant that the term Antarctic* or Southern Ocean was used positively and correctly but the article itself was not relevant. For example, an abstract might have a passing reference to the Southern Ocean but is focussed on Africa.

The dataset included publications of the following types in the analyses: articles, reviews, conference papers, books, and book chapters. The selection method follows a similar report on Arctic research.[21]

2.5 Analyses and indicators

The Field-Weighted Citation Impact

The Field-Weighted Citation Impact (FWCI) in SciVal shows how an entity's citations compare to the global average for similar publications (same year, type, and discipline). A score of 1.0 equals the world average; above 1.0 means higher-than-average impact, below 1.0 means lower. For example, 1.57 indicates 57% more citations than average. Where we list them, FWCI scores for countries and institutions are given after averaging using fractional counting based on the number of affiliated entities.

International Collaboration

International Collaboration refers to articles co-authored by researchers affiliated with institutions in at least two countries.

Source Normalised Impact per Paper

Source Normalised Impact per Paper (SNIP) is a field-normalised metric that measures a journal's citation impact by comparing the citations its articles receive to the expected citation rates in its subject field. SNIP is used in one of our analyses to identify publications in Q1 journals—those in the top 25th percentile by SNIP value. These journals typically represent the most influential and high-impact journals in their fields.

[21] Aksnes et al 2023.

3. Analyses of Antarctic research

3.1 Publication output: total and by country

The total annual publications identified in our search are shown in Figure 3.1.1 by year. This shows a steady rate of publication across all nations over 2016-2018, followed by an increase until 2021, followed by a gradual but monotonic decline to 2024. The peak in publications in 2021 may reflect the near absence of Antarctic fieldwork during COVID, with researchers' time being used to publish instead. Over this period, Antarctic publications fell from 0.11% of all publications in all fields to 0.09%, suggesting that Antarctic research is growing more slowly than all research fields on average.

Figure 3.1.1. Number of Antarctic publications by year.

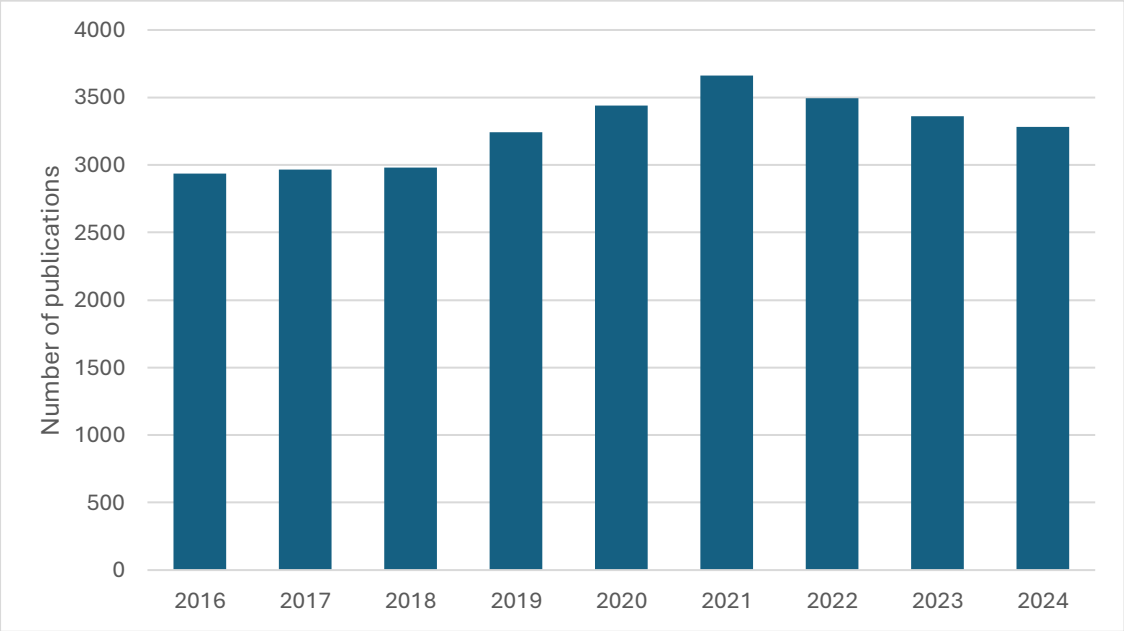


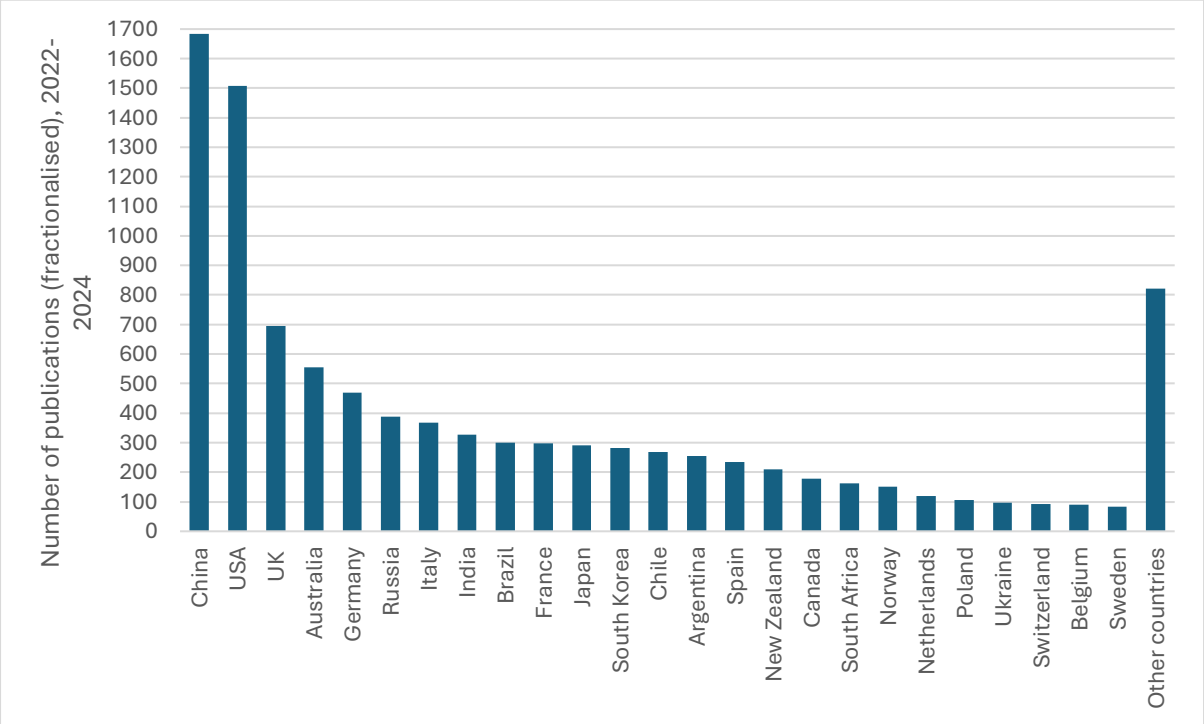
Figure 3.1.2 shows the fractional national contribution to publications in recent years (2022-2024). This suggests that China-based researchers are now the most prolific Antarctic publishers (16.8% of total publications), ahead of those in the US (15%). At a much lower volume, the next nations are the UK (6.9%), Australia (5.5%), Germany (4.7%), Russia (3.9%) and Italy (3.3%), followed by a long tail of various nations with contributions 3.3% down to 0.8%, with cumulative publications from other countries (including all non-Consultative Parties and non-signatory nations) making an important contribution to the total. More than 100 countries contribute to the 'Other countries' total, notably including Denmark (75 publications) and Turkey (65); both are Antarctic Treaty signatories.

Notably, all the top 25 countries except Canada are Consultative Parties (decision-making nations) to the Antarctic Treaty. Canada has tried repeatedly to apply for Consultative status based on its scientific contributions. These attempts have been unsuccessful, even though Canada's output, as judged by publications in Scopus, is higher than that of many existing

Consultative parties. This apparent shifting of the goalposts for Consultative status in recent years reinforces previously published findings.[22]

Compared with previous analyses of Antarctic literature, the most significant change in our publication dataset is in China-based publications. Previous general bibliometric analyses of Antarctic research found the US to have the highest overall output. The most recent study of which we are aware, which examines the period 2000-2020, has the US leading, followed by the UK, Australia, Germany and France, with China in seventh place.[23] Our findings also show that the US, UK, Australia, and Germany are in the top five countries and the same order as that earlier study, but with China now in first, rather than seventh, place.

Figure 3.1.2. Number of Antarctic publications (fractionalised) by country, total 2022-2024. The 25 nations with the largest number of publications are listed.



Focusing on the six leading Antarctic countries by fractionalised publication volume highlights substantial trends over the study period that reflect the changes in highest output in the recent three-year period described above. Figure 3.1.3 shows the fractionalised publications by year with a clear decline in US publications over the total period, aside from the 2020-2021 COVID bump. This represents an approximately 20% decline in research output over the period. By contrast, China's fractionalised publications have increased dramatically since 2017, nearly tripling by 2024 to overtake the US as the most prolific publisher of papers in 2022.[24] The other four leading nations show an overall decrease, with a ~30% monotonic decline evident for

[22] Hughes et al 2024.
[23] Wu et al 2022.
[24] The strong growth in China's scientific output is a general trend and not unique to Antarctic research. In 2016, China surpassed the USA to become the world's leading producer of scientific publications across all fields (Tollefson 2018). In Antarctic research, however, this shift occurred later when measured by fractional publication counts (see Figure 3.1.3a).

Australia since a 2019 peak. Russia had a notable increase in publications 2020-2023 before a noteworthy decline in 2024.

Exploring the trends regarding full-counting publications, Figure 3.1.3b shows similar broad patterns to Figure 3.1.3a but with shifts of countries relative to one another. In this analysis, France replaces Russia, but the other top six countries are unchanged. The dramatic rise in full-counting publications from China has not yet seen its output surpass that of the US, despite the latter's clear decline in total publication count. Regarding full-counting publications, Australia and Germany are much closer to one another than is observed in the fractionalised data (Figure 3.1.3a). Post-COVID declines are mainly evident for the US, Australia, and Germany, while the UK and France have largely maintained their previous total publication rate. Russia's publication output dropped by nearly 50% from 2023 to 2024, possibly reflecting the impact of international sanctions and decreased funding for research[OBJ]

Figure 3.1.3a. Number of Antarctic publications (fractionalised) by year for the largest countries in terms of publication output, 2016-2024

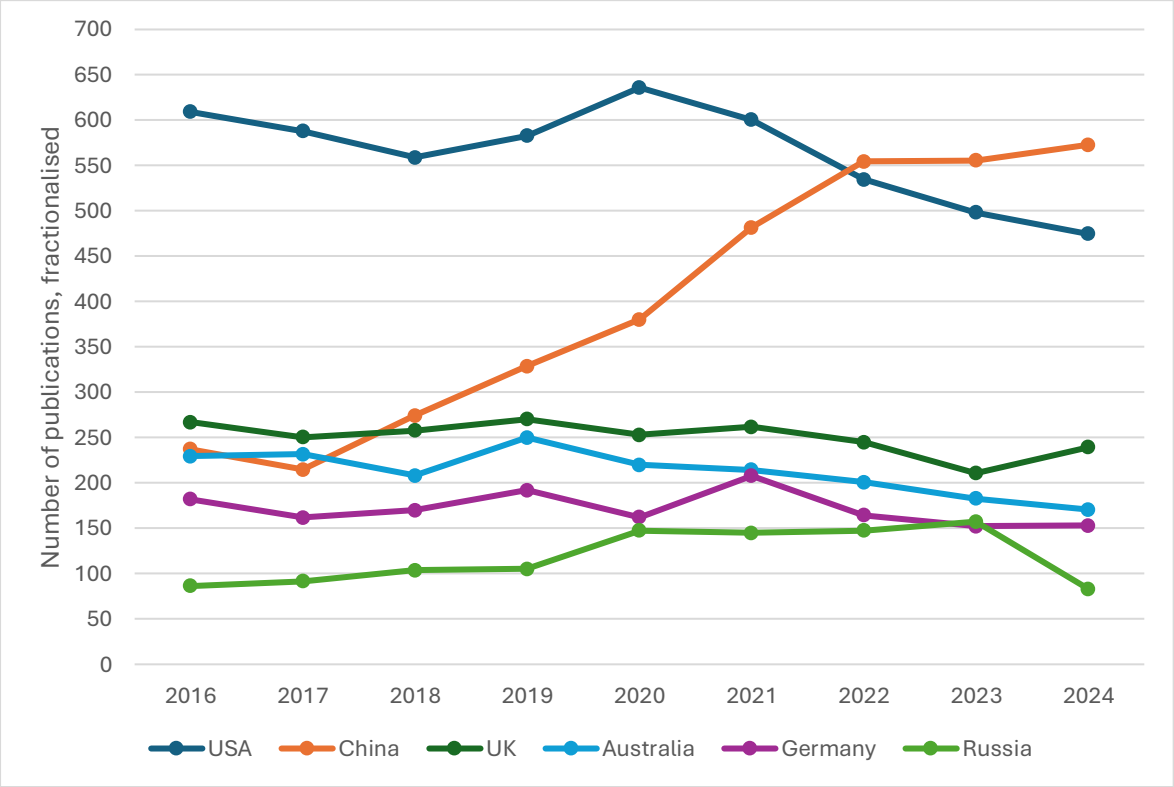
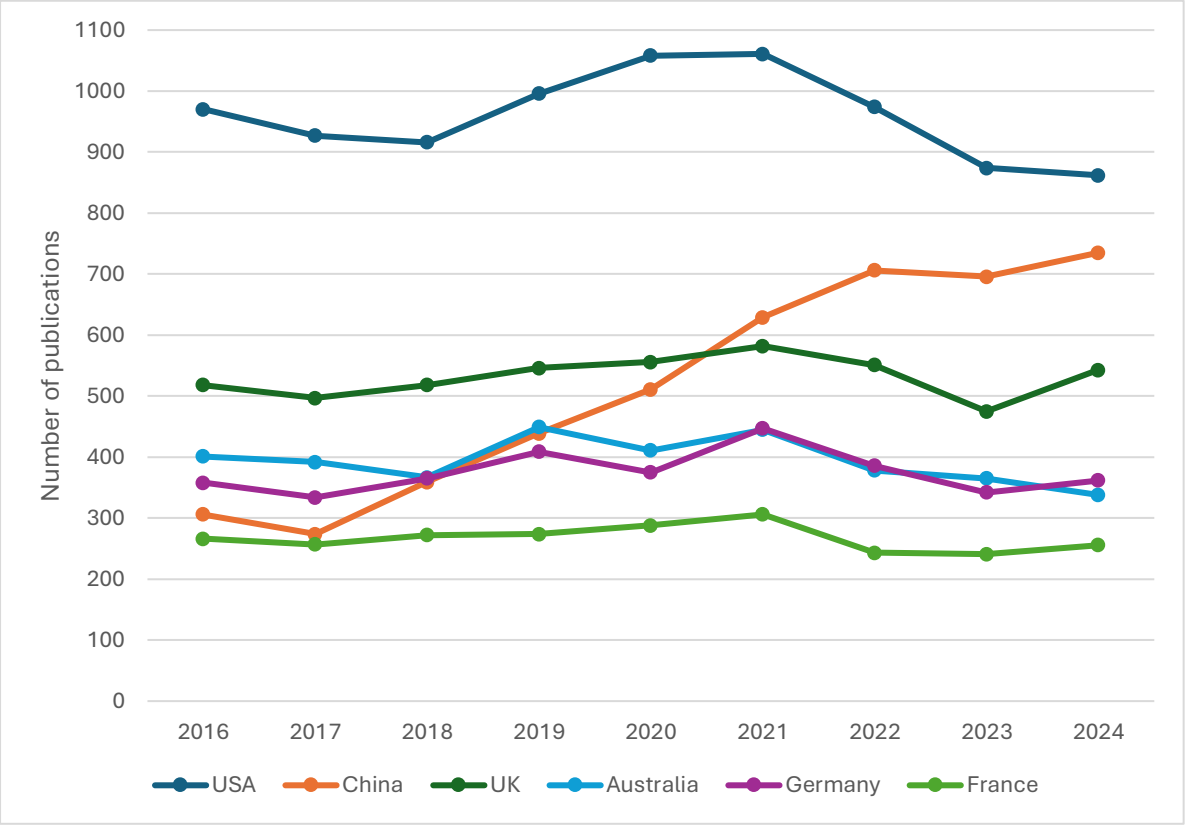


