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Coming of age? Asian Arctic research, 2004–2013

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ABSTRACT: This article surveys ten years of Asian involvement with Arctic research, from 2004 to 2013. The Asian countries have consolidated their Arctic research efforts, with publication output, funding and infrastructure showing a marked increase from 2008. Most of this research is in the natural sciences and relates to climate change, but there is also an emerging branch of social science studies. National polar institutes play important roles as links between the science communities and governments. Asian polar research still focuses more on Antarctica than the Arctic. As to the relationship between research and policies, there is little evidence that the Asian governments have aspirations of gaining political influence through their Arctic research.

Introduction

The Arctic is changing, not only as regards climatic fluctuation, but also in socio-economic and political aspects (Young 2011: 327). Noteworthy here is growing attention from non-Arctic states. At the Arctic Council (AC) ministerial meeting held in Kiruna, Sweden in May 2013, China, India, Italy, Japan, Singapore and South Korea were accepted as permanent observers.

Asian Arctic research efforts preceded applications for observer status in the AC, but have been little examined. The Asian countries' research in the region has sometimes been interpreted as an expression of wider interests concerning the Arctic. One typical example is the Indian newsoutlet Z News' coverage of Indian president Pranab Mukherjee's visit to Norway and Finland in 2014: the research efforts he mentions are understood as an Indian endeavour to establish a presence in the Arctic (Z News 2014).

Often the focus is on China, as with *The Economist's* (2014) linking of China's sixth Arctic scientific sea expedition to interests in commercial shipping on the northern sea route. Jakobson and Peng (2012: 4–6) point to research institutions as Chinese Arctic actors, and assert that their task is to provide recommendations to policymakers. Chen (2012: 362) interprets China's increasing allocation of resources to Arctic science and the ordering of a second icebreaker as part of a wider Arctic diplomatic strategy. These studies take research as an agent, a site and object in the political landscape, but without going more deeply into what the research actually entails in terms of disciplinary areas, research locations, funding models, places of publication, and whether international cooperation was involved. Some even equate increased Arctic research with political ambitions (such as Blank 2013).

However, before such conclusions can be drawn a more detailed examination is needed. How is Arctic research organised by the governments in the Asian countries? How has Asian Arctic research changed over the last decade? What aspects of the Arctic have Asian researchers studied, and where? How do China, India, Japan and South Korea compare? The ten-year period to 2013 was examined with the aim of uncovering the development of Asian research on the Arctic, in terms of the Asia's four largest economies, China, India, Japan and South Korea. Russia also has territory in Asia, but is also an Arctic country. I limit this survey to strictly non-Arctic countries.

After explaining my choices in mapping Asian Arctic research, I examine how the governments have institutionalised Arctic research, and then investigate the parameters of science: research activities in the Arctic, government spending on Arctic research and infrastructure, journal publications, and finally international memberships and cooperation. This ten-year period shows a marked increase in research infrastructure, in publication volume as well as new Asian initiatives for research networks for researchers residing both in Arctic and Asian countries. However, little evidence is found that this increase originates from aspirations for political influence.

Method, data and definitions

'Arctic research' is understood as referring to 'research on the basis of material from the Arctic region, around Arctic-based phenomena or which is directly aimed at usage in the Arctic region' (Aksnes and others 2012: 12–13) This definition does not necessarily require the scientist(s) to have been physically present in the Arctic area.

I have concentrated on parameters that were obtainable and comparable. Funding for research usually gives a good indication of how serious a government is in pursuing a given topic, but comparable data for the four Asian countries proved difficult to obtain. I consulted a range of sources: statistics, databases, relevant publications and the information from these countries' own polar institutes: the Polar Research Institute of China, India's National Centre for Antarctic and Ocean Research, Japan's National Institute of Polar Research and the Korea Polar Research Institute. The following indicators were chosen: the role of the national polar institutes, investments in infrastructure and scientific funding, research activities such as scientific cruises, and publication output. Scientific publishing is important in science, both for the standing of the various institutions and for the scientific debate. I used the worldwide databases Web of Science and Scopus to collect Asian Arctic research articles. However, while these are excellent for locating work published in Europe or North America, they are not comprehensive regarding publications in Asia, although journals in Asian languages are covered by the databases. Therefore I checked several Asian national science websites, China Knowledge Resource Integrated Database, India's National Institute of Science Communication and Information Resources Online Periodicals Repository, Japan's ScienceLinks and KoreaScience.

My findings are not exhaustive. There probably exists Arctic research that I have not located, perhaps published in Asian languages, such as Japanese and Korean. Despite this shortcoming, the findings give an indication of publication trends. Further, only scientific articles were included, not monographs or edited volumes. The articles were wholecounted: for each article with at least one, say, Indian (co-) author, I have counted that article as one. (Another option would have been fractional counting: taking one article and dividing it by the number of authors, see Pendlebury 2008: 4). When counting articles in this manner, one cannot simply add co-authorships: a figure of, say, 25% Chinese co-authors and 25% Korean co-authors does not necessarily mean that there were Chinese and Korean co-authors for exactly half of the articles. Most probably, some articles had both Chinese and Korean co-authors, and these were counted twice. Furthermore, not every article with 'Arctic' in its abstract, keywords or title that my searches revealed actually concerned the Arctic. I checked every single article to ensure only those which did involve the Arctic were included in the count. Articles are arranged by country on the basis of the author's institutional affiliation. Quite a few researchers work abroad, which meant they were coded with another country than their native one. On the macro-level, however, my figures should give a fair indication of publication trends. I found most of the articles in Scopus and Web of Science. While journals indexed in those two databases are peer-reviewed, this might not be the case of all the Asian journals found on the Asian science websites. Assuming that the articles found on the science websites were selected on basis of their scientific qualities, I have not distinguished further between refereed and non-refereed journals, unless explicitly stated.

National polar institutes: governmental links and research hubs

Much of the Arctic research conducted in Asian countries is undertaken by scientists working at universities, research institutes and research centres. However, the national polar institutes are central

to the coordination of polar and Arctic research; they also act as links between the government and the research communities.

