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Field science and scientific collaboration in the Svalbard Archipelago: beyond science diplomacy

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The presence of non-Arctic and non-European countries in the Arctic has been growing over the past two decades. Given the geographic distance of these countries from the polar region, their presence in the High North may seem surprising. In this article, we study the presence in Svalbard of scientists from different origins and how they interact through an analysis of the field missions in which they are involved. Combining network analysis and interviews, we highlight the role of the stations located in the archipelago for access to the field and the cooperation strategies of scientists, including those from countries that do not have stations above the Arctic Circle. We tackle issues of integration in this area by empirically discussing three logics: (1) scientific autonomy, (2) core-periphery structure, and (3) regional patterns of cooperation, thus going beyond an approach strictly limited to the analysis of science diplomacy policies.

Keywords: Arctic; scientific networks; Svalbard; polar diplomacy; network analysis.

1. Introduction

Polar regions have long been perceived and practiced as remote, ignored, and unknown spaces of the world whose exploration, for territorial conquest or scientific discovery, was the fruit of only a handful of adventurers wishing to create a feat in the context of competitions between nations (Sörlin 2013; Kaalund 2017). But this idea of polar regions being disconnected from the rest of the world must be reconsidered, as many countries are either sovereign or present in some way in these regions—often through scientific bases. In the Arctic, the lands and seas belong to countries that are already sovereign. While there is no question of making any territorial claim, science has become a privileged means for states that are far away to have a presence there, physically or through governance institutions. It is especially the case in Svalbard, where the 1920 treaty recognizes the sovereignty of Norway but gives the signatory countries the right to engage notably in scientific research (Ulfstein 1995; Jensen 2020).

While the Arctic region shreds an increasing international interest as the growing number of observer states within the Arctic Council (AC) since the late 1990s testifies, this interest must take the form of scientific activity. In the Arctic, science is therefore difficult to separate from its political dimension. Science diplomacy (SD), which combines scientific and political practices, is then of fundamental importance for any state that wishes to develop a presence in polar regions (Elzinga and Bohlin 1993; Berkman et al. 2010; Binder 2016).

This article aims to go beyond the official political narratives and study the concrete engagement of non-Arctic countries in Arctic science, as well as the dynamics of international

scientific cooperation in the region. Thus, instead of a top-down perspective, we carry a bottom-up analysis of scientific activity in the Arctic, focusing on science ‘on the ground’. In order to do so, we restrict our analysis to the Svalbard Archipelago, a Norwegian territory whose jurisdiction opens up the possibility for other countries to conduct activities and use its resources. We use the content of a research project database administered by Norway called Research in Svalbard (RiS). First, we show to what extent scientific activity in the Arctic region is connected to SD practices. Second, we analyse the dynamics of scientific cooperation in Svalbard, using a network analysis approach and interviews with scientists from French and Norwegian institutions doing fieldwork in Svalbard. Finally, we discuss the relations between the rationales of SD and scientific cooperation logics manifesting themselves on the field.

Three complementary logics are highlighted by analysing the RiS and interview data: (1) the use of national stations for doing science activities in the Arctic without collaborating, (2) a core-periphery structure with Arctic countries at the centre and countries dependent on the core countries for their scientific investment in the region on the periphery, and (3) regional logics with the growing involvement of European countries in the Arctic through paired regional collaborations. Drawing upon this, we argue that scientific integration in the region can be achieved through different means and that collaboration and autonomy can codevelop.

Section 2 reviews the importance of SD in the Arctic where engagement in regional governance is closely related to the opening of research stations, particularly in Svalbard.

Despite the many acceptances of SD, depending on the actors considered (Rüffin and Rüländ 2022), there is a consensus in the literature on the value of SD for governance and international dialogue in the Arctic (Berkman 2014; Caymaz 2021). The Arctic is often depicted as a ‘laboratory of global governance’, in which SD plays a major role in maintaining peaceful dialogue and opening up the region to exterior states (Bertelsen 2019). Some papers are more descriptive of the strategy used by non-Arctic countries to participate in regional dialogue through science and of what the role of an Observer in the AC comprises (Graczyk et al. 2017), and some contributions highlight the many different levels of engagement in scientific cooperation (Knecht 2017b; Knecht and Spence 2019). In particular, Knecht and Spence (2019) identify a gap in the scientific cooperation in the AC between the European observer states, which gained their status in the 1990s, and the late group of Asian countries, which joined in 2013. There thus needs to be a clear distinction between science as a political strategy for integration into Arctic dialogue and science as a dialogue itself through cooperation. The latter may not always be a political tool, but is a main element of SD, which uses scientific dialogue to pass on political incentives.

2.2 The gap between political discourses and scientific research on the ground

We observe a renewal in recent years of SD literature on the Arctic, which has an increasingly critical perspective (Rüffin and Rüländ 2022), in particular, moving on from the generally positive view of SD to the critique of a gap between discourses and practices (Ruffini 2020). Wood-Donnelly and Bartels (2022: 2) provide an interesting categorization of the literature on SD in the Arctic, with notably two main trends: (1) the role of science in cooperation, especially in environmental matters, and (2) the role of SD in the integration of non-Arctic states into cooperation networks and in asserting their legitimacy to participate in regional discussions. This literature emphasizes the versatility of the concept of SD, which is useful for understanding Arctic cooperation dynamics but does not always reflect the diversity of states’ strategies (Rüffin and Rüländ 2022). We note that the study of SD in the Arctic mainly relies on strategic documents and discourse analysis (Binder 2016; Łuszczuk, Padrtova, and Szczerbowicz 2020; Strouk 2020; Everett and Halaskova 2022; Rüffin and Rüländ 2022; Wood-Donnelly and Bartels 2022), which is a widely used method in political science. Some papers, such as Rüffin and Rüländ (2022), seek to go beyond this ‘top-down’ perspective, which ultimately reflects only the official ambitions and discourses of diplomats and little of the concrete role of scientists. They combine their analysis of policy documents with two more specific case studies, the AEIASC and international RiS. However, even these two case studies are based on a method of discourse and strategy analysis and reflect little of the researchers’ actual involvement in the field. This critique of going beyond just grey literature analysis has already been carried out by Knecht (2017a,b) and Spence (2016) who proposed an analysis of the actual participation of observers in the AC working groups, respectively, through running a database of stakeholder participation and a social network analysis. They also identified a gap between the official states’ discourse on their involvement in Arctic activities and their