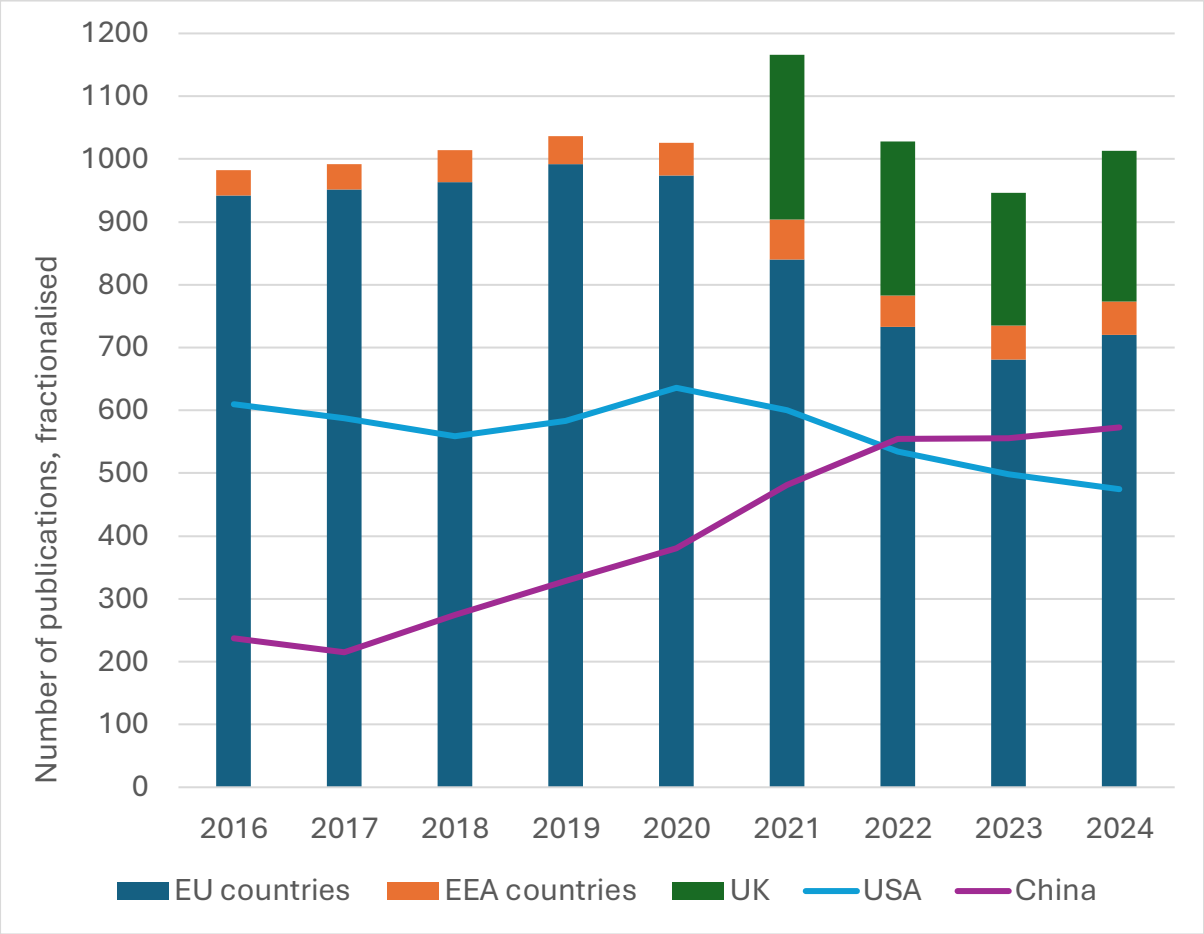
Figure 3.1.3b. Number of Antarctic publications (full counting) by year for the six largest countries in terms of (full count) publication output, 2016-2024. Note that different countries are listed from those in Figure 3.1.3a.



Given the high degree of cooperation in Europe in Antarctic research, we also show the results of grouping European countries in Figure 3.1.4. The EU/EEA produces more publications than the USA or China, which is maintained after Brexit.

Comparison of full-counting and fractionalised publications suggests that some countries are more collaborative, and the collaboration rates change over time. We return to this in Section 3.5.

Figure 3.1.4. Annual fractionalised publications by European nations over time. European Union (EU) and European Economic Area (EEA) country groupings are shown. UK publications are listed separately after Brexit. Time series of publications from the US and China are shown for comparison.



3.2 Publication output: by quartile, total and by country

Not all publication outlets are of equal quality, and to quantify this, we next explore the distribution of journal publications based only on the ranking (SNIP) quartile of the journal. Figure 3.2.1 shows that most journal publications in Antarctic and Southern Ocean research are published in first quartile (Q1) journals and relatively few are published in journals in the lower two quartiles. Antarctic research tends to be published in high-impact journals. In total, 52% of the publications in 2022-2024 appeared in Q1 journals. This compares to the average in all fields combined of 25%, suggesting that publications in this field are published in higher-than-average quality journals across all countries.

However, there is substantial variation by country regarding Q1 publication rates, as shown in Figure 3.2.2. Of the leading six nations, the US, UK, Australia and Germany publish on average approximately 65% of their publications in Q1 journals over 2022-2024. China has a lower rate of publication in Q1 journals, being 51%. The leading countries in Q1 publication rates are Switzerland and Finland, with more than 75% of their relatively small number of publications in Q1 journals. Meanwhile, Russia has the lowest rate of Q1 publications, at 14%, with Brazil, Argentina, India and Czechia (Czech Republic) also notably lower than average. We note that

non-English journals often have lower impact factors, and hence, lower Q1 ratios for a country may result from choices to publish in native-language journals. Again, Canada's position in thirteenth place is significant, as it suggests that this nation is producing more top-quartile Antarctic-related research than most of the Consultative Parties.

Figure 3.2.1. Proportion of Antarctic publications 2022-2024 by SNIP quartile categories.

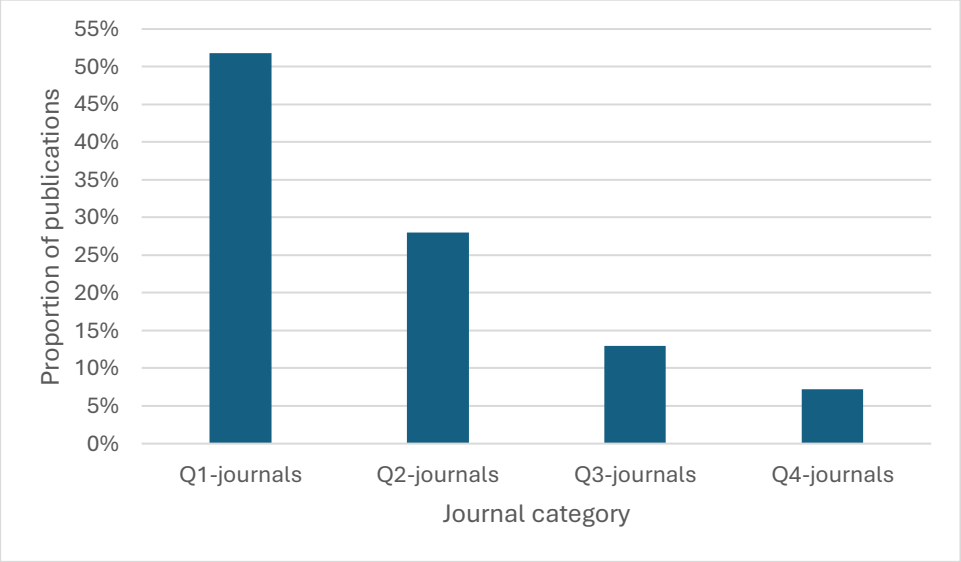
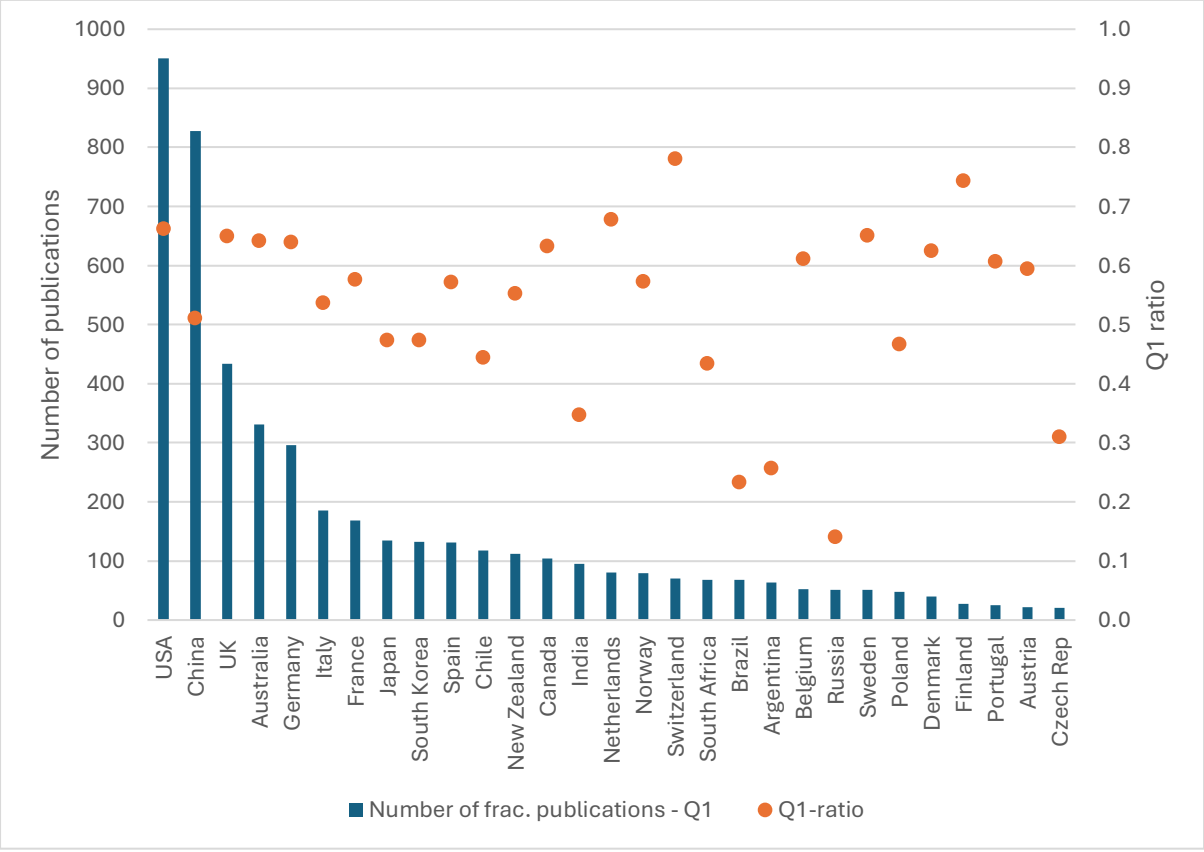
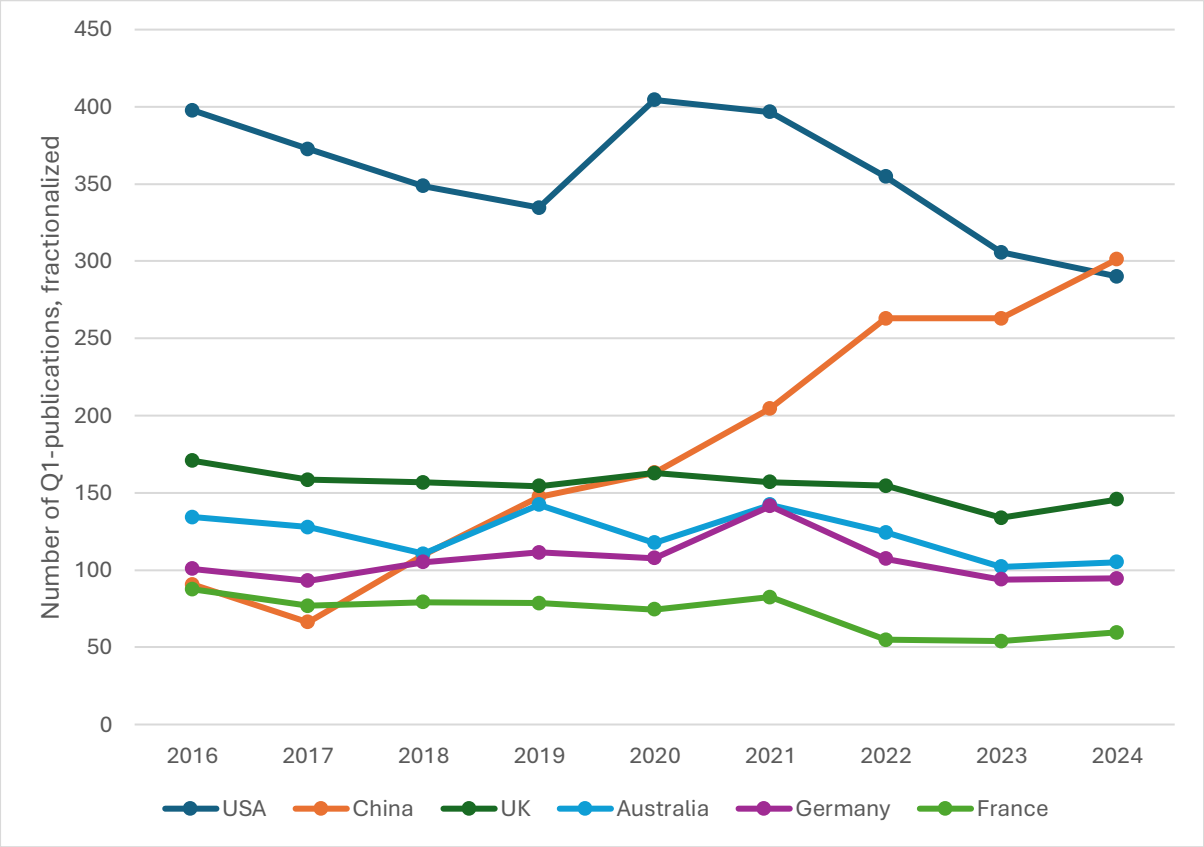