China has two national polar organisations, the Chinese Arctic and Antarctic Administration (CAA) in Beijing, and the Polar Research Institute of China (PRIC) in Shanghai. Both report to the State Oceanic Administration (SOA), which in turn reports to the Ministry of Land and Resources. The CAA, with a staff of around 40, holds a more administrative function, organising and drafting national polar research strategies and plans. PRIC has a more hands-on role, supervising and managing the polar research expeditions, research stations, the research vessel and icebreaker *Xuelong*, and acting as a domestic hub. As of 2006 PRIC had a staff of 124, rising to around 220 by 2013. The institute also conducts polar research (Brady 2010: 764; CAA 2011).

India's National Centre for Antarctic and Ocean Research (NCAOR) in Goa has overall responsibility for implementation of India's polar research programmes, which also includes undertaking research. The centre is autonomous but is part of the Ministry of Earth Sciences, which also incorporated the India Meteorological Department in 2006. NCAOR has a core staff of about 50; with affiliated researchers and project members, the total is approximately 110. On the occasion of the International Polar Year 2007–2008, the Indian government decided to extend the country's polar research to include the Arctic and to open a research station in Norway's Arctic Svalbard archipelago. Station management was delegated to NCAOR (Khare 2009: 110–111; NCAOR 2012; SaGAA 2011).

Japan's National Institute of Polar Research (NIPR) was established in 1973 under the Ministry of Education, Culture, Sports, Science and Technology (MEXT). It is Japan's key institution for polar science, with management responsibility for the country's polar stations. It is staffed by around 250 employees, but has another 300 affiliated scientists. Within NIPR, the Arctic Environment Research Centre (AERC) manages the Ny-Ålesund research station on Svalbard, facilitates research activities for Japan's research organs in the Arctic region and collects Arctic data (NIPR 2012a, 2012b). NIPR also serves as secretariat to the network Japan Consortium for Arctic Environmental Research (JCAR), with around 300 members. In addition to supporting its members' research, JCAR organises research plans and infrastructure, makes recommendations to MEXT and disseminates research outcomes to the public (JCAR 2012). Polar research is an integral part of Japan's overall science structure. In 2004, the Research Organisation of Information and Systems (ROIS) became the parent organisation to NIPR and other Japanese national institutes of informatics, mathematics and genetics. The intention is to facilitate holistic and interdisciplinary research on issues vital to humanity in the 21st century. In turn, RIOS is one of Japan's four inter-university research institute corporations. Under ROIS, NIPR is part of the Transdisciplinary Research Integration Centre, which works to create new paradigms in the fields of earth environment, life and human and social systems. Here NIPR contributes in the fields of life and earth sciences (NIPR 2012b: 4, 32; ROIS 2011). Unlike the other national polar institutes, NIPR does not manage Japan's research vessels and other sea-vessel research equipment. That task rests with the Japan Agency for Marine-Earth Science and Technology (JAMSTEC).

The Korea Polar Research Institute (KOPRI) conducts scientific research and long-term observations on issues that require data from the polar regions, and coordinates domestic research projects and international cooperation. It also contributes to Korean policy and public services by delivering information to the government and other stakeholders (KOPRI 2012c). KOPRI has an annual budget of around USD 50 million and close to 300 employees in total, some 220 of whom are scientists (de Pomereu 2012b; KOPRI 2012b). In 2011 Korea's Marine Technology Road Map was issued, which prescribed strengthening national competitiveness in the marine and polar fields. Following this, the Ministry of Land, Transport, and Maritime Affairs (MLTM) established the Korea Institute of Ocean Science and Technology (KIOST) in July 2012, as a modern replacement of the Korea Ocean Research and Development Institute (KORDI), which opened in 1973. KOPRI is hierarchically under KIOST, but operates independently. KIOST's personnel is planned to increase to more than 1,700 towards 2020, and there are promises of accompanying governmental budgeted funds (KIOST 2012a; 2012b; 2014).

Asian polar research historically and geographically: Antarctica first

In all these countries, research on Antarctica preceded Arctic research, and the four Asian countries studied here are all signatories to the 1959 Antarctic Treaty. Japan was one of the original signatories. Japan's first polar expedition reached Antarctica in January 1912. Some 45 years later, the Japanese established their Syowa Station in Antarctica. China, India and South Korea all commenced Antarctic research expeditions and established research stations in Antarctica in the 1980s. Even today, the four countries have more research stations and personnel located in Antarctica than in the Arctic: China has three camps and one station, India has three stations, Japan has one camp and four stations, and South Korea has two stations in the Antarctic (COMNAP 2014). Despite an increase in Arctic research efforts between 2004 and 2013, more resources, time and personnel are devoted to research in Antarctica (de Pomereu 2012a, 2012b; NCAOR 2013; NIPR 2012b).

As for the Arctic, Japan was again the first of the four to set up a research station there, in Ny-Ålesund on Svalbard in 1991. Chinese researchers joined in the Arctic expeditions of other countries in the 1990s, and in 1999 the country launched its first national Arctic expedition. In 2002, 11 years after the Japanese station was inaugurated, the Korean research station Dasan was opened in Ny-Ålesund. China followed suit in 2004, with its Yellow River station, and India opened its Himadri Ny-Ålesund station in 2008. Much of the explanation for this expansion of the Asian countries' polar research from Antarctica to the Arctic in recent years lies in their acknowledgement that climatic changes in the Arctic affect the Asian countries as well. For example, studies have indicated connections between developments in the Arctic region and changes in Indian monsoon intensity (CAA 2008; KOPRI 2012a; Nayak 2008: 356; NIPR 2012b: 39). Also researchers from other places in Asia are conducting polar research. Researchers at Taiwan's National University and National Ocean University are the most frequent Taiwanese researchers to publish on polar research. In 2009 scientists from Taiwan were scheduled to partake in China's Antarctic expedition, marking the first cross-straits polar-research cooperation (China Post 2009). In 2004 the Asian Forum for Polar Sciences (AFoPS) was established by the national polar research institutes of China, India, Japan, Malaysia and South Korea, with the aim to facilitate research cooperation in the Asian region on polar science. Indonesian, Philippine, Vietnamese and Thai research institutions are observers to the AFoPS (AFoPS 2015).