actual participation (Spence 2016) and recorded all contributions to the working groups through attendance at meetings and writing of reports. Not surprisingly, they demonstrate that there are different levels of involvement in the AC’s scientific activities, which do not necessarily match the narrative depicted in policy papers. Such analyses show the need to assess the involvement of actors more than describing their ambitions, which might be a gap in the Arctic governance literature (Knecht and Laubenstein 2020) and SD in general. However, these contributions mostly focus on the level of states’ involvement, little mentioning the case of individual scientists and referring to their contribution in Arctic fields. To overcome this limitation, we propose to carry out a ‘bottom-up’ analysis of scientific cooperation in the Arctic. In other words, by looking concretely at the scientific network of international cooperation in the region and its dynamics, we wish to enrich the analyses of the discourses of non-Arctic states that have scientific activity in the region. Is the assertion of substantial scientific activity, as in Liu’s (2018) paper, really a reflection of the integration of a state into Arctic science? Thus, in Section 3, we propose a method to measure the integration of countries into science in the Arctic, based on the study of research missions carried out in the Svalbard Archipelago.

In this prospect, we restrict the scale of our analysis of Arctic science to the Svalbard Archipelago. Indeed, all non-Arctic states with an Arctic research station, except China and Switzerland, have their only station located in Svalbard. The privileged localization of non-Arctic states’ research stations in Svalbard dates back to the 1920 Svalbard Treaty, which granted Norway sovereignty over the archipelago in exchange for the eight signatory states being able to exploit its resources. The exploitation of Svalbard’s mineral resources was then the subject of competition between Norway, eager to assert its sovereignty and gain economic benefits, and the Soviet Union (Pedersen 2009, 2017). After a fatal accident in 1962 at the Ny-Ålesund mine, combined with a general decline in demand, Norway restricted its mining activity on the archipelago. The opportunity to maintain a Norwegian presence arose with the proposal by the then director of the Norwegian Polar Institute (NPI) to install a European Space Research Organisation satellite in Ny-Ålesund and, from 1967, a research station (Paglia 2020). From then on, scientific research became part of a policy of ‘Norwegian presence’ (Roberts and Paglia 2016; Pedersen 2021), which, to be stronger, was combined with the ambitions of non-Arctic nations to open a station in the region. Indeed, from the 1990s onwards, Germany, Japan, the UK, The Netherlands, Italy, France, South Korea, China, and India successively opened a research station in Ny-Ålesund. Paglia (2020) shows that these initiatives by scientists who already had cooperation or research projects in Svalbard were then logistically supported by their home states. Pedersen (2021) further develops the relationship between the presence of these stations and the ‘politics of presence’ of both Norway and non-Arctic states, which can also be reflected in the very appearance of the stations. In addition to Ny-Ålesund and the stations from non-Arctic states, Poland also runs a research station in Svalbard, Hornsund, in the south of the Spitsbergen Island since 1957 (and the International Geophysical Year). Czechia also operates two small bases around the capital Longyearbyen and France, a small seasonal base near Ny-Ålesund,

in addition to its other research station there, shared with Germany.

The opening and maintenance of research stations is an important aspect of SD in the Arctic. [Goodsite et al. \(2016\)](#) argue that it is ‘necessary to consider the role of Arctic research stations beyond pure research’ (p. 646). First, the establishment of Arctic stations has been, for the Arctic states themselves, a tool for the conquest and control of their territory ([Sörlin 2013](#); [Doel et al. 2014](#); [Goodsite et al. 2016](#)). For non-Arctic states, they are a legitimization tool and are fully integrated into their SD strategy ([Goodsite et al. 2016](#); [Roberts and Paglia 2016](#); [Rüffin and Rüländ 2022](#)). Here, the case of Antarctica is an inspiring comparison, because the use of research stations as a legitimization tool is also apparent, as it is an argument for obtaining status in the Antarctic Treaty System. As [Gray and Hughes \(2016\)](#) discuss, there is no agreed mechanism to determine whether a party fulfils the criterion of a ‘substantial research activity’. Thus, most countries demonstrate this with the construction of a research station, which the authors do not see as a meaningful research activity: ‘this largely demonstrates logistical capacity, rather than research activity, and often results in major and persistent impacts on Antarctic terrestrial environments. Our study found that national investment in Antarctic infrastructure, estimated by the number of bed spaces at stations, was not a reliable indicator of scientific output’ (p. 1). By suggesting to consider other indicators of state investment in Antarctic science (by considering the proportionated publications of each state in Antarctic science), Gray and Hughes provide a new perspective on the integration of states in Antarctic science, beyond the rhetoric. This is also our goal, in the context of Arctic research and with the case of Svalbard where most of the non-Arctic states’ stations are located. The opening of an Arctic station is a clear marker of non-Arctic states’ investment in research, but what does this reveal about their effective integration? Moreover, many analyses are restricted to studying states that have ‘official’ status in Arctic science, either as observers to the AC ([Strouk 2020](#)) or as members of the IASC ([Łuszczuk, Padrtova, and Szczerbowicz 2020](#)). The analysis of research projects in Svalbard may reveal the inclusion of states that do not mention a strong scientific ambition in the Arctic but carry out projects there. Thus, in the following paper, we propose to analyse non-Arctic states’ scientific integration through the lens of their Svalbard research activity, which we agree may not be completely representative of their Arctic research activity, but which provides reliable data for a broader analysis. In particular, because Svalbard is the territory where most non-Arctic states have a *physical* research presence through a field station—which, as we discuss, can be a product of SD—we believe that it is a strategic area to focus on in our analysis of scientific integration in the Arctic.