Figure 3.2.2. Number of Antarctic top quartile (Q1) publications by country 2022-2024, fractionalised (left axis) and proportion (ratio) of top quartile publications (right axis).



Trends are also evident in the publication rate in Q1 journals, as shown for the most prolific six nations in Figure 3.2.3. The ordering and trends are broadly similar to those for all publication types (Figure 3.1.3a). As is the case for all publications, strong declines have been evident in US Q1 publications (27% overall reduction) and those of Germany, France, and Australia since 2021 (50%, 39% and 35%, respectively).

Figure 3.2.3. Number of Antarctic top-quartile publications, Q1 (fractionalised) by year for the largest countries in terms of publication output, 2016-2024



3.3 Publication output by subject area

Separating the publications by subject area suggests that Antarctic and Southern Ocean research is dominated by science, as shown in Figure 3.3.1. This is unsurprising and reflects the specific mention of scientific research in the Antarctic Treaty. However, it is essential to note that our dataset is biased away from HASS subjects. Of the sciences, the dominant subject area is Earth Sciences, with almost one-third of the total publications, which aligns with the earlier study of publications over 2000-2020.[25] Approximately 20% of publications are in biological sciences. Multidisciplinary sciences will include some of the most high-profile publications, such as those published in the leading journals *Nature* and *Science*. Still, this category is not restricted to such journals. No other subject area contributes more than 10% of total publications. Of the HASS subjects, 'History', 'Heritage', and 'Archaeology' are the most prominent in our database, followed by Human Society.

[25] Wu et al 2022.

However, the database's definition of ‘Earth Sciences’ is broad and includes, e.g., oceanography, atmospheric science, glaciology, and solid earth science. In contrast, ‘Biological Sciences’ include ecology, animal behaviour, and marine biology. Figure 3.3.2 shows a more detailed characterisation of the sciences, revealing a broad spread of topics led by Oceanography, Earth and Planetary Sciences, and Evolution, Behaviour, and Systematics.

Figure 3.3.1. Proportion of total Antarctic publication output by discipline/field (ANZSRC categories), total 2022-2024

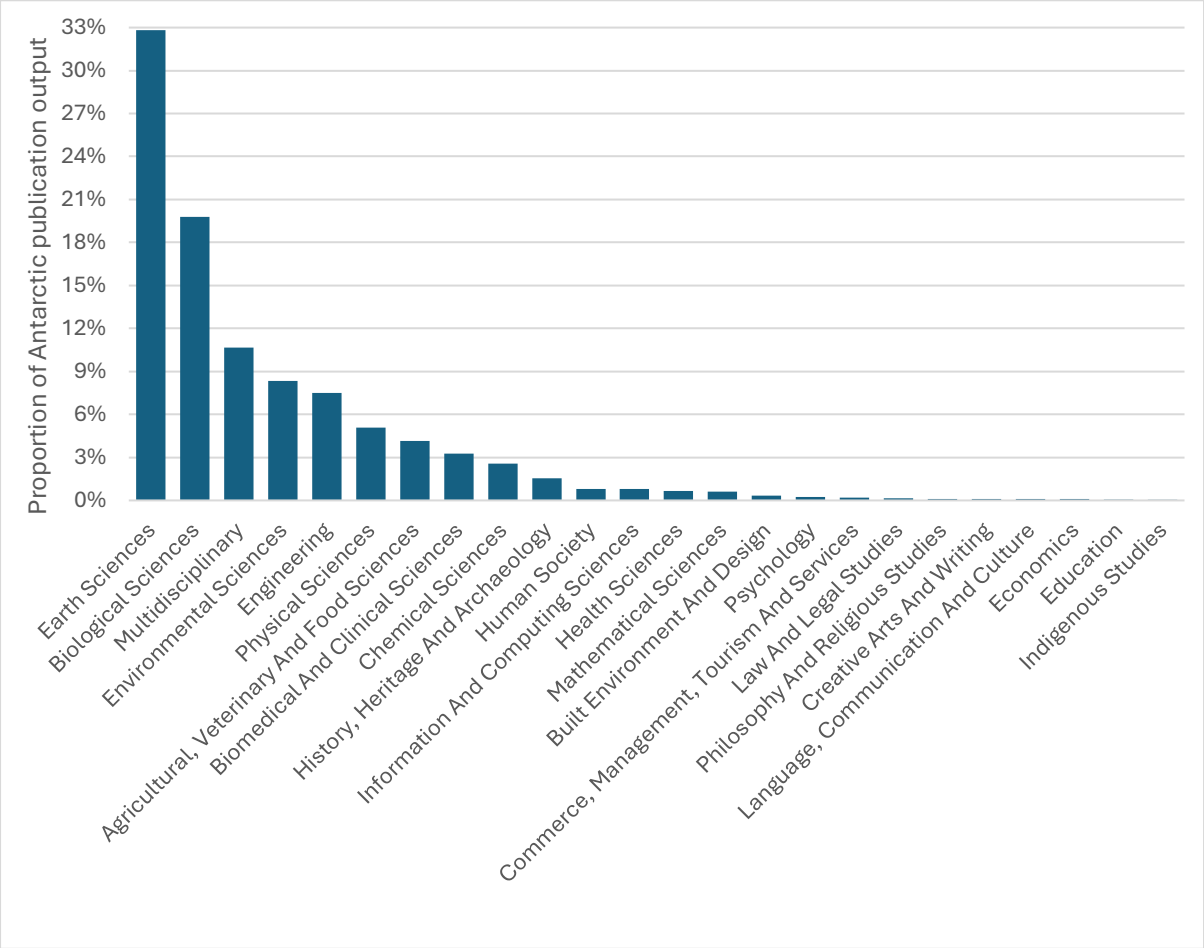
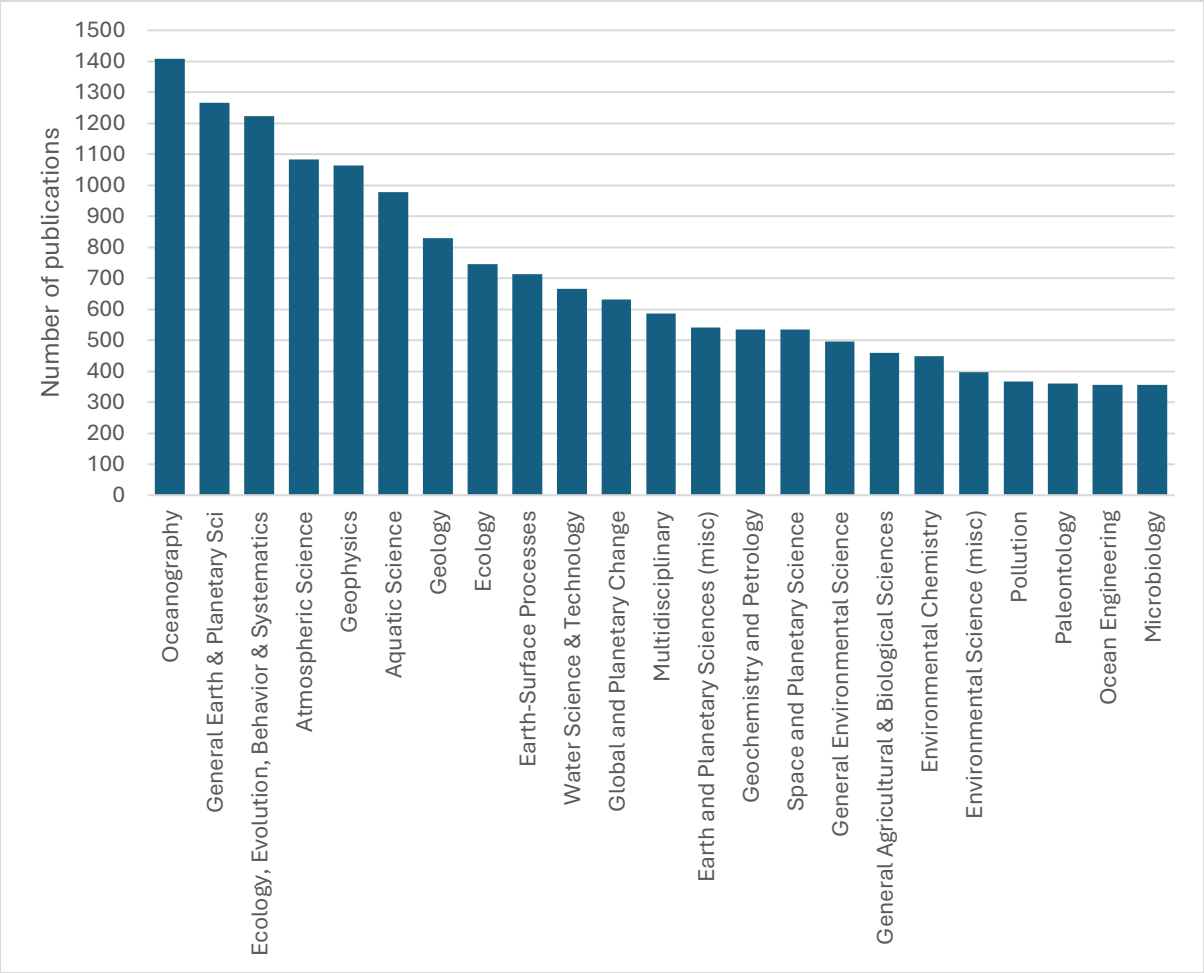