Svalbard: an increasing Asian share in Ny-Ålesund

Norway's Svalbard archipelago is the world's most northerly location equipped with modern infrastructure and research facilities. It is also ideal for tracking satellites with polar orbits. This is where the four Asian countries have set up permanent research stations. The 1920 Spitsbergen Treaty gives Norway full sovereignty over the archipelago and Norwegian law applies, but the treaty grants certain rights to the subjects of other signatories. This includes free access to the islands and equal right to pursue certain economic activities, notably mining, fishing, hunting and trade. Scientific research is not listed among these activities, but Norway has in practice conducted a liberal policy on research. In recent years the Norwegian government has actively encouraged the establishment of research stations in Ny-Ålesund, a former mining settlement now designated as the international base for natural sciences. Here Norway as well as France, Germany, Italy, the Netherlands, and the UK have research stations, in addition to the four Asian countries covered in this study. Russia's research base on Svalbard is located in the mining settlement of Barentsburg; and Poland has a Svalbard research station at Hornsund near the southern tip of the main island (Aksnes and others 2012: 57–59).

In Ny-Ålesund, all overnight stays are registered according to the scientists' institutional affiliation. The Asian share is shown in Fig. 1. Between 2004 and 2007 the Asian share was constituted only by Chinese, Japanese and Korean researchers, which can perhaps explain the three per cent increase from 2007 to 2008, when India opened its station. The change from 2010 to 2011 is also notable, with the Asian share jumping from 15% to 21%.

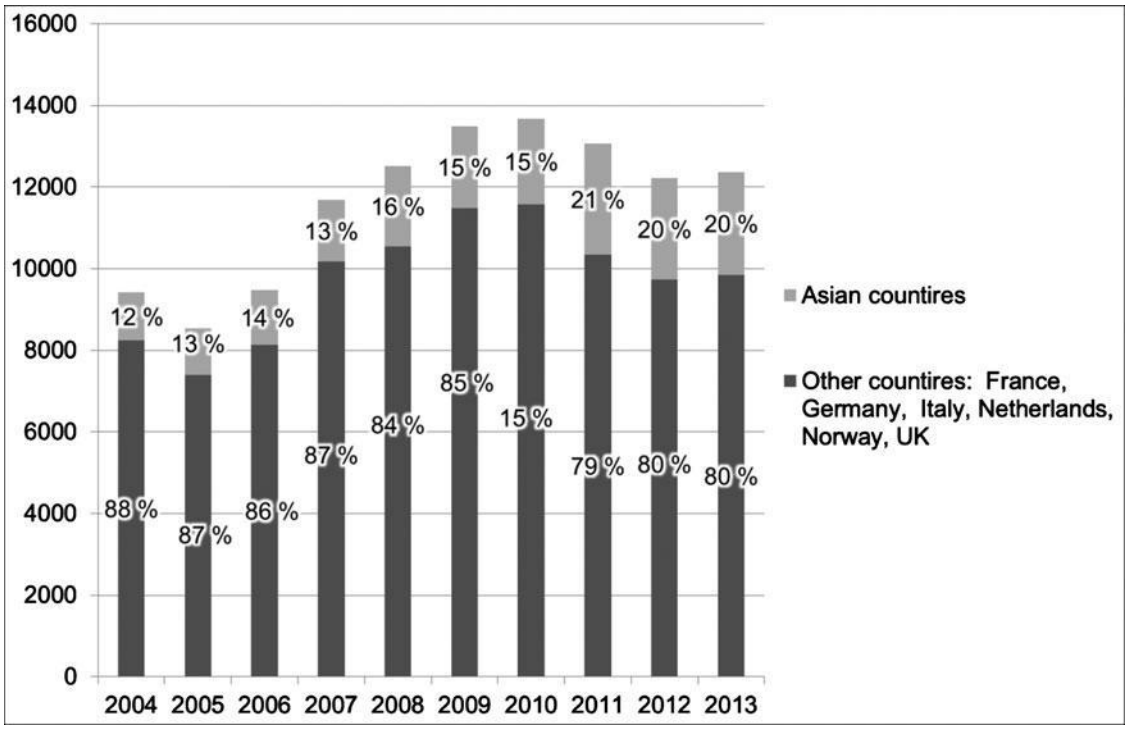

Fig. 1. Asian researchers' share of researchers' overnight stays in Ny-Ålesund 2004–2013.

That increase was driven largely by heightened activity on the part of Chinese as well as Indian researchers. Since 2011, the Asian share of overnight stays has remained stable at around 20%. The overall peak year in Ny-Ålesund was 2010: total stays have declined somewhat since then, but the general trend for the whole period 2004 to 2013 is an increase in overnight stays combined with a greater Asian share of those stays. The balance between states varies. China had the third largest number of Ny-Ålesund overnight stays 2010–2013, after Norway and French/German operations. There was almost a doubling, both in China's overnight stays between 2004 and 2013 and also in in India's overnight stays. The trend was less clear for Japan and Korea, whose annual overnight stays have fluctuated in the period covered here between 90 to 417 for Japan and 204 to 541 for Korea. That Japan is the country with least presence at its Ny-Ålesund station can probably be explained by the presence of Japanese scientists elsewhere in the Arctic. NIPR has also an office at the University Centre in Longyearbyen, the largest settlement on Svalbard (NIPR 2012a). All in all, the Asian presence in Ny-Ålesund has increased significantly, in total numbers and as a percentage, but is still much less than that of Norwegian or French/German activities.

Scientific cruises

Scientific cruises organised by Asian polar institutes have increased in volume over the period 2004 to 2013. Most Asian-managed sea expeditions were conducted after 2007. China sent the *Xuelong* on its third, fourth and fifth Arctic Ocean expeditions in 2008, 2010 and 2012. The Japanese research vessel *Mirai* undertook six scientific cruises from 2004 to 2013; between 2008 and 2013, it was only in 2011 that the *Mirai* did not visit the Arctic. Korean KOPRI has sent its research vessel *Araon* on scientific cruises annually since the vessel was completed in 2009. Scientific cruises are international by nature, normally involving researchers from outside the host country as well. For example, scientists from institutions in ten countries were involved in the *Araon*'s 2012 Arctic cruise, China and Japan included (Kang and others 2012: 9). On launching the Indian Arctic Programme in 2007, India sent its first team of scientists to Svalbard, and has since sent researchers to its Ny-Ålesund station several times a year. India's scientific cruises are conducted mainly in the Southern Ocean, with no Arctic cruises between 2004 and 2013 (Khare 2009: 111–112; NCAOR 2013: 72–76). Of the abovementioned scientific cruises, one is noteworthy for conducting more than scientific data gathering. The fifth Chinese Arctic expedition in August 2012 made a five-day stop at Iceland, on