3. Materials and methods

3.1 The RiS database

The study of scientific dynamics and cooperation between countries is traditionally performed using bibliographic databases such as the Web of Science Core Collection, Scopus, or Dimensions. These databases comprise scientific publication metadata. They can be used to build thematic corpora³ and to analyse their characteristics (e.g. the volume

of publications per country using the authors’ countries and international collaboration using coauthorship as a proxy for cooperation).

In the case of Arctic science, it is then possible to measure the scientific activity dealing with Arctic matters. Examples of this bibliometrics approach to Arctic science are given in the work of [Aksnes and Hessen \(2009\)](#) on the development of Polar research from 1981 to 2007 and more recently in the work of [Bordignon \(2021\)](#) on permafrost research from 1948 to 2020. In the former, Aksnes and Hessen predetermine a list of Arctic place names and select the publications mentioning them. In the latter, Bordignon selects all the publications dealing with permafrost and searches for all place names within these publications. Although different in their objective and scope (the second study focuses on permafrost research only), the two approaches offer to measure a share of Arctic paper and to follow the evolving share of Arctic publications per country across time. However, as noted by Aksnes and Hessen, the bibliometric approach does not guarantee that the research was carried out in the Arctic territory since it is possible to write on the Arctic without ever having set foot on the territory (e.g. using remotely available data). Sometimes, Arctic places occur in a publication together with non-Arctic places, which makes the categorization of ‘Arctic science’ even more problematic. When the research does not require accessing the territory, the logistical effort and the funding needed differ greatly. Indeed, as demonstrated by [Schild \(1996\)](#), logistic issues to access the Arctic are the biggest vector and reason for installing a station or developing joint research and international consortium. Thus, [Aksnes and Hessen \(2009\)](#) even interpret the difference between the share of articles produced on the poles and the presence on the poles (in terms of the number of staff and stations) as reflecting cases where the presence is purely strategic but not the result of a real scientific commitment. This argument, coupled with the limitations of the publication data mentioned later (mentioning the name of an Arctic location in a publication does not imply that a mission was carried out there, nor does it mean that the article deals specifically and solely with the polar region), justifies our looking at an alternative source.

As it includes the reporting of projects carried out in Svalbard, the periods of field presence, their duration, as well as the partners involved, the RiS database is particularly promising for better understanding Arctic-related scientific activity that results in field missions and the use of stations in Svalbard. As with every source, RiS has limitations, and in particular, as RiS is administered by Norway, only researchers going to conduct fieldwork in one of the scientific stations of Ny-Ålesund are obliged to report their project within the database. As a result, fieldwork conducted in other areas of Svalbard (e.g. in the Russian station of Barentsburg) is not necessarily reported. Still, several projects are recorded (186 Russian projects), which shows that the content of the database is not limited to the activity carried out in Ny-Ålesund.

In addition to the logistical argument that prompted the creation of the database, the second argument invoked by the Norwegian authorities for the development and the open access release of this database is that of better coordination of research. Indeed, the increase in interest in the Arctic and the multiplication of stations belonging to different countries are likely to lead to the development of research whose

purposes and results partially overlap. This is a known phenomenon mentioned by [Aksnes and Hessen \(2009\)](#) in the case of Antarctic research. This risk, combined with the fact that the Polar territories are protected areas, which are important not to overcrowd, legitimizes the establishment of international cooperation and better coordination of research. This last element is central in explaining the development of the RiS database. Given this objective, the database itself could be viewed and studied as a tool of SD in the Arctic. The international cooperation network that can be reconstructed from RiS is therefore at the core of the results presented in [Section 4](#).

3.2 From RiS research projects to network analysis

As of February 2022, the RiS database registers 4,124 distinct projects from fifty distinct countries. Apart from two projects, all the projects' starting years are after 1965. The two exceptions are the following:

- (1) The first, named 'Monitoring of Earth's magnetic field', dates back to 1921 and ends in 2014. Led by Norway only, this project is a long-term monitoring of the Earth's magnetic field at five separate sites: Ny-Ålesund, Longyearbyen, Bjørnøya, Hopen, and Jan Mayen.
- (2) The second is not a project per se, but the list of the installation of the sixteen weather stations present in Svalbard, their precise location, and their creation date from 1918 to 2016.

In [Section 4](#), we analyse the international relations between the countries present in Svalbard and highlight several types of cooperation based on an analysis of the 2,816 national projects (carried out by the institutions of a single country) and the 1,308 RiS projects carried out jointly by institutions belonging to different countries, i.e. 32 per cent of the total corpus. To analyse the relationships between countries, we use the methodological apparatus of network analysis.