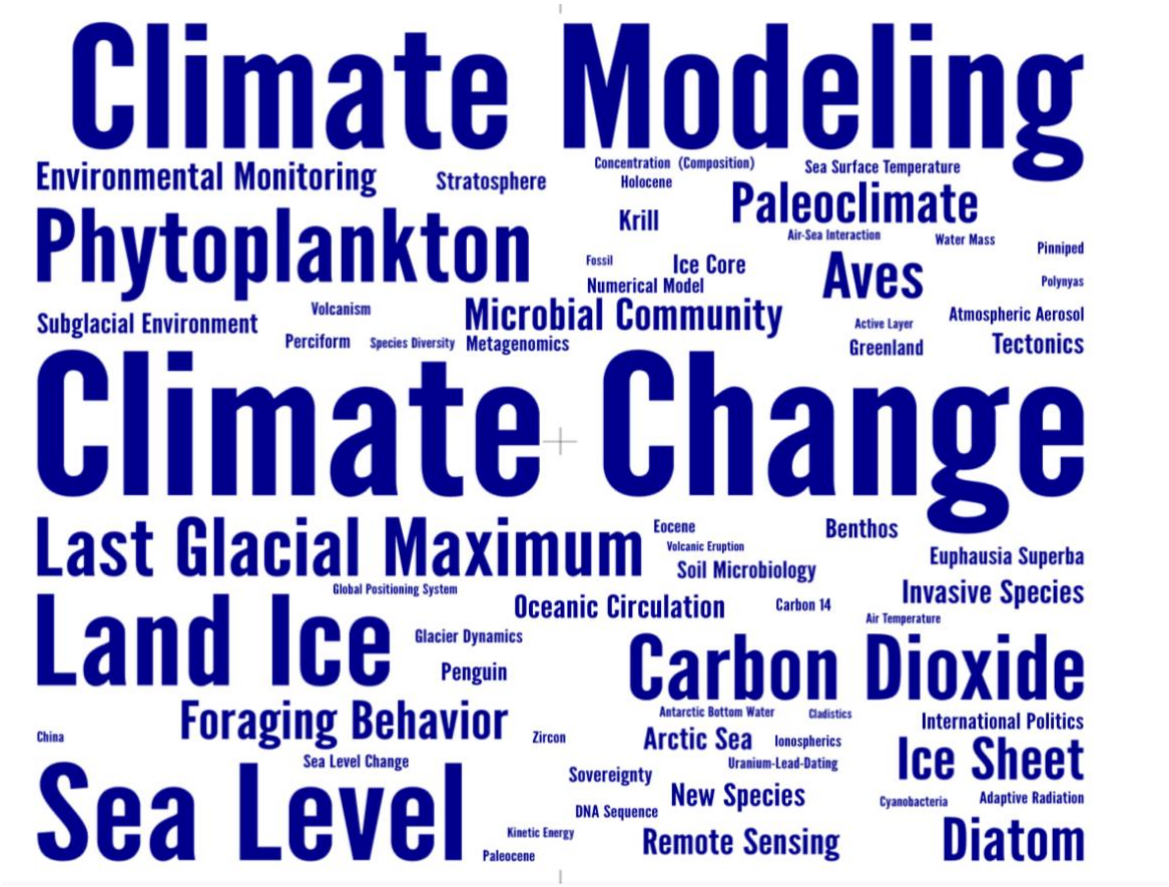
Figure 3.3.2. Number of Antarctic publications by All Science Journal Classification (ASJC) fields (largest), total 2022-2024



A word cloud analysis of topics is shown in Figure 3.3.2. This suggests that climate and climate change-related topics are most prominent, including sea level, land ice, and the Last Glacial Maximum. Regarding biology, phytoplankton research is most prominent, while studies on carbon dioxide are common, presumably across atmospheric sciences and the uptake of carbon dioxide by the ocean and marine life. The only keywords related to the HASS disciplines are

"sovereignty," "international politics," and possibly "China," indicating the prevalence of governance, geopolitics and law in Antarctic-related research in those disciplines.

Figure 3.3.2. Most frequently appearing topics in the Antarctic publications, 2016-2024, as a word cloud. The two most frequently appearing phrases, "Antarctic Region" and "Southern Ocean", have been removed.



3.4 Publication output by institution

Separating publications over 2022-2024 by contributing institution (Table 3.4.1; Table A2; full period Table A1) shows that the British Antarctic Survey (BAS, UK) is the most prolific institution regarding fractionalised publications. While having a much smaller number of fractionalised publications, CNRS (France) has the highest number of full count publications. This suggests that CNRS is frequently part of large teams of multi-institutional researchers. Following BAS in terms of fractionalised publications is the Ministry of Natural Resources of the People's Republic of China (China) and the Russian Academy of Sciences.

The leading university by both counts is the University of Tasmania (Australia), with more than twice the publication counts of any other university globally. Oceans University of China is the second highest in fractionalised counts, and the University of Colorado Boulder is the highest in full counting.

Despite being one of the top two leading publishing nations for Antarctic research, the USA does not have any institutions in the top 10 institutions globally in terms of either fractionalised or full counting. This reflects a highly distributed funding model that has operated in the US, supporting a wide range of US universities and government institutions.

Table 3.4.2 lists institutions according to Q1 journal publication statistics, showing the largest institutes only (complete listing in Table A3). BAS remains the leading institution globally regarding the number of fractionalised publications over 2022-2024, with 40% more fractionalised publications than the second-ranked Chinese Academy of Sciences. Again, CNRS has the most significant number of full-counting Q1 publications, despite having a relatively low number of fractionalised Q1 publications. Despite the prominence of the Russian Academy of Sciences in terms of total publications (Table 3.4.1), there are no Russian organisations listed in Table 3.4.1.

The University of Tasmania is again the leading university in fractionalised and full-counting Q1 publications. Of the institutions shown, Princeton University has the highest publishing rate in Q1 journals in Antarctic and Southern Ocean research (89%), although with a modest volume. A noticeably high publishing rate in Q1 journals is evident at the US universities listed, commonly above 70%.

Several government institutions have lower rates of publishing in Q1 journals, which may reflect their role in undertaking applied or policy-relevant research. Likewise, some universities and other organisations will have lower rates of Q1 publications where they have a broad remit in applied and fundamental research across a wide set of subjects.

Table 3.4.1. Number of Antarctic publications (fractionalised and full counts) for the 20 largest* institutions in terms of publication output. Total figures for 2022-2024.

Institution	Country	Number of publications (fractionalised)	Number of publications (full count)
British Antarctic Survey	UK	169.7	640
Ministry of Natural Resources of the People's Republic of China	China	154.3	398
Russian Academy of Sciences	Russia	135.8	333
University of Tasmania	Australia	126.4	418
Chinese Academy of Sciences	China	122.9	536
Consejo Nacional de Investigaciones Científicas y Técnicas	Argentina	112.1	347
Korea Polar Research Institute	South Korea	96.7	270
Ocean University of China	China	96.7	185
Alfred Wegener Institute - Helmholtz Centre for Polar and Marine Research	Germany	89.5	380
French National Centre for Scientific Research (CNRS)	France	86.0	664
Shanghai Ocean University	China	81.2	129
Dalian Polytechnic University	China	64.8	75
National Research Council of Italy	Italy	63.4	219
Polar Research Institute of China	China	63.2	200
Tongji University	China	60.3	120
University of Colorado Boulder	USA	59.2	219
National Oceanic and Atmospheric Administration	USA	56.8	252
Australian Antarctic Division	Australia	55.2	217
University of Chinese Academy of Sciences	China	54.8	229
University of California at San Diego	USA	51.3	212

* For a more comprehensive list of institutions, see Appendix Table A2.

Table 3.4.2. Number of top-quartile Antarctic publications (Q1) (fractionalised and full counts) for the 20 largest* institutions in publication output. Total figures for 2022-2024.

Institution	Country	Number of publications (fractionalised)	Number of publications (full counting)	Q1 ratio
British Antarctic Survey	UK	101.2	403	0.61
Chinese Academy of Sciences	China	71.7	345	0.60
University of Tasmania	Australia	68.6	270	0.61
Ministry of Natural Resources of the People's Republic of China	China	68.5	214	0.47
Alfred Wegener Institute - Helmholtz Centre for Polar and Marine Research	Germany	63.5	278	0.72
Ocean University of China	China	50.6	115	0.53
CNRS	France	48.7	436	0.58
Korea Polar Research Institute	South Korea	46.0	144	0.48
University of California at San Diego	USA	44.9	173	0.88
National Oceanic and Atmospheric Administration	USA	41.4	190	0.74
University of Colorado Boulder	USA	40.7	169	0.74
National Research Council of Italy	Italy	36.3	131	0.60
University of Washington	USA	35.7	124	0.77
Dalian Polytechnic University	China	35.0	38	0.55
University of New South Wales	Australia	33.8	109	0.82
CSIRO	Australia	33.0	138	0.69
Columbia University	USA	32.8	129	0.82
University of Chinese Academy of Sciences	China	32.2	143	0.60
Southern Marine Science and Engineering Guangdong Laboratory - Guangzhou	China	30.2	107	0.71
Australian Antarctic Division	Australia	29.2	135	0.56

* For a more comprehensive list of institutions, see Appendix Table A3.

3.5 International Collaboration

One measure of international collaboration in research is co-authorship of publications. This will be particularly prominent in the sciences and can be less prominent in some HASS disciplines due to sole-authorship traditions. Figure 3.5.1 shows Antarctic publications over time categorised by the number of nations involved. Approximately 55% of all published research involves a single nation.

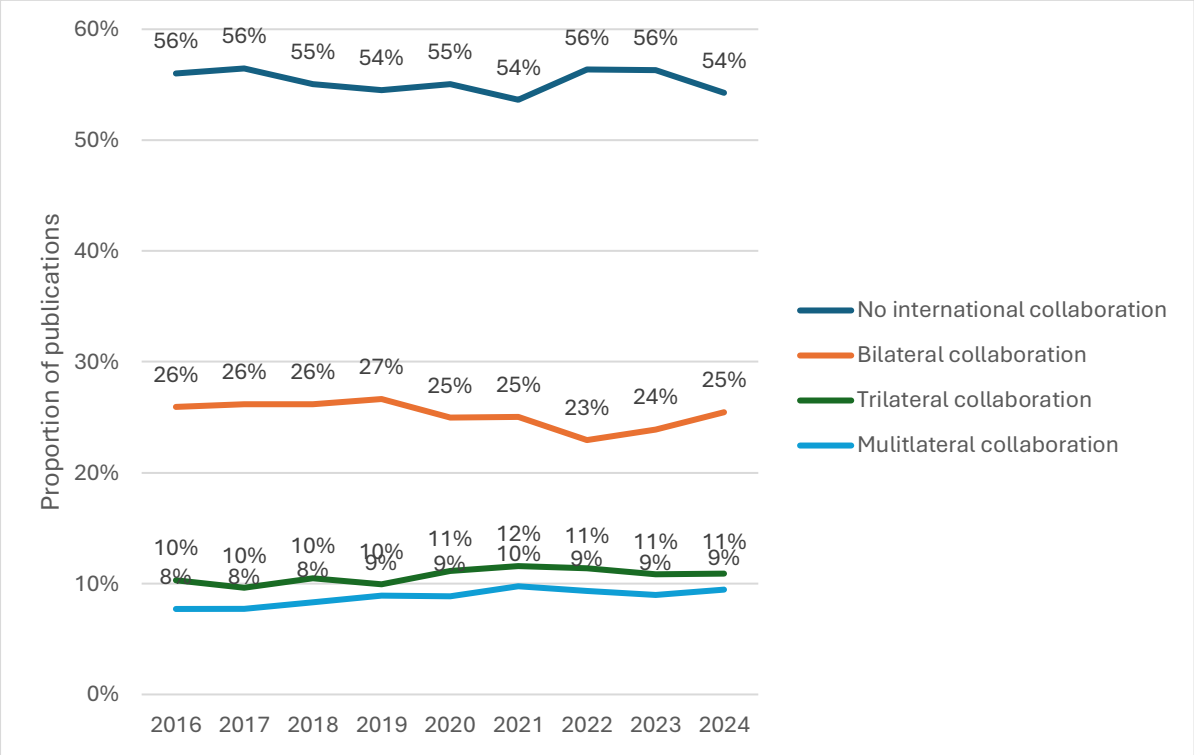
About 45% of all published Antarctic and Southern Ocean research involves collaboration with one or more other nations, which is five percentage points higher than that reported by a previous study (using Web of Science as a data source) for 2015.[26] This figure has remained relatively stable over the period surveyed in this report, as opposed to the continuous increase observed by earlier studies.[27]

This rate of international collaboration is significantly more than the rate for the full Scopus database for articles and conference papers in science and engineering fields, which in 2020 was just under 25%.[28] The difference indicates the cooperative nature of much Antarctic research. As previous researchers have suggested, the higher rate of co-authorship between countries in Antarctic research likely reflects the expense and logistical difficulties of research

[26] Jang et al 2015.
[27] Jang et al 2015.
[28] National Science Board, National Science Foundation. 2021. This report suggests that international cooperation had been increasing, in comparison to the stability in Antarctic cooperative research seen in Figure 3.5.1.

in remote and extreme environments, meaning that projects are more viable if supported by more than one nation.[29] However, the plateauing of this figure during the nine years observed in this report, in contrast to earlier decades, suggests that a ceiling may have been reached.

Figure 3.5.1. Antarctic publications by type of international collaboration, 2016-2024.



There is significant variation in international collaboration by country, as shown in Figures 3.5.2 and 3.5.3. The most frequent collaborators, with rates near or above 90%, are France, Canada, Norway, and The Netherlands. The lowest collaboration rates are with China, India, Russia, and, to a lesser extent, South Korea. These may relate in part to fluency in a common language.

Regarding modes of collaboration, the relatively low rate of multilateral collaborations by US institutes (Figure 3.5.4) is noteworthy, with a rate similar to that of Brazil and Argentina. US researchers' low rate of multilateral collaboration requires further exploration, but may relate to large bilateral research programs. The nations most frequently having multilateral collaborations are The Netherlands, South Africa, Norway, New Zealand, Spain and France.