invitation from the Icelandic president Olafur Ragnar Grimsson. This was four months after then-Chinese premier Wen Jiabao's official visit to Iceland, where China's SOA and Iceland's Ministry of Foreign Affairs signed a bilateral framework agreement on Arctic cooperation and a memorandum of understanding (MoU) on cooperation on marine and polar science and technology. In August the cruise members were invited to the presidential residence, and PRIC and the Icelandic Centre for Research signed research coooperation MoUs on Arctic issues such as climate change and sustainable development, Asian and Nordic economic cooperation, and Arctic strategies, policies and legislation. President Grimsson called the cruise delegation's visit a new pillar of bilateral cooperation between China and Iceland (Nielsson 2013). On its return, *Xuelong* sailed not along the northern sea route and through Russian waters as it had on its outward journey. Instead, it took the transpolar route crossing the Arctic Ocean, in order to investigate future shipping possibilities in the Arctic connecting east Asia and Europe (Nielsson 2013; PRIC 2013).

Increased investments in infrastructure and research funding

The polar institutes and governments of the four countries in focus made substantial investments in infrastructure and research programmes in the period under study. By early 2004, Chinese, Japanese and Korean polar research institutions had established research stations in Ny-Ålesund. India made a considerable investment when it established a research station in the Arctic in 2008. Moreover, following the 2012-framework MoU on cooperation on marine polar science and technology, the Chinese PRIC and the Icelandic Centre for Research (RANNIS) signed in 2013 an agreement to build a joint Aurora Observatory in Iceland, at Karholl near Akureyri. Several Chinese and Icelandic research institutions are affiliated with the observatory, which will focus on aurora, space and physics studies. The observatory was set up in 2013 as a non-profit foundation. The Chinese side put forward ISK 300 million (USD 2.4 million) for construction, expected to be completed in 2016. In October 2013 the observatory's management committee held its first meeting (PRIC 2013; RUV 2014).

Research institutions can seek funding from many sources, and thereby pursue research topics on their own. Major boosts in scientific fields usually require specific government allocations in funding. Furthermore, some infrastructure, like icebreakers, is so costly that only governments can pay. Between 2004 and 2013, both China's PRIC and Korea's KOPRI ordered new research vessels with icebreaker capabilities. Construction of the Korean *Araon* was started in 2007; since completion in 2009, it has visited both the Arctic and Antarctic annually. China's CAA and PRIC signed a contract in 2012 with the Finnish company Aker Arctic for a new research vessel. In 2013, work started on building this vessel, estimated to cost RMB 1.25 billion (USD 198 million). Delivery is set for 2015, with the maiden voyage to the Arctic in 2016. With their considerable activity in Antarctica, the Chinese have not been able to conduct scientific cruises in the Arctic annually, and the new ship is expected to help meet this logistical challenge (CAST 2012b; de Pomereu 2012a; KOPRI 2012a).

Most of the four governments have earmarked funding to Arctic research, often in combination or as part of larger national strategies for the future. In 2006 China's SOA established the research fund for the Chinese polar science strategy, which in the course of three years awarded a total of RMB 5,600,000 (USD 900,000) in funding to more than 70 research applications. Further, in 2012 SOA announced a new five-year polar research project on environmental issues and climate change, involving three Arctic missions and five Antarctic expeditions (CAST 2012a). In 2006 the Chinese government decided to boost the country's research and development efforts, aiming to devote 2.5% of GDP to research and development by 2020. As of 2012, China had reached 2.0% of GDP, up from 1.4% in 2006 (China 2006; World Bank 2014). This increase in Arctic research should be viewed in light of China's overall emphasis on science.

Following recommendations in a report by Japan's working group of Arctic research examination, MEXT instigated a five-year programme, the Arctic Climate Change Project, under the Green Network of Excellence (GRENE). GRENE was established the same year in a strategic effort for national growth, where 'green' innovation was singled out as an important part of Japan's future. The Arctic Climate Change Project was started in 2011, and is scheduled to run to 2016. Altogether 35

institutions and more than 300 scientists are involved. The project has four main goals: to understand the mechanisms of increased warming in the Arctic; to understand the Arctic system's impact on global climate and future change; to evaluate impacts of Arctic change on weather and climate in Japan, marine ecosystems and fisheries; and to prepare projections of sea-ice distribution and Arctic sea routes (GRENE 2011; NIPR 2014; Ohnishi 2015).

Also the South Korean government has placed Arctic research within a larger strategic complex. After the Marine Technology Road Map (adopted in 2011), the MLTM allocated about KRW 3.6 trillion (USD 3.3 billion) towards 2020 to marine and polar technology development. In addition to research funding, support goes to KIOST, Korea's only government-run ocean science research institute, and towards the goal of making the coastal cities of Busan and Incheon hubs for ocean and polar research and industry (KIOST 2012a; 2012b).

Journal publications

Publishing one's findings is one of the researcher's main goals in order to contribute added knowledge to the scientific dialogue and to build one's career. Asian annual publication output of articles concerning the Arctic have more than doubled over the ten years studied here, although Japan's output remained fairly stable. In 2004 Japan published more Arctic articles than the other three countries combined. China surpassed Japan in terms of article output in 2009. Especially notable are China's two jumps in output volume, 2008–2009, and then 2011– 2012. The fairly low total volume of articles from India reflects the fact that the Arctic is a new research area for the country's research institutions (Fig. 2).

Table 1. Academic articles on Arctic issues by Asian authors, 2004—2013

	China	India	Japan	S. Korea
Co-author(s) nationality, in %				
Only nationals	45	65	33	40
AC member-states	41	26	52	51
United States	39	18	35	41
Other Asian countries[1]	9	10	10	18
Topic: Climate change,*%*	65	46	59	50
Published: in national periodicals,%	29	23	17	23
Number of articles published	1120	133	976	298

[1] *= at least one author from one of the other three Asian countries in the study.*