The network considered is obtained from the links between countries and projects. A link is established between each pair of countries contributing to the same project, which, in the language of network analysis, amounts to moving from a two-mode network (Project–Country) to a one-mode network (Country–Country) directly linking countries participating in common projects. The links making up this network can be defined in two different ways:

- (1) Binary: the link between two countries is worth 1 when there is at least one joint project between the two countries, and the link is worth 0 when the two countries have no joint projects;
- (2) Valued: a value is assigned to the link according to the number of joint projects.⁴

When the network is weighted by the number of joint projects, we can see that it is strongly polarized around a few countries and Norway, in particular ([Fig. 1](#)). Norway occupies a truly central position in the network since it has both the most partner countries and the highest volume of collaborative projects (in other words, it is the node in the network with the highest unweighted and weighted degrees).

In what follows, we highlight three logics of cooperation, their manifestation, and their dynamic:

- (1) First, we distinguish between countries according to their greater or lesser propensity to develop projects without international partners and therefore autonomously. We explore the link between this propensity for scientific autonomy and the ease of access to a station.
- (2) Second, we demonstrate that the overall structure of the network follows a 'core-periphery' logic and we use a partitioning algorithm to highlight the countries belonging to the core and those belonging to the periphery.
- (3) Third, we demonstrate the existence of privileged intra-continental links, particularly at the European level.

The dynamic is examined by considering the network as a whole and then distinguished between two main periods (the state of the network before 2005 and the state of the network after 2005). The choice of this periodization is consistent from the point of view of the distribution of RiS projects ([Table 1](#)) as the pace of change in the number of projects per year changes after 2005 and the fact that, as explained by [Spence \(2016: 80\)](#): 'the acclaimed 2005 Arctic Climate Impact Assessment (ACIA) [marks the beginning of a period when] the Arctic and the Arctic Council grew in prominence globally'. Interestingly, Spence used the same periodization in her core-periphery analysis of the AMAP (one of the AC's working groups) and found 'that actors from non-Arctic states have always played a role in the work of the AMAP and their role has increased in the last decade as the Arctic has gained in prominence [and that] Arctic Council Member states have consistently made up the core of the AMAP's networks of experts and officials; while non-Arctic states have held peripheral positions' (2016: 75). To better dive into and assess the dynamics of the core-periphery structure found in the RiS network, we use a partitioning algorithm. In [Section 4.2](#), we present the partitioning algorithm we use to bring out the core-periphery structure along with its outcome, that is, the positioning of the countries in this structure and the evolution of this positioning.

3.3 Interviews

As this network analysis is based on field project data and not on publications, it leaves more room to interpret cooperation in the data as cooperation in the field. However, it does not say how these scientific collaborations are formed and performed in the field. Thus, we also conducted a series of interviews with scientists working in French and Norwegian research institutions to understand why they chose to conduct fieldwork in Svalbard and how they got access to Svalbard and collected narratives of experiences in the field. Twenty-five interviews were conducted between February and April 2020 with twelve researchers working in Norwegian institutions based in Tromsø and ten researchers working in French institutions as well as three people involved in Svalbard research management (two from the NPI, in charge of the management of Ny-Ålesund, and one from the Svalbard Integrated Arctic Earth Observing System⁵). We decided to restrict our sample to two home countries, France and Norway: France, to gather the narratives of researchers from a non-Arctic country that is yet historically engaged in Svalbard research, with two research stations, the Corbel base since the 1970s and the Rabot station in Ny-Ålesund, founded in 1999