Figure 3.5.5 shows the breakdown of the modes of collaboration by science subject. Global and Planetary Change, Palaeontology, and Multidisciplinary Sciences have the most common rate of multilateral collaborations expressed in co-authorship. Ecology is the most unilateral subject area listed.

[29] Jang et al 2015.

Figure 3.5.2. Number of publications and proportion of international collaboration by country, total 2022-2024. Only the 20 leading countries are listed.

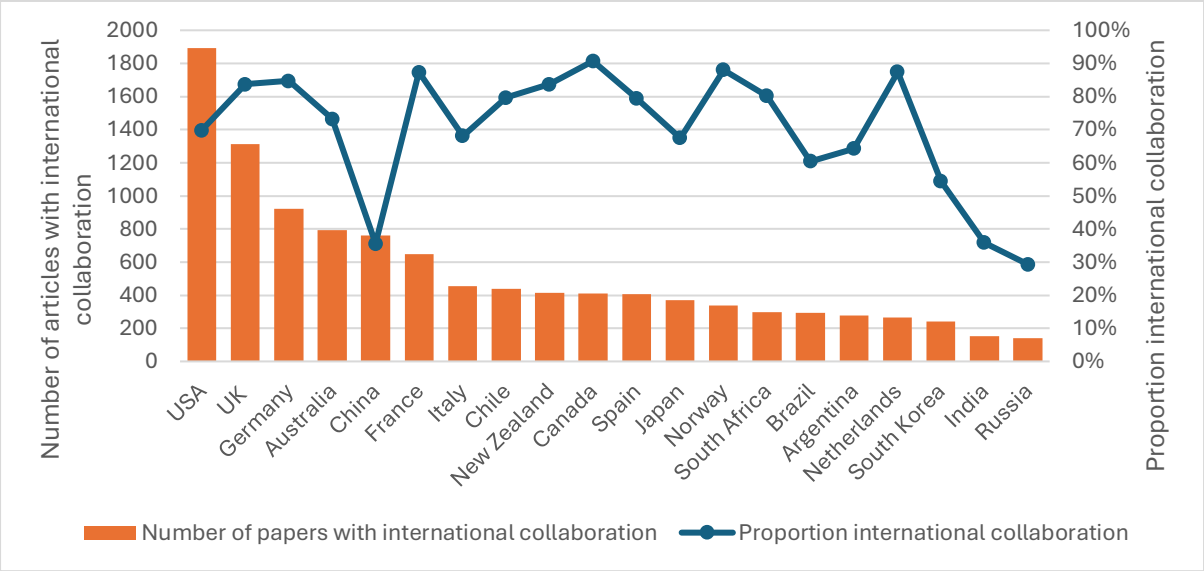
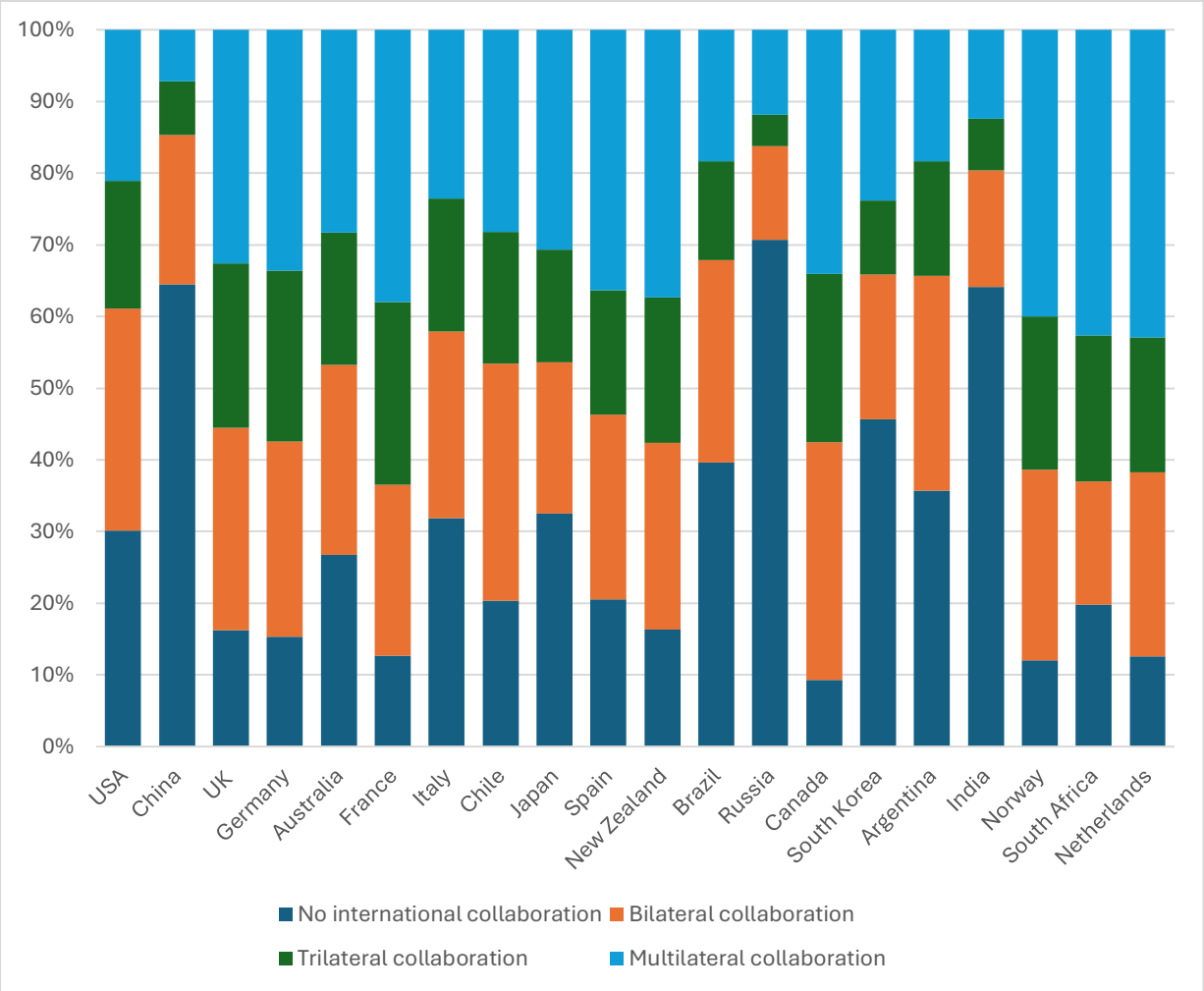


Figure 3.5.3. Proportion of international co-authorship and total number of Antarctic publications fractionalised by country (2022–2024). Only the 20 leading countries are listed.*

* China (CHN), USA (USA), UK (GBR), Australia (AUS), Germany (DEU), Russia (RUS), Italy (ITA), India (IND), Brazil (BRA), France (FRA), Japan (JPN), South Korea (KOR), Chile (CHL), Argentina (ARG), Spain (ESP), New Zealand (NZL), Canada (CAN), South Africa (ZAF), Norway (NOR), Netherlands (NLD).

Figure 3.5.4. International collaboration by country. Only the 20 leading countries are listed. Proportions by collaboration type, 2022-2024.[30]



[30] Collaboration rates are generally much higher at the country level than measured at the overall global level. This is because articles with international collaboration are counted once for each contributing country when reported at the individual country level, while they are not multiplied when counted globally.

Figure 3.5.5. International collaboration by science subject in terms of ASJC-fields (largest). Proportions by collaboration type, 2022-2024.

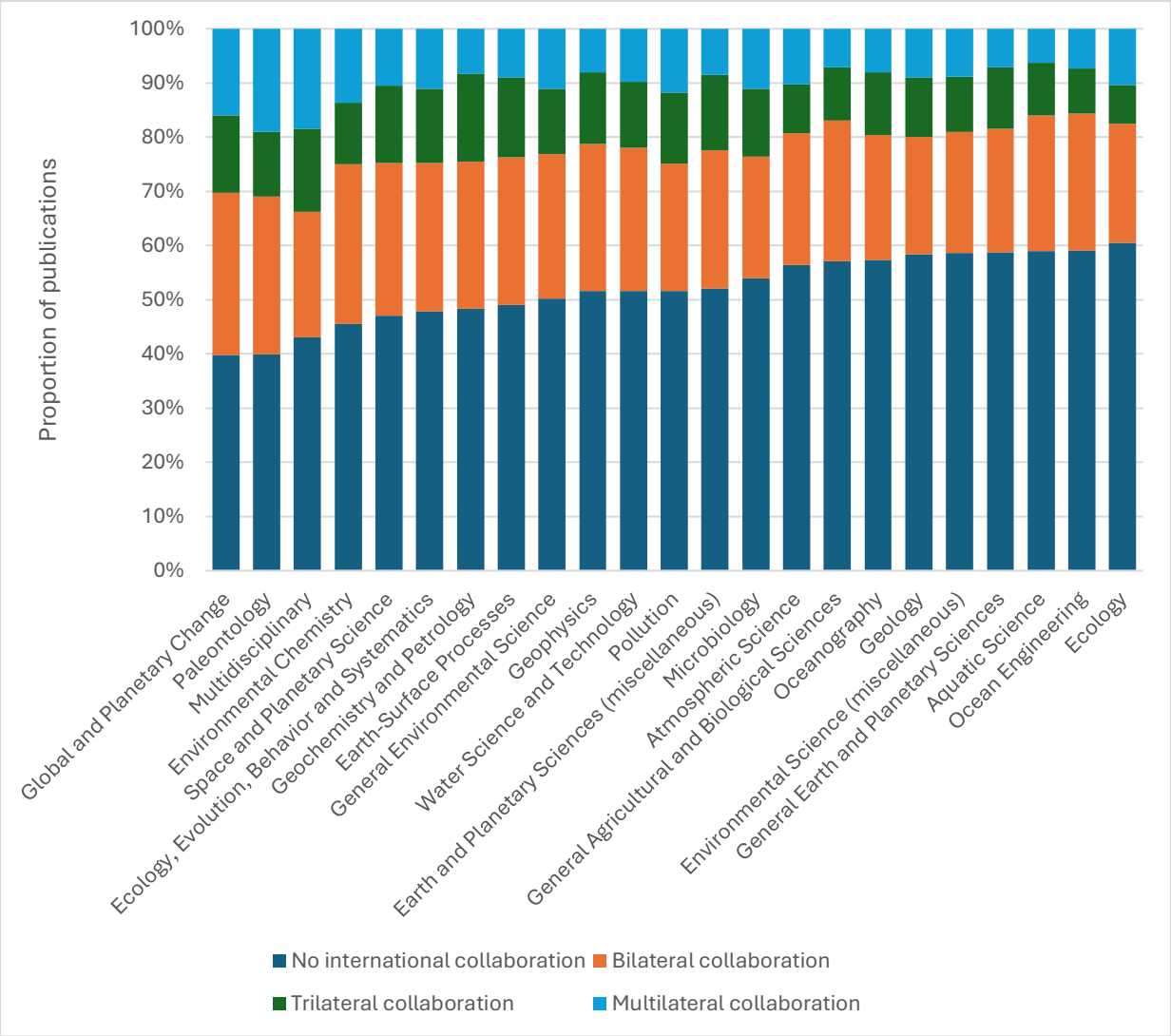
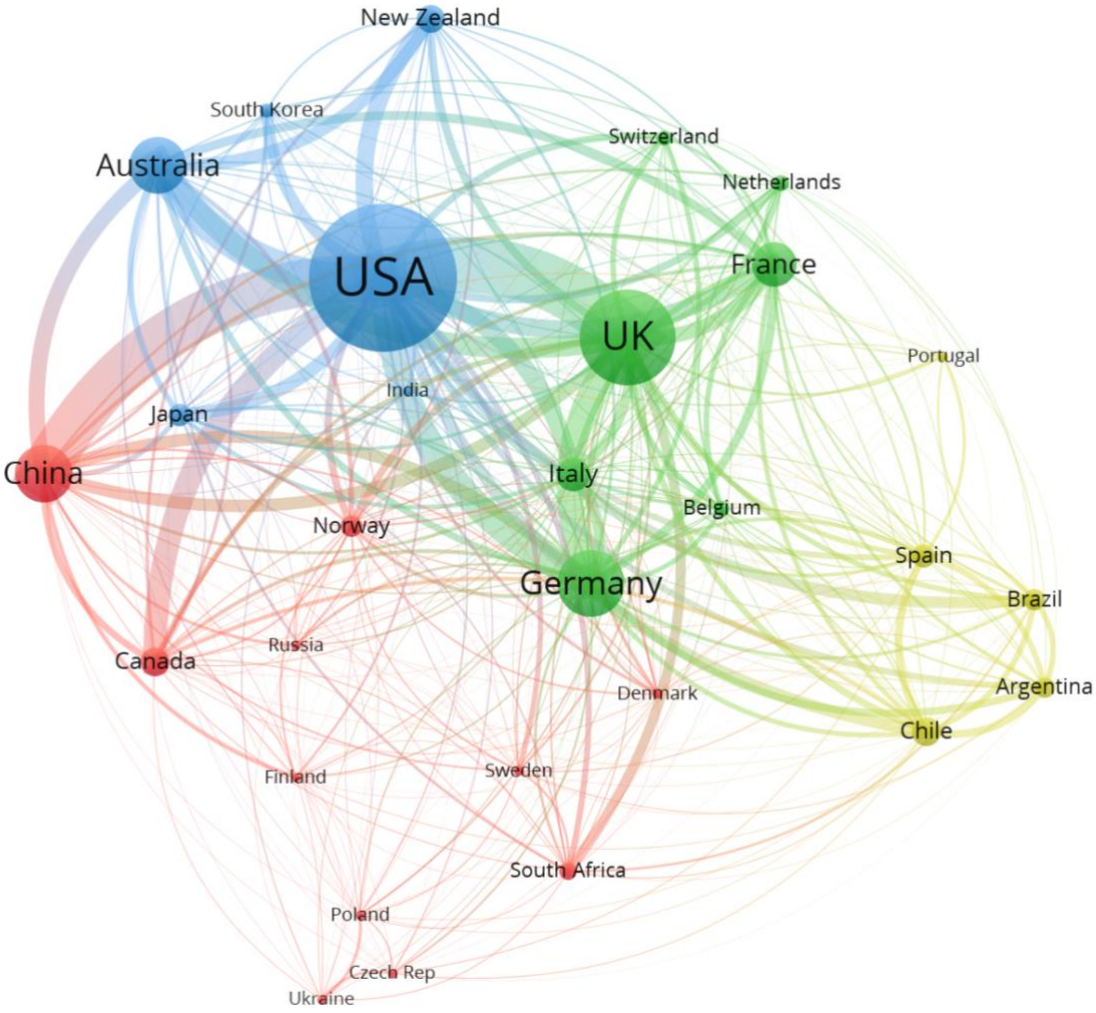


Figure 3.5.6 visualises international collaboration and its volume. The size of each circle represents the number of internationally collaborative articles produced by that country. The width of the lines connecting the circles indicates the volume of collaboration between countries, measured by the number of co-authored articles. The distance between the circles reflects the relative intensity of collaboration: countries with stronger collaborative ties—i.e., relatively high numbers of joint publications—are positioned closer together. This arrangement allows for identifying clusters of countries that collaborate more closely with each other, highlighted by different colours.