In line with the international orientation of the polar science community, co-authorship with scientists from other countries is common, as shown in Table 1. India stands out because its articles are mostly written by Indian author(s), but the total number of articles is modest. Japan is the most outward-focused, with 77% of its articles co-written with authors from other countries. As a group, scientists from the eight AC member-states are co-authors, writing together with Japanese and Korean scientists, of more than half of the articles. The United States is the most frequent collaboration country of all four Asian countries, followed by the UK at 10% for China, by Germany at 8% for India, and Canada for Japan at 15%. China is Korea's second-largest collaboration partner, with co-authoring of 11% of the articles. Collaboration among the four Asian countries is not as prevalent as with the AC countries, but Korea stands out, with co-authors from the other Asian countries on 18% of the articles. The publication outlets chosen provide further confirmation of the international orientation of Asian researchers: between 71% and 83% of the articles analysed here were published in journals not originating nationally. During the ten-year period, Asian researchers published frequently in such acclaimed international journals as *The Journal of Geophysical Research: Atmospheres, Geophysical Research Letters, The Journal of Climate* and *Polar Biology*. The publication pattern is concentrated around a few major journals, such as the abovementioned international ones. There are also a high number of articles published in thematic national peer-reviewed journals such as China's *Advances in Atmospheric Sciences*, India's *Mausam*, the *Journal of the Meteorological Society of Japan* and South

Korea's *Ocean and Polar Research*. The rest of the articles are published in a great variety of international and national journals, many with only one article, and equally many with two to five articles. Some of the national journals might not be peer-reviewed.

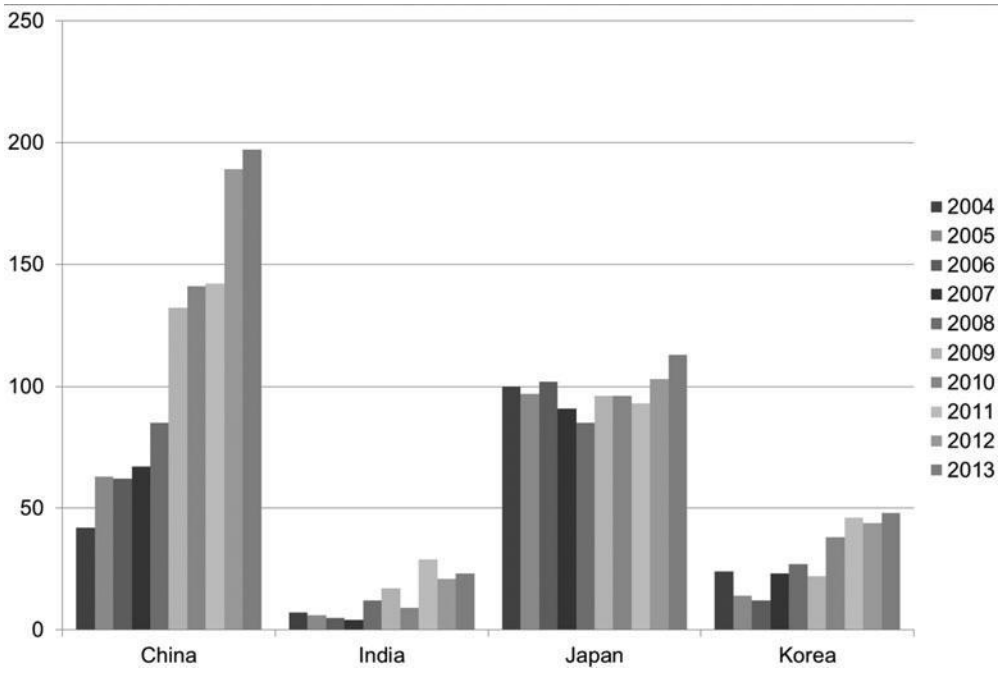

Fig. 2. Arctic article outputs by country, 2004–2013.

Topically, the natural sciences dominate. Climate change and climate-related issues stood for most of Asian Arctic publications, although the proportion varied from country to country (see Table 1). The number of citations of an article is an indication of that article's influence in the scientific dialogue. One of the most cited articles with Chinese authors is that by Liu and others (2012), studying the impact declining sea ice in the Arctic has had on winters in Europe and parts of the USA. They find that the decline of sea ice has resulted in cold and snowy winters in recent years. One of the most cited articles involving Indian authors is Srinivas and others (2009). This article concerns bacterial diversity in Kongsfjorden and Ny-Ålesund on Svalbard, mapping the bacteria's fatty acid profiles. One of the most cited articles with Japanese authors is Shimada and others (2006), which also study the ice cover of the Arctic Ocean. They link receding ice cover in the Bering Sea to inflow of warm summer water from the Pacific. One of the most cited articles involving South Korean authors is Jhun and Lee (2004), which finds a close relation between the East Asian winter monsoon intensity and Arctic Oscillation.

There are also some thematic variations. Five percent of the Chinese articles focused on governance aspects of the Arctic, from a social science or legal angle; 21% of India's articles pertained to bacterial studies, 22% of the Japanese articles dealt with various aspects of oceanography, and 12% of the Korean articles were related to shipping and navigation. This focus on shipping is in line with Korea's economic profile, in which shipbuilding is a cornerstone industry. It is worth noting that between 2004 and 2013 only Chinese researchers published a significant amount of social science articles. These articles were all published after 2008, which co-incides with and reflects the rise in global attention to Arctic natural resources starting around 2008–2009 when the US Geological Service published estimates on the undiscovered oil and gas potential in the Arctic. The Chinese articles present studies of the Arctic countries' own Arctic policies, of Arctic governance structures and mechanisms such as the AC and UNCLOS, of sea route administration and resources such as oil and gas; some also discuss the implications for China. Most of these articles have been published in national journals in Chinese, some likely non-referred, targeted at a Chinese readership.

That there were very few policy-related articles with Indian, Japanese and South Korean authors but considerably more articles with Chinese authors is probably due to several reasons. Firstly, Chinese authors became interested in governance and politics related to the Arctic earlier than did counterparts in the neighbouring countires. Secondly, authors from other Asian countires have also written on Arctic governance and policy implications, but have published such writings elsewhere and not in scholarly journals. For example, the Indian Society for the Study of Peace and Conflict and the Indian Council of World Affairs have published issue briefs and policy notes on Arctic issues. This difference probably also reflects researchers' perceptions of which issues are worth studying in the context of their own countries. A Japanese business approaching investment in the Arctic would probably not create more attention beside the standard business-buzz surrounding any new venture. In 2011, for example, a group of Japanese companies, with the Japan Oil, Gas and Metals National Corporation (JOGMEC), Japan's stockpiling agency as the major shareholder, formed the Greenland Petroleum Exploitation Co. Ltd. (GreenPeX). In 2013 GreenPeX was granted two petroleum exploration licenses by Greenlandic authoritites (Ohnishi 2015). By contrast, a similar case with Chinese companies would probably receive much more attention.