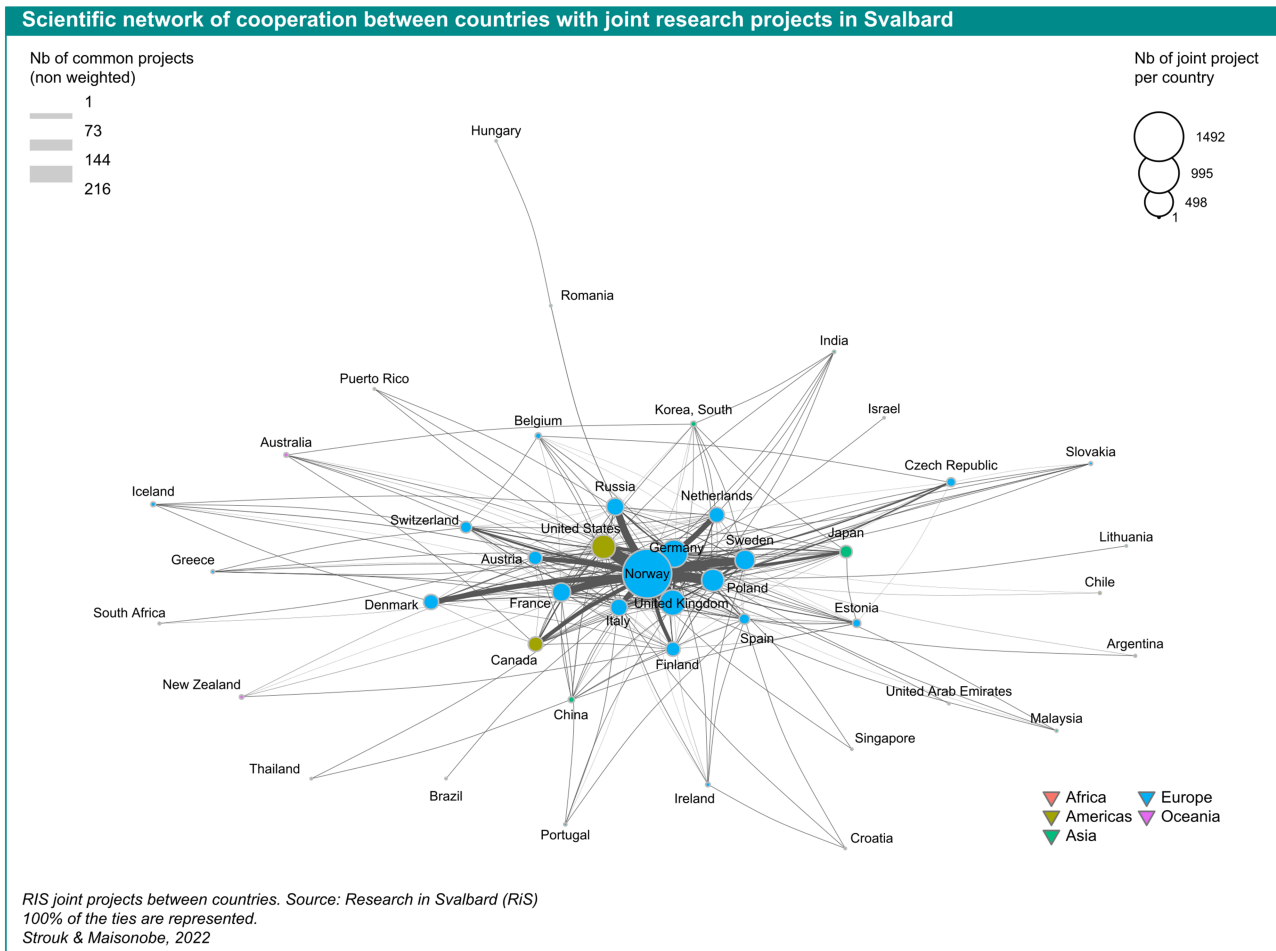


Figure 1. International network of joint research projects in Svalbard.

Table 1. Evolution of RiS projects over time. Number of stations in Svalbard.

	Number of projects	Share of international projects (%)	Share of projects involving Norway (%)	Mean number of countries per project	Number of stations
Before 1985	31	32	81	1.48	4
1985–95	149	56	66	1.85	8
1995–2005	940	39	78	1.53	11
2005–15	1,350	27	54	1.36	13
After 2015	1,654	29	54	1.39	13

and then merged with the German station in 2003 to become the French-German AWIPEV Research Base. We could then collect narratives of researchers out of the Arctic and rely on further logistical challenges to conduct RiS, which may, we assumed, enhance their collaboration strategies. We also interviewed Norwegian researchers located in Tromsø, which is the main city before Svalbard and hence where many scientists doing fieldwork on Svalbard are located. We thus could collect narratives from researchers who are centrally involved in Svalbard research.

These interviews were mostly conducted in person (sixteen interviews), in Paris or Tromsø, and were then conducted online due to the COVID-19 restrictions in place in both countries from mid-March 2020 (nine interviews). The interviews with French researchers were conducted in French, and

we have translated the related quotes in Sections 4 and 5; the interviews with the Tromsø-based researchers were conducted in English. They involved semistructured conversations with scientists around a set of themes: where they go to conduct fieldwork in Svalbard, when, how, and with whom—touching upon issues of accessibility, collaborations in the field, and geopolitical incentives to research activity. We are using these interviews to complete and inform the network analysis as they interact with similar findings or help ask the relevant questions to the findings from the network analysis. Finally, these interviews help to better understand how the researchers effectively use the RiS database, and what could be its limits—in particular, that researchers tend to only use it when they have to book Norwegian-owned equipment, a bed in the stations, or a flight to the village.

4. International cooperation in the Arctic

4.1 National vs international projects

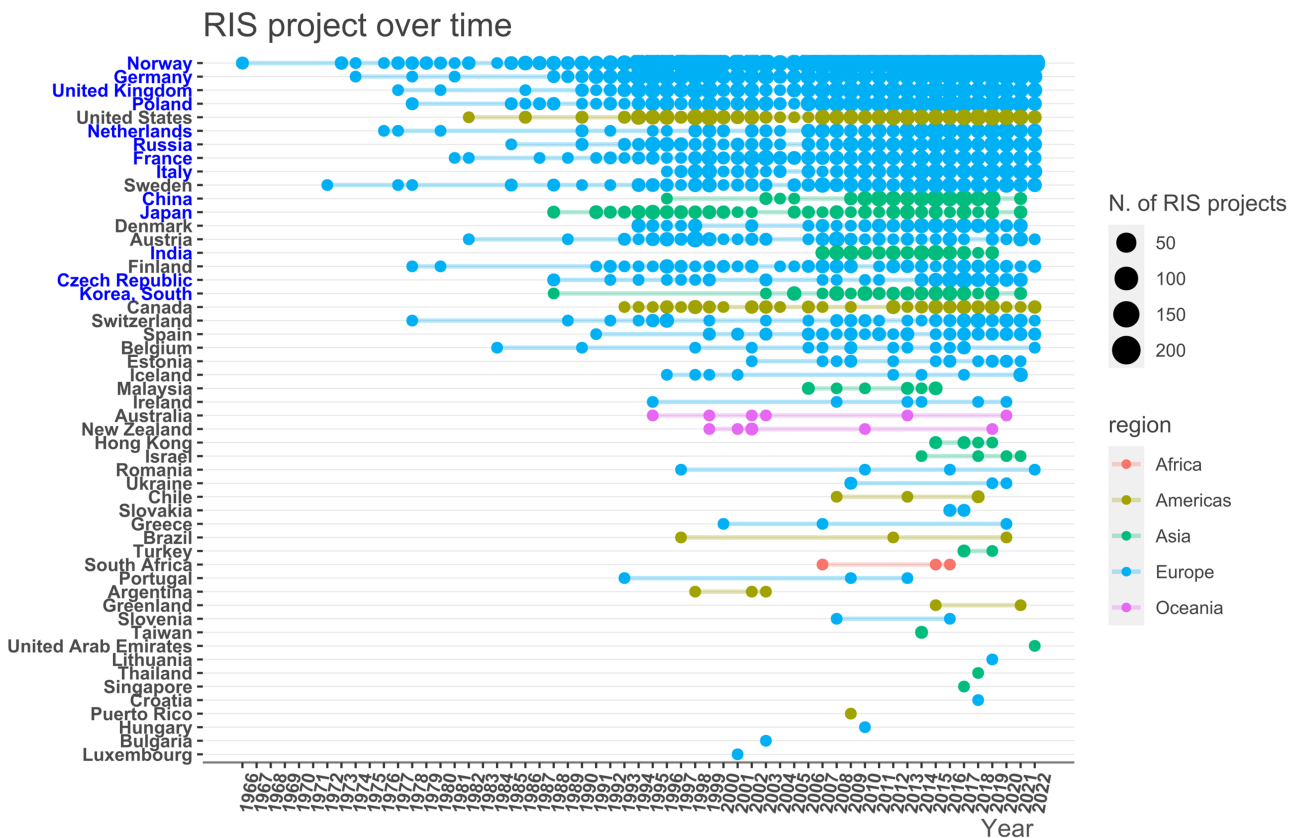
Interestingly, the share of projects that are not the result of international cooperation amounts to 68 per cent. Among them, half are originating from a Norwegian institution. The other half, i.e. 1,409 projects, are originating from thirty-five countries. Most of these national projects originate from countries owning a station in Svalbard (87 per cent), evidencing that owning a station makes easier the pursuit of independent projects.⁶ This observation relates to the progressive decrease in the share of international projects registered in RiS across decades (Table 1). As foreign stations have been established in Svalbard, the share of international projects has decreased (from 56 per cent to 27 per cent) as has the share of projects involving Norway, which has stood at 54 per cent since 2005. However, Table 1 also shows a slight rebound in the share of international projects (from 27 per cent in 2005–2015 to 29 per cent after 2015) and in the average number of countries per project during these two periods (from 1.36 to 1.39). This late rebound in internationalization may result from the incentives for cooperation and the desire for better coordination mentioned earlier (at the end of Section 3.1).