Of the large publishing nations, the USA collaborates most commonly with the UK, China and Australia, with fewer collaborations with Germany. Despite its relatively small volume of publications, Canada has relatively high collaboration rates with US researchers.

The UK collaborates most with the USA, followed by Germany, Australia, and France. Australia collaborates as much with China as with New Zealand, but mainly with the US and UK in similar measures. New Zealand has a relatively high collaboration rate with US researchers, likely due to their shared field logistics and field station proximity.

Figure 3.5.6. Graphical illustration of international research collaboration, based on bilateral and trilateral publications 2022-2024*. The meaning of the lines, circles and their relative spacing are described in text.



* Limited to countries contributing to at least 100 Antarctic publications during the period. Software source: VOSviewer, https://www.vosviewer.com.

The heatmap, Table 3.5.1, visualises the collaboration networks between countries, using a colour scale to indicate the intensity of collaboration. The intensity is measured by the proportion of internationally co-authored articles shared between countries. Only the largest countries are shown in the number of published articles.

To interpret the heatmap, it is essential to read it **column-wise**. Each column represents the collaboration profile of a specific country—that is, how strongly other countries collaborate with that country in relative terms.

For example, New Zealand shows strong collaboration with Australia, whereas Australia's collaboration with New Zealand appears less intense. This asymmetry occurs because the absolute number of co-authored articles between the two countries is the same. Still, Australia produces a much larger volume of internationally co-authored papers overall. As a result, the collaboration with Australia represents a larger share of New Zealand's international collaborations than vice versa.

Table 3.5.1. Heat map matrix showing country-to-country relative collaboration intensity based on bilateral and trilateral publications, 2022-2024. The table should be read column-wise, indicating how strongly other countries collaborate in relative terms. Only the 20 leading publishing nations are shown.

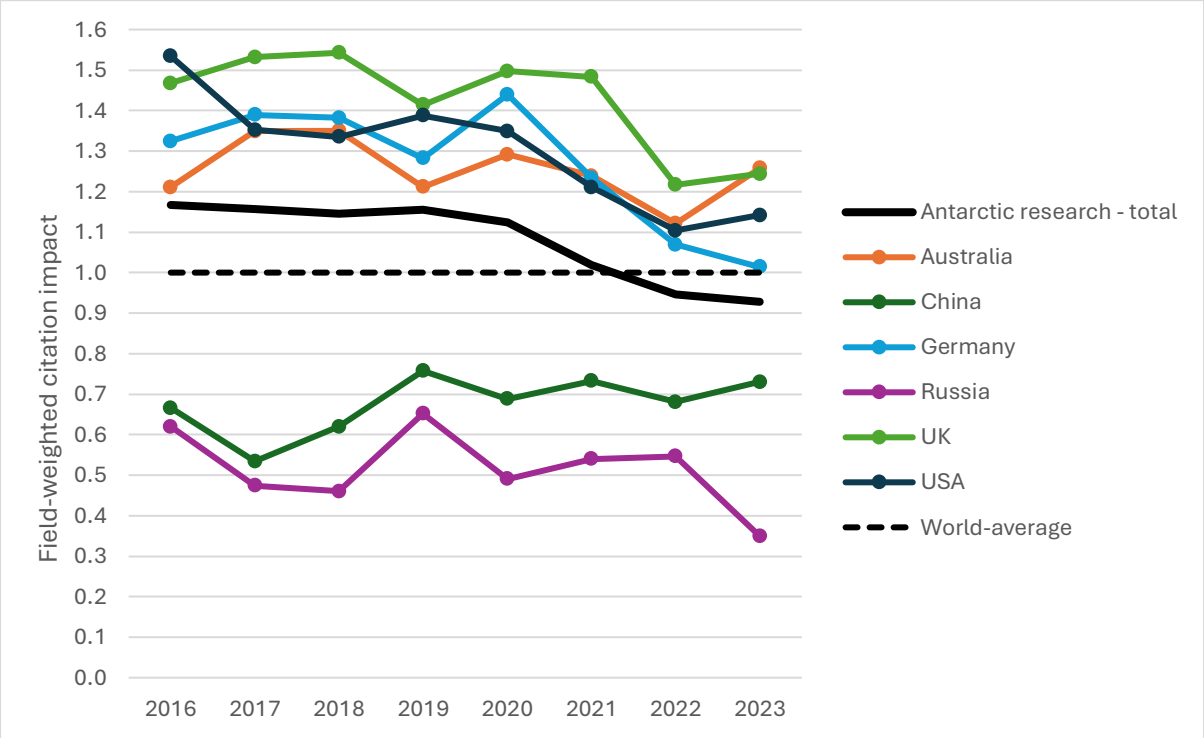
COLLABORATING COUNTRY	COUNTRY																			
		Argen-tina	Austra-lia	Brazil	Canada	Chile	China	France	Germ-any	India	Italy	Japan	Nether-lands	New Zealand	Norway	Russia	South Africa	South Korea	Spain	UK	USA
	Argentina		0.01	0.07	0.01	0.09	0.00	0.03	0.05	0.01	0.01	0.00	0.03	0.00	0.00	0.00	0.01	0.00	0.08	0.01	0.01
	Australia	0.01		0.01	0.05	0.02	0.04	0.10	0.05	0.02	0.02	0.08	0.05	0.20	0.10	0.00	0.07	0.02	0.03	0.09	0.07
	Brazil	0.07	0.00		0.01	0.07	0.00	0.02	0.02	0.02	0.01	0.00	0.02	0.01	0.01	0.00	0.06	0.00	0.04	0.02	0.03
	Canada	0.01	0.02	0.01		0.05	0.02	0.04	0.03	0.00	0.01	0.02	0.02	0.05	0.04	0.01	0.03	0.01	0.01	0.03	0.05
	Chile	0.11	0.01	0.07	0.07			0.05	0.03	0.00	0.02	0.03	0.02	0.02	0.02	0.00	0.02	0.01	0.12	0.03	0.03
	China	0.01	0.10	0.01	0.11	0.01		0.05	0.08	0.01	0.03	0.07	0.07	0.02	0.06	0.04	0.02	0.05	0.02	0.06	0.11
	France	0.05	0.06	0.03	0.06	0.06	0.01		0.06	0.02	0.06	0.03	0.08	0.04	0.05	0.01	0.04	0.02	0.04	0.07	0.04
	Germany	0.11	0.04	0.04	0.06	0.06	0.03	0.09		0.03	0.10	0.04	0.07	0.05	0.08	0.03	0.07	0.03	0.06	0.12	0.06
	India	0.01	0.01	0.02	0.00	0.00	0.00	0.01	0.02		0.00	0.02	0.01	0.00	0.04	0.00	0.00	0.02	0.01	0.01	0.01
	Italy	0.02	0.01	0.02	0.02	0.03	0.01	0.07	0.07	0.00		0.06	0.02	0.03	0.03	0.02	0.03	0.02	0.05	0.05	0.04
	Japan	0.00	0.04	0.00	0.02	0.03	0.01	0.02	0.02	0.02	0.04		0.02	0.01	0.03	0.01	0.04	0.03	0.01	0.02	0.03
	Netherlands	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.02	0.01	0.01	0.01		0.02	0.02	0.00	0.00	0.01	0.02	0.03	0.02
	New Zealan	0.00	0.08	0.01	0.05	0.02	0.00	0.02	0.02	0.00	0.02	0.01	0.03		0.05	0.00	0.02	0.03	0.03	0.04	0.04
	Norway	0.00	0.03	0.01	0.03	0.01	0.01	0.02	0.03	0.03	0.01	0.02	0.03	0.04		0.01	0.02	0.01	0.01	0.03	0.02
	Russia	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.00	0.02	0.01	0.01	0.01	0.03		0.00	0.00	0.01	0.00	0.00
	South Africa	0.01	0.02	0.03	0.02	0.01	0.00	0.02	0.02	0.00	0.01	0.02	0.01	0.01	0.02	0.00		0.00	0.01	0.05	0.01
	South Korea	0.00	0.01	0.00	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.02	0.02	0.03	0.01	0.00	0.00		0.01	0.01	0.03
	Spain	0.08	0.01	0.04	0.01	0.10	0.00	0.03	0.03	0.01	0.03	0.01	0.03	0.03	0.02	0.01	0.02	0.01		0.02	0.01
	UK	0.03	0.13	0.06	0.09	0.08	0.03	0.16	0.18	0.03	0.10	0.04	0.17	0.13	0.16	0.01	0.23	0.02	0.08		0.13
	USA	0.09	0.19	0.14	0.38	0.15	0.11	0.19	0.18	0.05	0.17	0.17	0.21	0.27	0.16	0.02	0.14	0.17	0.09	0.25	

3.6 Citation impact

Academic impact may be measured according to citation rates of individual publications relative to their field of research, with a metric known as Field-Weighted Citation Impact (FWCI). Figure 3.6.1 shows the average FWCI for the Antarctic publications 2016-2023. This reveals that global Antarctic research (solid black line) was more heavily cited than average before 2021, after which it swiftly became cited less frequently than average. This is surprising as there would appear to be no apparent reason within Antarctic research to explain this. However, a similar pattern was also observed for Arctic research.[31] Further exploration of the six leading publishing nations shows that the UK, Germany, and, to a lesser extent, Australia and Russia have seen a significant reduction in FWCI over the same period, contributing to the global FWCI change. Figure 3.6.2 shows a change in FWCI for a larger number of countries, comparing average FWCI over 2016-2019 and 2020-2023. This reveals that the drop in average FWCI is widespread, especially among nations with high FWCI. The notable exception to that rule is New Zealand, whose average FWCI increased substantially between the two periods. India and China are other nations that have increased their FWCI, although only marginally.

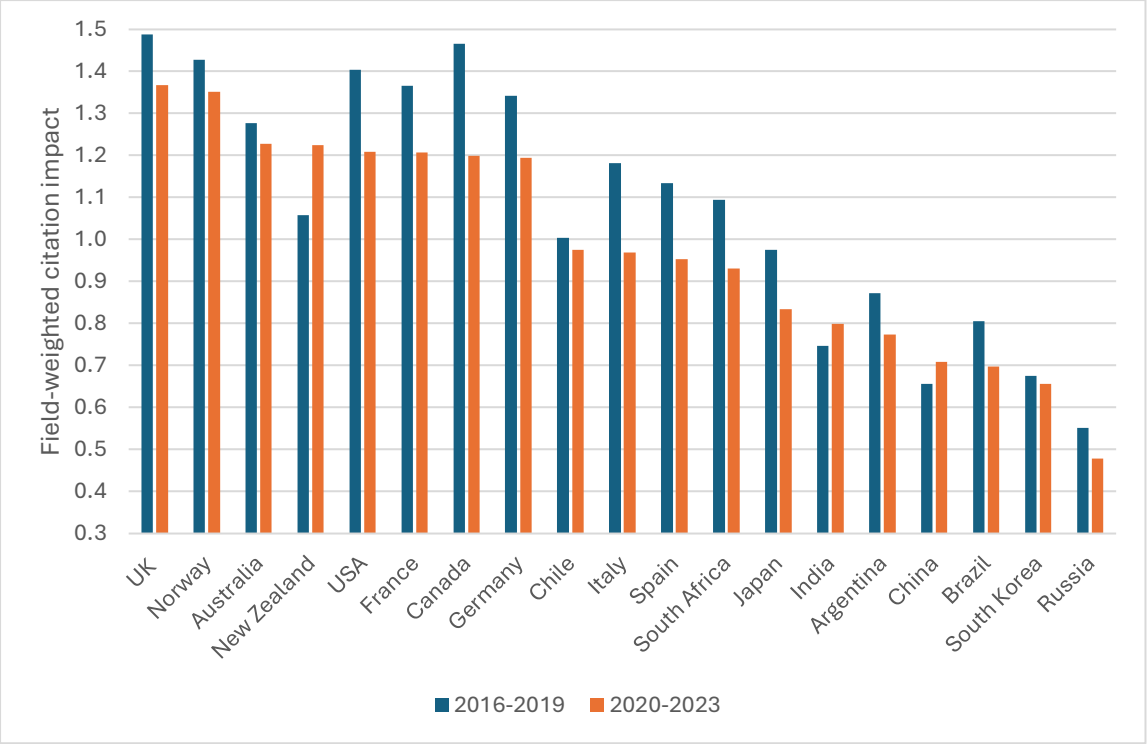
Figure 3.6.1 shows that China's FWCI increased before 2020 but has been steady since and is well below average. This lower-than-average FWCI, combined with the rapid increase in Antarctic publications from China since 2017, may add to the reduction in overall Antarctic FWCI since 2020 (noting FWCI lags publications by 2 years).