Altogether, Asian output more than doubled over the ten years studied here, due mainly to the Chinese increase. Responsiveness towards the international science community is evident in co-authorships and publication outlets. Articles are generally based in natural science disciplines, with climate change as a major focus.

International memberships and cooperation

While some of the government funding for Arctic research can be linked to national strategy rationales, the researchers and scientific organisations are outwardly focused on the international scientific community. This is shown by the co-authorships noted above, and is also reflected in the affiliations with Arctic science committees, such as the International Arctic Science Committee (IASC) and the Ny-Ålesund Science Managers Committee (NySmac), and international research networks like the international cooperation network on ocean-ridge crest research (Interridge) and the polar earth-observation network, Polenet. Of the four countries studied here, Japan has the largest number of affiliations to international scientific bodies, and India the fewest. This is probably explained by how long each country has focused on the Arctic: as noted, Japan has a longer history of Arctic research than the other three. Asian institutions are not only involved in existing mechanisms for scientific cooperation, they are also creating their own.

In 2004, AFoPS, the forum aimed at strengthening cooperation among Asian scientists on polar research, was established. It was first an initiative with Chinese, Japanese and Korean members, but India and Malaysia joined AFoPS in 2007 (NIPR 2009). Most Arctic research is within the natural sciences, but Asian initiatives for social science cooperation have also emerged recently. In 2011 the Korea Maritime Institute, the Korea Transport Institute of the Republic of Korea, and the US East–West Center together established the North Pacific Arctic Conference (NPAC), which has since become an annual event. The aim of these conferences is to bring together participants from the Arctic and non-Arctic countries, to share ideas and thoughts on challenges in the Arctic. From the Asian countries, researchers have come from China, Japan and Korea. Climate change, Arctic sea routes, safety and security in Arctic shipping, natural resources and governance are among the issues which have been discussed at the NPACs (Kim 2015).

In June 2013, China's PRIC held a China–Nordic Arctic Cooperation Symposium in China, with Chinese and Nordic researchers participating. At the symposium, PRIC proposed establishing a China–Nordic Arctic Research Centre. In December the same year the China– Nordic Arctic Research Centre (CNARC) was officially launched in Shanghai, China. At its inception there were ten member institutions, Chinese and Nordic. Serving as a platform for academic Arctic research cooperation, CNARC aims to increase awareness of the Arctic globally, to support sustainable development in the Nordic Arctic and the coherent development of China globally. In addition to an annual conference, CNARC was established with the intention of facilitating Chinese–Nordic joint research projects and

supporting researchers for visiting scholar exchanges. The PRIC Director serves as CNARC Director, and PRIC also serves as the secretariat for CNARC (AsiArctic 2013). Both NPAC and CNARC have been positively received by reseachers from the Arctic countries.

Concluding remarks: research and politics

Since 2004, there has been an increase in government funding allocations to Arctic research and scientific infrastructure in China, India, Japan and South Korea. Asian scientists spent more time in the Arctic in 2012 and 2013 at the Svalbard research stations and on scientific cruises, than in 2004 and 2005. We have also noted the marked increase in article output, dominated by the natural sciences and climate-change research, but with an emerging body of literature within the social sciences from 2008. That Asian scientists study climate change should come as no surprise. In 2004, Asian Arctic research was just emerging. By 2013 it had become consolidated, mature and intensified, national variations notwithstanding.

Asian Arctic research picked up from 2008, reflecting surging global interest in the Arctic. However, the context of Asian Arctic research should not be forgotten. Asian Arctic research in 2013 was still the 'little brother' of Asian Antarctic research, with more resources and personnel devoted to expeditions and science in the Antarctic. Nor are Asian countries the only non-Arctic countries to increase their research focus on the Arctic. Neither France, Germany, Italy, the Netherlands nor the UK are Arctic states, but they all have research stations in Ny-Ålesund, where they, together with Norway, account for around 80% of the overnight stays. Despite its recent growth, Asian Arctic research has remained less comprehensive than the Arctic research activities and output of other countries.

Earlier accounts have emphasised Asian Arctic research as politically motivated, but without prior examination to back up the claims. What does the study presented here indicate about the relationship between science and researchers on the one side, and policies and government officials on the other?

There exist several connecting areas between Arctic science and politics, domestically and internationally. As is common practice worldwide, Asian scientists offer advice to their home governments. China incorporated the concept of a 'scientific outlook on development' into its constitution in 2008, emphasising the importance of scientific advice in the future growth of the country (Hallding and others 2009: 124). As research and development are national priorities in China, the increase in Arctic research should be understood in this context. India's NCAOR did the work in mapping the country's seabed in support of India's UNCLOS submission for delimitation of the country's continental shelf beyond 200 nautical miles (NCAOR 2014). Korea's KOPRI has provided input to the Ministry of Education, Science and Technology, the MLTM, the Ministry of the Environment and the Ministry of Foreign Affairs and Trade. KOPRI also assisted the government in South Korea's application for permanent observer status on the AC (KOPRI 2009: 49). Furthermore, the Asian polar institutes execute their governments' research agendas and manage the national science infrastructure.

Internationally, the AC is a prime example of a setting in which the scientific community supplies advice to decisionmakers. The working groups, task forces and expert groups provide important input to this political-level forum. The AC observer manual for subsidiary bodies prescribes the working groups as the primary body where observers may contribute. The topics dealt with in the working groups are often technical and scientific in nature, and the meetings provide spaces for experts and bureaucratic representatives to discuss the issues at hand. These working groups are thus important arenas for the Asian states in their new status as permanent observers. Engaging in the activities of the working groups can provide them with information and contacts, but it is also there that they have the opportunity to add relevant knowledge. It is too early to conclude on the Asian effort here, as the timeframe studied goes only to 2013, the same year as permanent observer status was granted. Moreover, the recent CNARC and NPAC initiatives of China's PRIC and South Korea's Korea Maritime Institute and Korea Transport Institute create arenas for bringing Arctic and non-Arctic

researchers together on Arctic legal and social-science issues. These collaborative ventures can provide governments with input from the meetings and findings.