Taking a closer look at the countries contributing to RiS projects over time enables us to witness diversification as well as the participation of a growing number of non-European and non-Arctic countries after 2000 (Fig. 2). Among the top twenty countries in the total number of RiS projects are the thirteen countries to own a station in Svalbard.⁶ Most of

them started to be regularly involved in RiS projects around the same time they opened a station on-site. Seven countries are in the top twenty, but they do not own any station on-site, but only two of them are non-Arctic states: Austria and Switzerland. In both cases, the majority of these two countries' projects are international (87 per cent for Austria and 78 per cent for Switzerland), confirming the need to be either (1) connected to a foreign station or (2) an Arctic country, to intensively carry out RiS—without benefitting the access to a locally based research station.

Compared to their weight in Arctic science as measured by Aksnes and Hessen (2009), the Arctic countries (excluding Norway) contribute relatively little to the research conducted in Svalbard. This is easily explained if one considers that they have other means of access to the Arctic territory and they have stations on their own territories. As Svalbard legally allows the installation of foreign stations from non-Arctic countries, the place lends itself particularly well to the participation of researchers from non-Arctic countries and the development of international missions.

While there is a link between having an on-site station and the propensity to pursue autonomous projects, having an on-site station does not negate the importance of international collaboration. Arctic science, because of its interdisciplinarity, the use of equipment, and therefore its cost, lends itself particularly well to the development of international collaborations (Katz and Martin 1997; Elzinga 2001). Even with the infrastructure for research provided, Svalbard remains a very expensive place to conduct fieldwork, due to the costs



Source: RiS database

Counting method: complete. M. Maisonobe, 2022.

Figure 2. Evolution of RiS projects over time and across nations.

of shipping equipment, hiring trainees, or gathering supplies (Mallory *et al.* 2018).

However, the case of Asian countries with a station differs from that of European countries in this area, except Japan. Indeed, the Asian dynamic of integration in Svalbard is only reflected in a fairly limited number of international projects, in fact, seventy-seven. While the number of projects involving at least one Asian country after 2005 is almost 7.5 times greater than before 2005 (from forty-seven to 341), the subset of international projects has remained practically stable (from thirty-seven to forty). In other words, while eight out of ten Asian projects were international before 2005, only one out of ten Asian projects was international after 2005.

Of the eleven Asian countries with projects in RiS, four now have a station: Japan (since 1991), South Korea (since 2002), China (since 2004), and India (since 2008). In all, of the 311 national projects from Asia recorded on the RiS database, 131 are Chinese, seventy-three are Indian, fifty-eight are South Korean, and thirty-four are Japanese. At the same time, these countries are involved in ten, one, eight, and fifty-three international projects, respectively. While having an on-site infrastructure facilitates the implementation of national projects, it is interesting to reckon that the Asian country with the longest station history is involved in the fewest national projects, i.e. Japan. It confirms that having easy access to the field can go hand in hand with participation in international cooperation projects, including with scientists from countries that also have a station on-site. Indeed, the international projects in which Japan is involved are mainly with European and North American countries. This observation is also consistent with the core-periphery structure highlighted in Subsection 4.2: international projects preferably involve core countries. Of course, this logic of attachment does not prevent the coexistence of cooperation mechanisms based on regional logic as observed for European countries (Section 4.3), but this type of intraregional cooperation logic does not seem to be developing within Asia yet. Except for the case of Japan, Asian scientists use their stations quite autonomously, without implying institutions from other countries in their research projects. This could be explained by the fact that scientists from China, India, and South Korea benefit from adequate funding and resources for their polar missions, whereas European researchers are much more encouraged to coordinate their forces at the international level and/or to collaborate with Norway to benefit from the resources necessary for their field missions. These elements (the funding schemes and resources available) are of course dependent on political choices and therefore can be seen as resulting from distinct national SD agendas: with certain countries, such as China, promoting the development of national autonomy in Arctic matters and resolved to avoid dependence on Norway (Liu 2018).