Figure 3.6.1. Field-Weighted Citation Impact for Antarctic research total for the six largest countries, 2016–2023.



[31] Aksnes et al 2023.

Figure 3.6.2. Field-Weighted Citation Impact for Antarctic research, for the largest countries in publication output, 2016-2019 and 2020-2023.



Examining FWCI by institute (Table 3.6.1) reveals that the highest FWCI institutes are dominated by US institutes, largely government-funded space and research centres. Some smaller volume nations have very high average FWCI, as shown in Table A4, where the overall highest FWCI institute is the University of Utrecht (The Netherlands), followed by the University of NSW (Australia). The Universidad de Chile (Chile) is notable as the sole South American institute in the top ten highest FWCI institutes.

At the lower end of FWCI are institutes commonly found in Russia and China. The result for China is somewhat surprising given the high rate of Q1 publishing from China-based researchers. This requires further exploration, but could result from a lower visibility of this research, lesser familiarity with emerging researchers producing the research, lower rates of collaboration with other highly publishing nations, or a perceived lower quality of this research.

Table 3.6.1. Number of Antarctic publications (fractionalised) and field-weighted citation impact for the 20 largest* institutions in terms of publication output, 2020-2023.

Institution	Country	Number of articles (fractionalised)	Field-weighted citation impact
University of Washington	USA	70.7	1.64
National Oceanic and Atmospheric Administration	USA	83.1	1.55
British Antarctic Survey	UK	238.5	1.37
University of California at San Diego	USA	78.2	1.33
University of Tasmania	Australia	175.2	1.21
CNRS	France	126.4	1.21
Australian Antarctic Division	Australia	78.4	1.11
University of Colorado Boulder	USA	91.3	1.11
Alfred Wegener Institute - Helmholtz Centre for Polar and Marine Research	Germany	143.4	1.10
Chinese Academy of Sciences	China	159.7	0.83
National Research Council of Italy	Italy	76.7	0.82
Consejo Nacional de Investigaciones Científicas y Técnicas	Argentina	157.6	0.78
Ocean University of China	China	119.2	0.77
Ministry of Natural Resources of the People's Republic of China	China	177.5	0.59
Korea Polar Research Institute	South Korea	128.5	0.57
Polar Research Institute of China	China	75.8	0.50
Shanghai Ocean University	China	100.8	0.49
St. Petersburg State University	Russia	70.1	0.49
Russian Academy of Sciences	Russia	207.1	0.46
Wuhan University	China	72.4	0.43

* For a more comprehensive list of institutions, see Appendix Table A4.

4. Conclusions and main findings

We examined Antarctic and Southern Ocean publications in the Scopus database from 2016 to 2024. The total number of publications peaked in 2021, presumably associated with COVID restrictions, and then fell slightly every year until the end of the study period in 2024.

China is now the leading publisher of Antarctic and Southern Ocean research in quantity and quality (top-quartile journal) publications, overtaking the US in 2022 and 2024, respectively. This contrasts with the steady decline in publications in the database from the other leading nations, notably the US, Germany, Australia, and the UK. While Russia has a high number of total publications, its publication numbers in the top-quartile journals are comparatively very small. These results may indicate a changing of the guard in Antarctic and Southern Ocean research.

International collaboration, a hallmark of Antarctic research, remains steady throughout the period, despite substantial nation-to-nation variation. We show variations between levels of bilateral and multilateral cooperation between countries. We highlight that China, India, and Korea have notably lower rates of international co-authorship and suggest that this may be related to common language challenges.

Regarding individual institutions, the British Antarctic Survey is the global leader in total and top-quartile publications. The UK has the highest field-weighted citation index overall, although many individual US institutions also rate highly. The University of Tasmania is the leading university globally regarding Antarctic and Southern Ocean publications.

The prominence of Canada in the statistics is noteworthy, given that this state is not a Consultative member of the Antarctic Treaty. Indeed, Canada has experienced multiple failed attempts to apply for Consultative status based on its scientific contributions. Our analysis suggests that their volume and quality are comparable or higher than those of many other nations with Consultative status.

Our analysis is focused on contributions to publications regardless of the authorship role in the publication. For instance, it does not assess research leadership, as may be indicated by first or, in some fields, senior author. Intellectual leadership in Antarctic and Southern Ocean research is, therefore, not explored in this study despite being highly relevant to credibility in the Antarctic Treaty System and worthy of future study.

Our study examines the trends and patterns in Antarctic and Southern Ocean publications, but understanding their drivers requires further analysis and study. One example is the relatively low citation rates of papers from China despite the strongly growing rate of China's publications in top-quartile journals.

Finally, our analysis is constrained by the Scopus database's science focus, and more research is required into trends and patterns in humanities, arts, and social science publications.

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Author contributions

KL conceived the study with input from Lars Kullerud at the UArctic. RD designed and implemented the Scopus search, with guidance from KL, EL, and MAK. DWA undertook statistical analyses and prepared the figures and tables. EL reviewed relevant literature. MAK, EL, DWA and RD drafted the manuscript, and all authors commented.

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APPENDIX

Table A1. Number of Antarctic publications (fractionalised and full counting) by institution, total 2016-2024

Institution		Number of publications (fractionalised)	**Number of publications (full counting)**
British Antarctic Survey	UK	561.5	1905
Russian Academy of Sciences	Russia	378.9	915
Alfred Wegener Institute - Helmholtz Centre for Polar and Marine Research	Germany	364.2	1490
University of Tasmania	Australia	348.6	1224
Consejo Nacional de Investigaciones Científicas y Técnicas	Argentina	327.8	1025
Ministry of Natural Resources of the People's Republic of China	China	320.7	805
Chinese Academy of Sciences	China	298.7	1243
Korea Polar Research Institute	South Korea	291.9	779
CNRS	France	283.2	2135
Ocean University of China	China	217.0	395
National Oceanic and Atmospheric Administration	USA	194.1	760
University of California at San Diego	USA	180.7	663
University of Colorado Boulder	USA	180.0	670
Australian Antarctic Division	Australia	173.6	731
National Research Council of Italy	Italy	169.8	575
Shanghai Ocean University	China	169.3	271
CSIRO	Australia	167.9	815
Columbia University	USA	163.0	613
University of Washington	USA	159.7	543
Wuhan University	China	158.1	272
University of New South Wales	Australia	136.2	457
Polar Research Institute of China	China	131.9	408
University of Bremen	Germany	129.1	520
Institut de recherche pour le développement	France	125.7	1296
CSIC	Spain	124.2	670
University of Otago	New Zealand	122.1	345
Tongji University	China	121.1	230
St. Petersburg State University	Russia	119.0	246
University of Cambridge	UK	116.4	417
Australian National University	Australia	114.8	369
National Centre for Antarctic & Ocean Research	India	111.4	294
University of Canterbury	New Zealand	110.8	275
University of Chinese Academy of Sciences	China	110.3	456
Universidade de São Paulo	Brazil	109.1	307
University of Cape Town	South Africa	107.2	316
Research Organisation of Information and Systems, National Institute of Polar Research	Japan	105.8	465
California Institute of Technology	USA	102.3	450
Utrecht University	Netherlands	101.7	411
Masaryk University	Czech Republic	100.0	207
NIWA	New Zealand	98.0	347
University of Southampton	UK	96.2	489
Dalian Polytechnic University	China	91.8	108
Woods Hole Oceanographic Institution	USA	91.7	392
National Center for Atmospheric Research	USA	89.9	366
Universidad de Magallanes	Chile	89.4	315
Universidad de Concepción	Chile	89.4	327
University of Melbourne	Australia	88.3	248
Universidad Austral de Chile	Chile	88.0	266
Monash University	Australia	87.5	251
Universidad de Buenos Aires	Argentina	86.1	287

Universidad de Chile	Chile	85.2	299
NASA Goddard Space Flight Center	USA	80.3	340
Ohio State University	USA	79.6	321
National Oceanography Centre	UK	76.3	411
Massachusetts Institute of Technology	USA	75.3	292
Universidad Nacional de La Plata	Argentina	75.0	243
Japan Agency for Marine-Earth Science and Technology	Japan	74.8	294
University of Pretoria	South Africa	74.6	211
National Academy of Sciences of Ukraine	Ukraine	74.6	205
Lomonosov Moscow State University	Russia	73.5	171
United States Department of Energy	USA	71.4	440
Jet Propulsion Laboratory, California Institute of Technology	USA	70.8	355
Ministry of Earth Sciences	India	70.8	221
Pennsylvania State University	USA	69.1	290
RAS - P.P. Shirshov Institute of Oceanology	Russia	68.8	210
Rutgers - The State University of New Jersey, New Brunswick	USA	68.2	210
University of Oxford	UK	68.1	266
Victoria University of Wellington	New Zealand	67.7	287
Polish Academy of Sciences	Poland	67.6	265
The University of Tokyo	Japan	66.9	284
Oregon State University	USA	66.8	326
German Aerospace Center	Germany	66.3	178
Swiss Federal Institute of Technology Zurich	Switzerland	65.0	282
Helmholtz Centre for Ocean Research Kiel	Germany	63.9	240
University of Wisconsin-Madison	USA	63.2	251
Chinese Academy of Fishery Sciences	China	63.1	140
University of California at Santa Cruz	USA	62.6	249
Hokkaido University	Japan	62.6	260
Stanford University	USA	62.1	224
University of Bristol	UK	61.6	255
University of Copenhagen	Denmark	61.1	264
Princeton University	USA	60.8	261
Sorbonne Université	France	60.6	612
Sun Yat-Sen University	China	60.4	215
Southern Marine Science and Engineering Guangdong Laboratory - Guanzhou	China	60.0	216
University of Edinburgh	UK	59.1	254
Universidade Federal do Rio Grande	Brazil	59.0	145
University of Barcelona	Spain	59.0	169
University of Science and Technology of China	China	58.9	171
Cooperative Research Centres Australia	Australia	58.8	397
Université de La Rochelle	France	57.4	296
Universidade Federal do Rio Grande do Sul	Brazil	56.6	147
University of Leeds	UK	56.5	238
University of Bergen	Norway	56.3	219
The Graduate University for Advanced Studies	Japan	55.5	272
University of Adelaide	Australia	55.1	185
Centre national d'études spatiales	France	54.8	691
Universidade Federal de Minas Gerais	Brazil	54.4	159
University of Western Australia	Australia	53.8	179
Beijing Normal University	China	53.7	193
University of California at Irvine	USA	53.6	227
University of Maine	USA	53.5	171
Durham University	UK	52.4	188
University of Exeter	UK	52.3	223
University of Texas at Austin	USA	52.2	203
Museo Argentino de Ciencias Naturales Bernardino Rivadavia	Argentina	51.9	139
University of Hawai'i at Mānoa	USA	51.6	231
University of Hamburg	Germany	51.5	164
Norwegian Polar Institute	Norway	51.3	230
Universidade Federal do Rio de Janeiro	Brazil	51.2	143
National Antarctic Scientific Center Of Ukraine	Ukraine	51.1	169

University of Waikato	New Zealand	51.0	167
University of Genoa	Italy	50.8	162
China University of Geosciences, Wuhan	China	50.6	148
Université Paris Cité	France	50.3	665
Imperial College London	UK	50.2	233

Table A2. Number of Antarctic publications (fractionalised and whole counts) for the largest 75 institutions in terms of publication output. Total figures for the 2022-2024 period.