Of the parameters investigated here, can we find any evidence of research being used to pursue political goals? The strongest candidate would be the Icelandic invitation to the Chinese scientific cruise expedition in 2012 to Iceland, where President Grimsson explicitly identified the visit as a pillar in bilateral relations between the two countries. While the Chinese side seemed happy to engage, the initiative was not Asian, but Arctic, coming from Iceland. In looking at Asian countries' interest in the Arctic, we should not lose sight of the relative importance of the region. While the Arctic might be of high importance to the foreign policies of smaller Nordic countries, it ranks further down the foreign-policy agendas of other Arctic countries like the USA. For Asian countries there are other areas closer to home that are more important. The heightened political and scientific focus on Arctic resources since 2008 is not exclusively Asian, but more a global phenomenon. It is difficult to prove aspirations of achieving political impact by the use of research, unless they are made explicit, as in the case of the Icelandic president.

The study presented here reveals a maturing Asian natural-science effort on the Arctic, and an emerging branch within the social sciences. The Asian science community is focused on scientific progress and the international scientific community. Like their counterparts in other countries, Asian researchers may be in contact with both domestic and international polities, providing scientific input when invited. As such, there is little reason for alarm: all research that can contribute to knowledge-building should be welcomed, regardless of the institution or the author's postal address.

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References

AFoPS (Asian Forum for Polar Sciences). 2015. *Who are we?* Incheon: AfoPS. URL: http://www.afops.org/m11.php (accessed 29 May 2015).

Aksnes, D. W., K. Rørstad and T. Røsdal. 2012. *Norsk polarforskning – forskning på Svalbard. Ressursinnsats og vitenskapelig publisering – indikatorer 2010 [Norwegian Polar Research – research at Svalbard. Resource input* and *scientific publishing – Indicators 2010]*. Oslo: Nordic Institute for Studies in Innovation, Research and Education (report 3/2012).

AsiArctic. 2013. The China–Nordic Arctic Research Center (CNARC) officially launched. URL: http://asiarctic.no/index. php/other-events/147-the-china-nordic-arctic-research-center-cnarc-officially-launched (accessed 2 July 2014).

Blank, S. 2013. China's Arctic strategy. *The Diplomat*, 20 June 2013. URL: http://thediplomat.com/2013/06/ chinas-arctic-strategy/?allpages=yes (accessed 4 November 2014).

Brady, A.-M. 2010. China's rise in Antarctica? *Asian Survey* 50 (4): 759–785.

CAA (Chinese Arctic and Antarctic Administration). 2008. Arctic research activites of the Chinese (in Chinese). URL: http://www.chinare.cn/caa/gb_article.php?modid=04010 (accessed 3 October 2014).

CAA (Chinese Arctic and Antarctic Administration). 2011. CAA's main responsibilities (in Chinese). URL: http://www.chinare.cn/caa/gb_article.ph?modid=02001 (accessed 2 October 2014).

CAST (China Association for Science and Technology). 2012a. *China launches polar environmental assessments*. Beijing: CAST. URL: http://english.cast.org.cn/n1181872/n1182018/ n1182078/13722705.html (accessed 2 October 2014).

CAST (China Association for Science and Technology). 2012b. *China to boost Arctic research*. Beijing: CAST. URL: http://english.cast.org.cn/n1181872/n1182018/n1182078/ 13722719.html (accessed 2 October 2014).

Chen, G. 2012. China's emerging Arctic strategy. *The Polar Journal* 2 (2): 358–371.

China (Government). 2006. *China issues guidelines on scitech development program*. Beijing: Government of China. URL: http://www.gov.cn/english/2006–02/09/content_184426.htm (accessed 2 October 2014).

China Post. 2009. Taiwan, China to conduct polar research. Taipei: *China Post*, 29 March 2009. URL: http://www.chinapost.com.tw/china/national-news/2009/03/ 29/202074/Taiwan-China.htm (accessed 29 May 2015).

COMNAP (Council of Managers of National Antarctic Programs). 2014. *Our members*. Christchurch: Council of Managers of National Antarctic Programs. URL: https:// www.comnap.aq/Members/SitePages/Home.aspx (accessed 2 July 2014).

de Pomereu, J. 2012a. *China spreads its polar wings: investigating the infrastructure*. Brussels: International Polar Foundation. URL: http://www.sciencepoles.org/article/ china-spreads-its-polar-wings-investing-in-infrastructure (accessed 2 October 2014).

de Pomereu, J. 2012b. *Korea's polar ambitions*. Brussels: International Polar Foundation. URL: http://www.sciencepoles.org/interview/koreas-polar-ambitions (accessed 2 October 2014).

GRENE (Green Network of Excellence). 2011. *Introduction of GRENE*. Tokyo: GRENE. URL: http://grene.jp/english/about/ (accessed 5 November 2014).

Hallding, K., G. Han and M. Olsson. 2009. China's climateand energy security dilemma: shaping a new path of economic growth. *Journal of Current Chinese Affairs* 38 (3): 119–134.

Jakobson, L. and J. Peng. 2012. *China's Arctic aspirations*. Stockholm: Stockholm International Peace Research Institute (SIPRI policy paper 34).

JCAR (Japan Consortium for Arctic Environmental Research). 2012. *Japan consortium for Arctic environmental research*. Tokyo: JCAR. URL: http://www.jcar.org/english/menu01/ (accessed 26 November 2014).

Jhun, J. G. and E. J. Lee. 2004. A new East Asian winter monsoon index and associated characteristics of the winter monsoon. *Journal of Climate* 17 (4): 711–726.

Kang, S.-H., S. I. Nam, J. H. Yim, K. H. Chung and J.K. Hong. 2012. *Cruise report: RV 'Araon' ARA03B, August 1–September 10, 2012.Chukchi borderland and Mendeleyev Ridge*. Incheon: Korea Polar Research Institute.

Khare, N. 2009. Indian scientific endeavors in Ny-Alesund, Arctic. *Antarctic Record* 53 (1): 110–113.

Kim, J.-D. in press. 2015. Findings and challenges of the North Pacific Arctic Conference. In: Lunde, L., J. Yang and I. Stensdal (editors). *Asian countries and the Arctic future.* Singapore: World Scientific.

KIOST (Korea Institute of Ocean Science and Technology). 2012a. *KIOST backs new future for marine and polar fields*. Ansan: KIOST. URL: http://eng.kiost.ac/kordi_eng/ main.jsp?sub_num=336&state=view&idx=661&ord=0 (accessed 3 October 2014).