In what follows, we focus more specifically on the structure of the collaborative network. We apprehend the structure of this network and its dynamics as a reflection of the diplomatic relations between the states present there.

4.2 Core-periphery

The research and analysis of core-periphery structures is a problem that interests specialists in international relations as

well as ‘world system’ theorists. The network approach is particularly well suited to identifying and analysing the evolution of this type of structure. The work of Smith and White (1992) provides a pioneering example. There are several methods for identifying this type of structure (see the review by Yanchenko and Sengupta 2023). The definition that most researchers agree on is (1) that the core is a set of nodes that are highly connected to each other, (2) that the periphery is a set of nodes that are loosely connected to each other, and (3) that the periphery is sparsely connected to the core (Borgatti and Everett 2000). In the typical case that interests us, there is only one core and the countries belonging to the core have a higher number of distinct partners than the countries belonging to the periphery. The core countries, therefore, form a ‘rich club’, in the sense that they are both the most central countries in the network in terms of the number of partners (degree centrality) and they are also highly connected to each other (Ma, Mondragón, and Jiang 2015).

To identify this type of structure, a matrix representation is particularly appropriate. Since the focus here is on international links, the diagonal remains empty. As the links are not oriented, the matrix is symmetrical. A field is black when there is at least one international project between the two countries considered and white when there is none during the period considered. The matrices shown in Fig. 3 are obtained by ordering the countries from the most connected to the least connected (in terms of the number of distinct partners).

In an ideal-typical core-periphery structure, the core countries form a block of black fields in which all possible relationships are realized (probability of intrablock connection P_{11} equal to 1) and the peripheral countries form a block of white fields in which none of the possible relationships are realized (probability of intrablock connection P_{22} equal to 0). The ideal-typical model, therefore, has the form shown in Fig. 4. As the matrix is symmetrical, the probability that the countries in Block 1 are connected to the countries in Block 2 (P_{12}) is equal to the probability that the countries in Block 2 are connected to the countries in Block 1 (P_{21}).

In Fig. 3, we can see that another set of countries is in an intermediate situation in the sense that they are fairly well connected to the most central countries and each other and poorly connected to the least central countries. To account for this complexity and to be able to highlight intermediate blocks (‘semicore’ and/or ‘semiperiphery’), we apply a method called the stochastic blockmodel, as implemented in the R package Greed (Côme *et al.* 2021). This is a probabilistic method for identifying blocks of countries constant in terms of connection probability. The partition obtained is hierarchical (a dendrogram is obtained), which makes it possible to obtain different levels of partitioning.

First, we check that the solution with two partitions (a core and a periphery) is indeed a core-periphery solution in the sense of Gallagher, Young, and Welles (2021) (where $P_{11} > P_{21} > P_{22}$). We can see that P_{11} , the probability that the core countries are connected to each other (0.8 before 2005 and 1 from 2005 onwards), is greater than P_{21} and P_{12} , the probabilities that the peripheral countries are connected to the core (0.17 before 2005 and 0.36 from 2005 onwards), which is itself greater than P_{22} , the probability that the peripheral countries are connected (0.01 before 2005 and 0.04 from 2005 onwards).

of the ‘European project’. Several of the interviewees, Norwegian and French, mention the role of the EU as a key funder of scientific research in the Arctic. Further analysis of the RiS project data could potentially show this large share of EU-funded projects as mentioned during the interviews. What these quotes from French researchers also show is that scientists are aware of the political dimension of their presence in Svalbard and their collaborations with other nations. In their papers on research in Ny-Ålesund, Peder Roberts and Eric Paglia mention that researchers live and interact distinctively from the policies that explain the international gathering in the research village: ‘individual scientists working along Kongsfjorden are often unaware of, or choose to ignore, the geopolitical function of their work’ Roberts and Paglia (2016: 907). However, from our interviews, we note how researchers take up the politics of funding and SD as major drivers for the support they receive to conduct RiS and how they may be encouraged to collaborate with other countries. They do not necessarily perceive this dynamic as negative or impeaching the conduct of their research. Quite the contrary, we note that researchers appear resigned in this political dimension of science in Svalbard, as long as they receive the support they need. The following quotes show this political conscience of scientists in Svalbard, and it is interesting to see when they result from a direct question around the geopolitical dimension of research (Direct Question - DQ) or the researcher making that connection themselves (Researcher’s Connection - RC):

I think that in terms of fundamental research, the research we do up there is very interesting. I think it’s more of a geopolitical tool than a real desire on the part of countries to fund research. I think that research is somewhat at the service of countries’ political issues. For example, in the last five years, a lot of countries that don’t really have a strong link with the Arctic have suddenly set up stations up there [...] I think there is also a strategic, geopolitical side to it. For negotiations when there is no more sea ice, for the opening up of sea lanes, questions of mineral prospecting and all that. It’s about having access to the discussion through research. You can see it a bit in the way that... there are a lot of official visits. So the Minister for Research turns up... It’s a site that’s very popular with political bodies. [...] For us scientists, it’s not a problem because we’re here to do science, so it doesn’t matter who they are or where they come from. (Interviewee 3, France – RC)

Of course, research also serves as a guarantee! Of course. It’s an indirect or direct way of demonstrating your power, and therefore your legitimacy. (Interviewee 4, France – DQ)