Institution	Country	Number of publications (fractionalised)	Number of publications (full counting)
British Antarctic Survey	UK	169.7	640
Ministry of Natural Resources of the People's Republic of China	China	154.3	398
Russian Academy of Sciences	Russia	135.8	333
University of Tasmania	Australia	126.4	418
Chinese Academy of Sciences	China	122.9	536
Consejo Nacional de Investigaciones Científicas y Técnicas	Argentina	112.1	347
Korea Polar Research Institute	South Korea	96.7	270
Ocean University of China	China	96.7	185
Alfred Wegener Institute - Helmholtz Centre for Polar and Marine Res	Germany	89.5	380
CNRS	France	86.0	664
Shanghai Ocean University	China	81.2	129
Dalian Polytechnic University	China	64.8	75
National Research Council of Italy	Italy	63.4	219
Polar Research Institute of China	China	63.2	200
Tongji University	China	60.3	120
University of Colorado Boulder	USA	59.2	219
National Oceanic and Atmospheric Administration	USA	56.8	252
Australian Antarctic Division	Australia	55.2	217
University of Chinese Academy of Sciences	China	54.8	229
University of California at San Diego	USA	51.3	212
CSIRO	Australia	48.9	187
University of Washington	USA	47.5	156
Wuhan University	China	46.4	92
Southern Marine Science & Engineering Guangdong Lab - Guanzhou	China	44.1	152
University of New South Wales	Australia	43.0	142
Columbia University	USA	40.3	176
CSIC	Spain	40.3	220
Sun Yat-Sen University	China	40.1	135
University of Cape Town	South Africa	38.9	118
Institut de recherche pour le développement	France	37.8	398
Utrecht University	Netherlands	37.1	129
University of Cambridge	UK	37.0	125
University of Otago	New Zealand	36.9	119
St. Petersburg State University	Russia	35.2	80
Australian National University	Australia	34.8	127
National Centre for Antarctic & Ocean Research	India	34.7	112
University of Bremen	Germany	34.3	154
Research Organisation of Information and Systems, National Institute of Polar Research	Japan	33.5	154
Ministry of Earth Sciences	India	32.9	105
Lomonosov Moscow State University	Russia	31.8	70
Universidad de Magallanes	Chile	30.7	118
University of Canterbury	New Zealand	30.4	105
California Institute of Technology	USA	30.1	130
NIWA	New Zealand	30.0	117
Chinese Academy of Fishery Sciences	China	29.8	64
Universidade de São Paulo	Brazil	29.6	96
Shanghai Jiao Tong University	China	29.2	89
Masaryk University	Czech Rep	28.5	70
University of Southampton	UK	28.5	162
Universidad Nacional de La Plata	Argentina	28.5	95
Monash University	Australia	28.0	81
Bulgarian Academy of Sciences	Bulgaria	27.7	45
United States Department of Energy	USA	27.7	178
National Academy of Sciences of Ukraine	Ukraine	27.7	80

University of Melbourne	Australia	27.6	76
Woods Hole Oceanographic Institution	USA	27.4	125
Ministerio de Planificación, Chile	Chile	27.2	127
Universidad de Buenos Aires	Argentina	25.8	80
RAS - P.P. Shirshov Institute of Oceanology	Russia	25.8	90
National Center for Atmospheric Research	USA	25.5	121
Massachusetts Institute of Technology	USA	25.3	106
Universidad de Chile	Chile	25.2	102
Polish Academy of Sciences	Poland	24.9	100
Northumbria University	UK	24.7	93
Universidad Austral de Chile	Chile	24.5	103
Hokkaido University	Japan	24.5	98
China University of Geosciences, Wuhan	China	24.3	76
University of Pretoria	South Africa	24.1	76
Japan Agency for Marine-Earth Science and Technology	Japan	23.9	98
Ohio State University	USA	23.3	105
Universidade Federal de Minas Gerais	Brazil	23.2	80
Universidade Federal do Rio Grande do Sul	Brazil	23.0	63
CAS - Institute of Atmospheric Physics	China	22.9	112
Universidad de Concepción	Chile	22.6	105
National Oceanography Centre	UK	22.4	129
Xiamen University	China	22.2	61
Universidad de la República	Uraguay	22.2	45
NASA Goddard Space Flight Center	USA	22.2	92
University of Johannesburg	South Africa	22.1	117
University of Oslo	Norway	21.9	66
University of Genoa	Italy	21.9	63
The University of Tokyo	Japan	21.7	103
National Antarctic Scientific Center Of Ukraine	Ukraine	21.7	77
Ministry of Agriculture of the People's Republic of China	China	21.6	61
Victoria University of Wellington	New Zealand	21.4	96
China University of Geosciences, Beijing	China	21.4	58
Swiss Federal Institute of Technology Zurich	Switzerland	20.9	108
Stanford University	USA	20.8	75
University of Copenhagen	Denmark	20.7	96
Princeton University	USA	20.5	88
University of Edinburgh	UK	20.1	86
The Graduate University for Advanced Studies	Japan	20.0	100
University of East Anglia	UK	19.9	79
Universidade Federal do Rio de Janeiro	Brazil	19.7	64
Jet Propulsion Laboratory, California Institute of Technology	USA	19.4	96
University of Science and Technology of China	China	19.4	63
University of Siena	Italy	19.0	60
Pennsylvania State University	USA	18.8	109
University of Hamburg	Germany	18.8	62
Stony Brook University	USA	18.8	62
University of California at Santa Cruz	USA	18.6	85
Nanjing University of Information Science & Technology	China	18.5	55
Istanbul Technical University	Turkey	18.5	33
German Aerospace Center	Germany	18.2	52
University of Western Australia	Australia	18.2	56
University of Oxford	UK	18.2	85
Seoul National University	South Korea	18.0	55
Oregon State University	USA	18.0	106
Delft University of Technology	Netherlands	17.9	55
China Meteorological Administration	China	17.8	52
Pontificia Universidad Católica de Chile	Chile	17.6	72
Sorbonne Université	France	17.4	179
Zhejiang University	China	17.3	49
Universidade Federal do Rio Grande	Brazil	17.2	47
University of Bristol	UK	16.8	66
University of Bergen	Norway	16.7	72

CAS - Institute of Oceanology	China	16.6	74
Texas A&M University	USA	16.6	64
Universidade Federal de Viçosa	Brazil	16.5	44
University of Waikato	New Zealand	16.5	49
Nanjing University	USA	16.2	54
Beijing Normal University	China	16.1	64
University of Exeter	UK	16.1	70

Table A3. Number of top-quartile Antarctic publications (Q1) (fractionalised and whole counts) for the largest institutions in terms of publication output. Total figures for the 2022-2024 period.

Institution	Country	Number of articles (fractionalised)	Number of articles (full counting)	Q1 ratio
British Antarctic Survey	UK	101.2	403	0.61
Chinese Academy of Sciences	China	71.7	345	0.60
University of Tasmania	Australia	68.6	270	0.61
Ministry of Natural Resources of the People's Rep of China	China	68.5	214	0.47
Alfred Wegener Institute - Helmholtz Centre for Polar and Marine Res	Germany	63.5	278	0.72
Ocean University of China	China	50.6	115	0.53
CNRS	France	48.7	436	0.58
Korea Polar Research Institute	South Korea	46.0	144	0.48
University of California at San Diego	USA	44.9	173	0.88
National Oceanic and Atmospheric Administration	USA	41.4	190	0.74
University of Colorado Boulder	USA	40.7	169	0.74
National Research Council of Italy	Italy	36.3	131	0.60
University of Washington	USA	35.7	124	0.77
Dalian Polytechnic University	China	35.0	38	0.55
University of New South Wales	Australia	33.8	109	0.82
CSIRO	Australia	33.0	138	0.69
Columbia University	USA	32.8	129	0.82
University of Chinese Academy of Sciences	China	32.2	143	0.60
Southern Marine Science and Engineering Guangdong Laboratory - Guanzhou	China	30.2	107	0.71
Australian Antarctic Division	Australia	29.2	135	0.56
Utrecht University	Netherlands	28.4	105	0.77
Consejo Nacional de Investigaciones Científicas y Técnicas	Argentina	28.2	114	0.26
Polar Research Institute of China	China	27.7	101	0.46
Tongji University	China	27.3	65	0.49
Wuhan University	China	27.2	57	0.59
Sun Yat-Sen University	China	26.5	98	0.69
Institut de recherche pour le développement	France	25.9	286	0.70
CSIC	Spain	25.7	147	0.66
University of Bremen	Germany	25.4	117	0.75
Australian National University	Australia	25.1	96	0.72
University of Cambridge	UK	24.8	92	0.71
University of Otago	New Zealand	23.8	84	0.66
National Center for Atmospheric Research	USA	23.6	112	0.76
Northumbria University	UK	21.6	83	0.87
Woods Hole Oceanographic Institution	USA	21.5	98	0.79
United States Department of Energy	USA	21.3	113	0.78
University of Cape Town	South Africa	21.2	74	0.56
California Institute of Technology	USA	21.1	92	0.73
University of Southampton	UK	19.3	116	0.68
Shanghai Ocean University	China	18.7	44	0.27
Monash University	Australia	18.4	64	0.72
Massachusetts Institute of Technology	USA	18.1	62	0.72
Russian Academy of Sciences	Russia	18.1	67	0.14
Japan Agency for Marine-Earth Science and Technology	Japan	17.6	72	0.74
University of Canterbury	New Zealand	17.3	55	0.61
NIWA	New Zealand	16.9	69	0.58
University of Edinburgh	UK	16.8	73	0.83
Princeton University	USA	16.8	73	0.89
Universidad de Concepción	Chile	16.8	79	0.74
Swiss Federal Institute of Technology Zurich	Switzerland	16.7	86	0.80

CAS - Institute of Atmospheric Physics	China	16.2	86	0.73
Hokkaido University	Japan	16.1	65	0.65
University of Melbourne	Australia	16.0	51	0.67
University of East Anglia	UK	15.6	66	0.83
National Oceanography Centre	UK	15.5	93	0.69
NASA Goddard Space Flight Center	USA	15.3	58	0.69
Stanford University	USA	15.2	49	0.73
China University of Geosciences, Wuhan	China	14.9	52	0.62
Research Organisation of Information and Systems, National Institute of Polar Research	Japan	13.9	77	0.42
Shanghai Jiao Tong University	China	13.4	50	0.49
Delft University of Technology	Netherlands	13.2	41	0.74

Table A4. Number of Antarctic publications (fractionalised) and field-weighted citation impact for the largest 75 institutions in terms of publication output, 2020-2023.

Institution	Country	Number of articles (fractionalised)	Field-weighted citation impact
Utrecht University	Netherlands	48.3	1.81
University of New South Wales	Australia	62.1	1.74
Jet Propulsion Laboratory, California Institute of Technology	USA	30.0	1.70
NASA Goddard Space Flight Center	USA	31.6	1.64
University of Washington	USA	70.7	1.64
CSIRO	Australia	68.3	1.62
National Center for Atmospheric Research	USA	45.3	1.58
National Oceanic and Atmospheric Administration	USA	83.1	1.55
Universidad de Chile	Chile	35.5	1.55
University of Canterbury	New Zealand	50.4	1.53
Institut de recherche pour le développement	France	53.7	1.52
Columbia University	USA	68.8	1.50
California Institute of Technology	USA	44.5	1.50
University of Southampton	UK	37.5	1.44
Universidad de Concepción	Chile	36.9	1.39
British Antarctic Survey	UK	238.5	1.37
Victoria University of Wellington	New Zealand	35.0	1.34
University of California at San Diego	USA	78.2	1.33
University of Melbourne	Australia	38.5	1.33
Woods Hole Oceanographic Institution	USA	33.7	1.31
Massachusetts Institute of Technology	USA	33.5	1.31
Monash University	Australia	39.3	1.28
Oregon State University	USA	31.1	1.28
Pennsylvania State University	USA	33.5	1.27
German Aerospace Center	Germany	30.3	1.26
Australian National University	Australia	49.2	1.22
Dalian Polytechnic University	China	54.7	1.21
University of Tasmania	Australia	175.2	1.21
CNRS	France	126.4	1.21
University of Bremen	Germany	56.4	1.18
United States Department of Energy	USA	36.1	1.18
CSIC	Spain	57.6	1.11
Australian Antarctic Division	Australia	78.4	1.11
University of Colorado Boulder	USA	91.3	1.11
Alfred Wegener Institute - Helmholtz Centre for Polar and Marine Research	Germany	143.4	1.10
Japan Agency for Marine-Earth Science and Technology	Japan	39.7	1.08
University of Cape Town	South Africa	44.0	1.08
NIWA	New Zealand	46.0	1.02
University of Cambridge	UK	50.3	1.02
Universidad Austral de Chile	Chile	47.8	0.98
Ohio State University	USA	34.2	0.91
University of Otago	New Zealand	47.5	0.88
Universidade Federal de Minas Gerais	Brazil	32.0	0.87
University of Pretoria	South Africa	37.4	0.84
Hokkaido University	Japan	34.3	0.84
Chinese Academy of Sciences	China	159.7	0.83
National Research Council of Italy	Italy	76.7	0.82
The University of Tokyo	Japan	34.5	0.82
Southern Marine Science and Engineering Guangdong Laboratory - Guanzhou	China	42.9	0.81
University of Chinese Academy of Sciences	China	65.6	0.81
Universidade de São Paulo	Brazil	44.4	0.78
Consejo Nacional de Investigaciones Científicas y Técnicas	Argentina	157.6	0.78
Ocean University of China	China	119.2	0.77
Universidad Nacional de La Plata	Argentina	36.2	0.76

National Centre for Antarctic & Ocean Research	India	53.8	0.75
Universidad de Magallanes	Chile	47.8	0.73
Research Organisation of Information and Systems, National Institute of Polar Research	Japan	53.7	0.71
Ministry of Earth Sciences	India	42.7	0.69
Universidad de Buenos Aires	Argentina	35.4	0.69
University of Science and Technology of China	China	31.5	0.68
Tongji University	China	62.4	0.62
RAS - P.P. Shirshov Institute of Oceanology	Russia	42.1	0.61
Ministry of Natural Resources of the People's Republic of China	China	177.5	0.59
Korea Polar Research Institute	South Korea	128.5	0.57
Masaryk University	Czech Republic	41.3	0.57
Polar Research Institute of China	China	75.8	0.50
Shanghai Ocean University	China	100.8	0.49
St. Petersburg State University	Russia	70.1	0.49
Universidade Federal do Rio Grande do Sul	Brazil	34.3	0.49
Russian Academy of Sciences	Russia	207.1	0.46
National Antarctic Scientific Center Of Ukraine	Ukraine	38.1	0.45
Wuhan University	China	72.4	0.43
National Academy of Sciences of Ukraine	Ukraine	43.4	0.37
Lomonosov Moscow State University	Russia	41.5	0.30