KIOST (Korea Institute of Ocean Science and Technology). 2012b. *KIOST celebrates opening for Korea's marine science development*. Ansan: KIOST. URL: http://eng.kiost.ac/kordi_eng/main.jsp?sub_num=360&state=view&idx=663 (accessed 1 November 2014).

KIOST (Korea Institute of Ocean Science and Technology). 2014. *Organization*. Ansan: KIOST. URL: http://eng.kiost.ac/kordi_ eng/?sub_num=423 (accessed 1 November 2014).

KOPRI (Korea Polar Research Institute). 2009. *KOPRI annual report 2008*. Incheon: KOPRI.

KOPRI (Korea Polar Research Institute). 2012a. *KOPRI history*. Incheon: KOPRI. URL: http://eng.kopri.re.kr/home_e/contents/e_1300000/view.cms (accessed 1 November 2014).

KOPRI (Korea Polar Research Institute). 2012b. *KOPRI staff*. Incheon: KOPRI. URL: http://eng.kopri.re.kr/home_e/contents/e_1600000/eng_staff/staffEng.do (accessed 1 November 2014).

KOPRI (Korea Polar Research Institute). 2012c. *KOPRI vision and mission*. Incheon: KOPRI. URL: http://eng.kopri.re.kr/home_e/contents/e_1200000/view.cms (accessed 1 November 2014).

Liu, J. P., J. A. Curry, H. J. Wang, M. R. Song and R. M. Horton 2012. Impact of declining Arctic sea ice on winter snowfall. *Proceedings of the National Academy of Sciences of the United States of America* 109 (11): 4074–4079.

Nayak, S. 2008. Polar research in India. *Indian Journal of Marine Sciences* 37 (4): 352–357.

NCAOR (National Centre for Antarctic and Ocean Research). 2012. *NCAOR*. Goa: NCAOR. URL: http://www.ncaor.gov.in/ (accessed 15 November 2014).

NCAOR (National Centre for Antarctic and Ocean Research). 2013. *Annual report 2012–2013*. Goa: NCAOR.

NCAOR (National Centre for Antarctic and Ocean Research). 2014. *Delimitation of the outer limits of the continental shelf*. Goa: NCAOR. URL: http://www.ncaor.gov.in/pages/researchview/8 (accessed 4 November 2014).

Nielsson, E. T. 2013. The Arctic at a crossroads: north meets east. *Arctic Update*. URL: http://www.dnv.com/industry/oil_gas/publications/updates/arctic_update/2012/01_2012/the_arctic_at_a_crossroads.asp (accssed 3 March 2015).

NIPR (National Institute of Polar Research). 2009. *Asian forum for polar sciences (AFoPS). Report to XXXII ATCM*. Buenos Aires: Secretariat of the Antarctic Treaty. URL: www.ats.aq/documents/ATCM32/ip/Atcm32_ip089_e.doc (accessed 4 November 2014).

NIPR (National Institute of Polar Research). 2012a. *Arctic environment research center*. Tokyo: National Institute of Polar Research, Division for Polar Research, Arctic Environment Research Center. URL: http://www.nipr.ac.jp/english/polar-research02.html (accessed 1 November 2014).

NIPR (National Institute of Polar Research). 2012b. *National Institute of Polar Research Japan 2012–2013*. Tokyo: NIPR.

NIPR (National Institute of Polar Research). 2014. *Arctic climate change research project*. Tokyo: NIPR. URL: http://www.nipr.ac.jp/grene/e/index.html (accessed 2 June 2014).

Ohnishi, F. in press. 2015. Japan's Arctic policy development: from engagement to a strategy. In: Lunde, L., J. Yang and I. Stensdal (editors). *Asian countries and the Arctic future*. Singapore: World Scientific.

Pendlebury, D.A. 2008. *White paper: using bibliometrics in evaluating research*. Sydney: Thomson Reuters

PRIC (Polar Research Institute of China). 2013. *Substantial progress has been made on the China–Iceland Joint Aurora Observatory*. Shanghai: PRIC. URL: http://www. pric.gov.cn/detail/News.aspx?id=92739a68-d8d3–4f2c-87d2–637677274d14 (accessed 6 June 2014).

ROIS (Research Organization of Information and Systems). 2011. *Research organization of information and systems 2011*. Tokyo: ROIS. URL: http://www.rois.ac.jp/pdf/ youran_2011e.pdf (accessed 5 December 2014).

RUV (Icelandic National Broadcasting Service). 2014. *300 milljónir í norðurljósarannsóknir* [300 millions to northern research]. Reykjavik: RUV. URL: http://www.ruv.is/ frett/300-milljonir-i-nordurljosarannsoknir (accessed 5 November 2014).

SaGAA (National Conference on Science and Geopolitics of Arctic and Antarctic). 2011. *Brochure*. New Delhi: SaGAA. URL: http://www.sagaa.co.in/pdf_files/brochure.pdf (accessed 26 October 2012).

Shimada, K., T. Kamoshida, M. Itoh, S. Nishino, E. Carmack, F. McLaughlin, S. Zimmermann and A. Proshutinsky. 2006. Pacific Ocean inflow: Influence on catastrophic reduction of sea ice cover in the Arctic Ocean. *Geophysical Research Letters* 33 (8): L08605.

Srinivas, T. N. R., S. S. S. N. Rao, P. V. V. Reddy, M. S. Pratibha, B. Sailaja, B. Kavya, K. H. Kishore, Z. Begum, S. M. Singh and S. Shivaji. 2009. Bacterial diversity and bioprospecting for cold-active lipases, amylases and proteases, from culturable bacteria of Kongsfjorden and Ny-Alesund, Svalbard, Arctic. *Current Microbiology* 59 (5): 537–547.

The Economist. 2014. China and the Arctic: polar bearings. *The Economist*, 15 July 2014: 47.

World Bank. 2014. World databank. Washington DC: World Bank. URL: http://databank.worldbank.org/data/home.aspx (accessed 5 November 2014).

Young, O. R. 2011. If an Arctic Ocean treaty is not the solution, what is the alternative? *Polar Record* 47 (04): 327–334.

Z News. 2014. *Presidential visit helps India establish presence in key Arctic region*. New Delhi: *Z News*. 20 October 2014. URL: http://zeenews.india.com/news/india/presidential-visit-helps -india-establish-presence-in-key-arctic-region_1487403.html (accessed 5 November 2014).