I felt encouraged to set up research programmes with either the Germans or the Norwegians. We have an incentive to internationalise our research [...] A presence in Svalbard is a way for them to show that they also have scientific power and legitimacy. (Interviewee 1, France – DQ)

I think countries use research as a means: what is called ‘science diplomacy’ [...] they use science as a way to be there [...]. And of course, they do science. But they are also there because it is a good place to be. It has the combination to be the place on the planet where you can go at the

furthest north, you know you can just buy your ticket, register your project in RiS, and go! [...] And then because of the [Svalbard] treaty. Then, people also want to be there, show presence. (Interviewee 5, Norway – RC)

Thus, scientific cooperation in the field cannot be disconnected from geopolitical incentives and such dynamic is not only perceivable in official documents and narratives but also from the researcher’s experience on the ground: from their interpretation as to why they receive financial and logistical support, are encouraged to conduct research to a specific location, and collaborate with specific international partners. This creates a dynamic of cooperation with Norway, or beyond Norway, with regional partners, or in strict autonomy. Indeed, when a station is run far from Ny-Ålesund, as is the case of the Polish station in Hornsund or the Russian station in Barentsburg, the autonomy towards the Norwegian management is even stronger. There, researchers who are not Polish or Russian have to collaborate with colleagues from that country to use the stations. This logic may explain the development of regional links that do not involve Norway. In the network, we thus observe a privileged link between Poland and Czechia (seventeen common projects) and between Poland and Estonia (five common projects).

5. Discussion: disentangling the drivers behind international scientific cooperation logics

In this paper, we explore how the narrative of science as a tool for diplomacy in the Arctic effectively enacts (1) autonomous integration strategy, (2) international scientific projects with Norway at the core, and (3) intra-European cooperation. In particular, for non-Arctic countries, opening a research station is often part of a SD strategy, but it does not necessarily lead to international scientific collaborations, despite being the main narrative of SD. The costs and logistical challenges of Arctic fieldwork create a need to coordinate research and its means, especially for countries that do not own a station on-site as well as for European countries. Funding schemes, especially at the European level, also enact collaborations. Lastly, we do have to consider the field site as a place to meet and exchange. This is rather a specific characteristic of Ny-Ålesund, as the Norwegian management and set-up of the research village are directed towards meeting, coordinating, and presenting research projects, following the principles of conferences—but in the field. Arctic fieldwork is often depicted as a solitary activity or restricted to a single team of people, whereas its costs and living conditions tend to lead to coordination and collaboration. With thirteen research stations, a shared canteen, a gym, a library, and laboratories, Ny-Ålesund is thus a place to meet researchers from other countries and other disciplines. However, that does not necessarily lead to bi- or multinational cooperation projects. Every week, researchers are invited not only to present their projects, display posters, and participate in thematic (‘flagship’) meetings but also to meet randomly in the alleys of the village or at the cafeteria. The fieldwork becomes a moment to network, and the researchers we interviewed share how they perceive Ny-Ålesund as a place of socialization, which may enact scientific exchanges:

‘It’s not too much about nationality, what can bring people together are common scientific interests. After that, there

publication data, to improve our way of analysing them in a comparable way (Maisonobe 2021). Our analysis is solely based on the Svalbard Archipelago, which is a hotspot of international science in the Arctic, but it should be noted that this situation could well change in the future. Norway is criticized for trying too hard to control scientific activity in the archipelago (Kelman et al. 2020; Pedersen 2021). China is now considering developing certain scientific activities in other Arctic territories, among which are Iceland and Finland (Lipin 2022). France also announced that they plan to open a floating base in Greenland in 2024 (French Government 2022) although this plan has been postponed. Finally, other national fieldwork databases contain information on scientific collaborations in other areas of the Arctic and could complete our analysis, such as the Greenlandic Isaaffik database⁷ or the American Arctic Research Mapping Application (ARMAP) database.⁸

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Data availability

Research in Svalbard data is publicly available to access and download on the RiS data portal: <https://www.researchinsvalbard.no/>. The dataset comprising all the country-to-country ties derived from the RiS database we use in this study has been made publicly available on Zenodo as a supplement to this research article: <https://doi.org/10.5281/zenodo.10847891>. However, interview data cannot be disclosed to uphold the privacy of the individuals who participated in the study

Notes

1. With the limited space to discuss this rich literature, we would also like to highlight the contributions from Turekian and Neureiter (2012), Davis and Patman (2015), Copeland (2016), Ruffini (2017), Kaltofen and Acuto (2018), Turekian (2018), Flink (2020), Ruffini (2020), and Büyüktanir Karacan and Ruffini (2023) for further developments on SD theories, in particular, some critical considerations.
2. Whose territory lies above the Arctic Circle: the USA, Canada, Denmark, Iceland, Norway, Sweden, Finland, and Russia.

3. As it is possible to search within the title, abstract and even (in the case of Dimensions) within the full text of the publications indexed.
4. It is also possible to normalize this value according to the number of countries participating in each project. For each project, the weight of the link could be, for example, a fraction of the number of participating countries. This is not the approach we are taking here.
5. The Svalbard Integrated Arctic Earth Observing System is a coordination tool for long-term measurements in and around Svalbard, specifically for Earth System sciences. It provides specific and coordinated funding, scientific reports, infrastructures, databases, networking, and projects. Launched in 2018, it is joined by most of the non-Arctic countries having a research station in Svalbard except for France, the UK, and China. Website: <https://www.sios-svalbard.org/>.
6. The thirteen countries owning a station in Svalbard are Norway, Germany, Japan, the UK, The Netherlands, Italy, France, Poland, Czechia, Russia, South Korea, China, and India.
7. <https://isaaffik.org/>.
8. <https://armap.org/>.

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