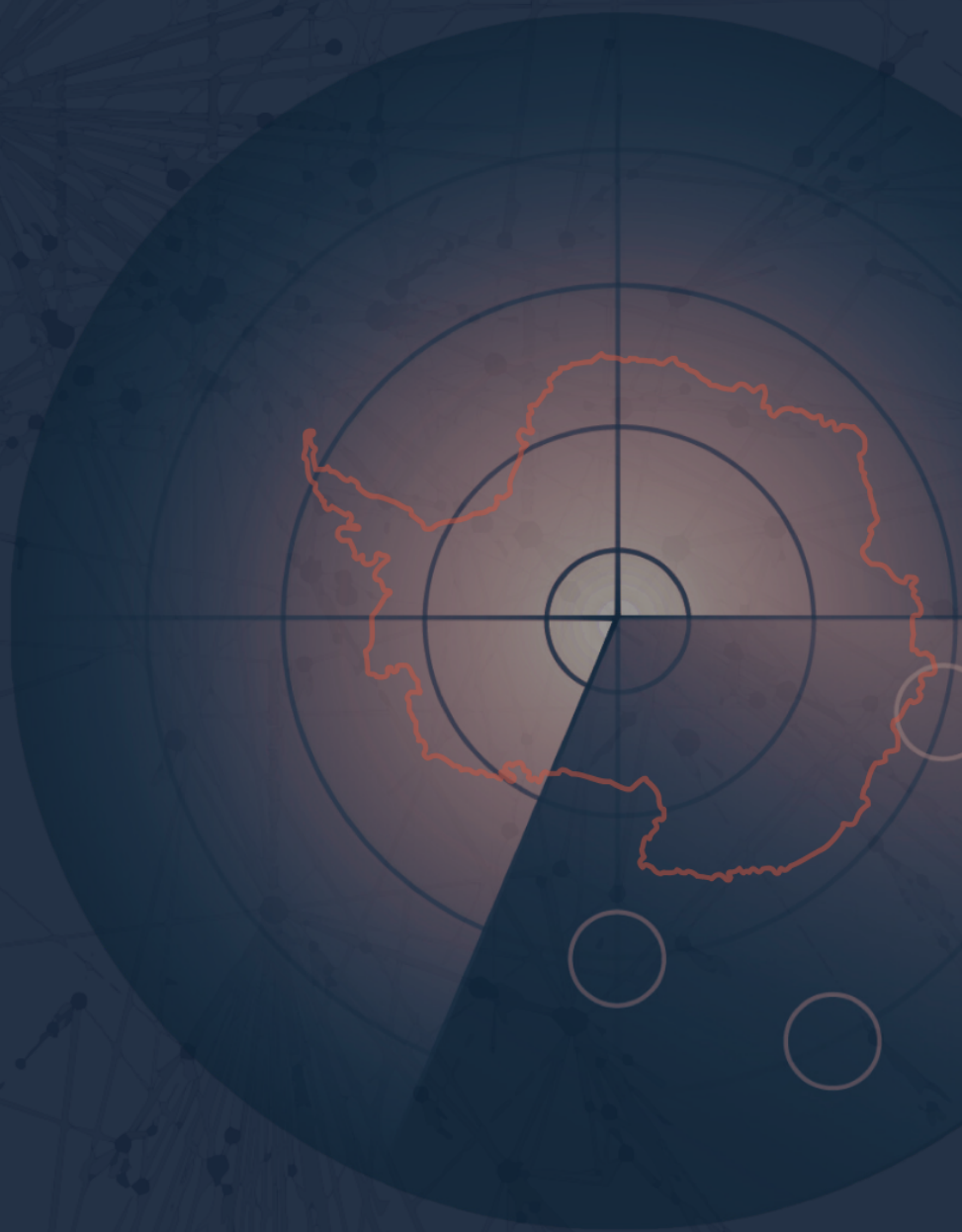


# China in the Arctic

Underwater Acoustic Research



datenna

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## **/ About Datenna**

Datenna is the world's leading provider of data on China's industrial, technological and academic landscape, delivered through its proprietary data platform. The data in the platform is entirely drawn from publicly available information that is translated into actionable open-source intelligence (OSINT). This is delivered exclusively to government clients worldwide, empowering them in their mission to safeguard economic security.

Datenna's unique intelligence platform enables its clients to explore company profiles and shareholder structures, track Chinese governmental subsidies granted to universities and companies, investigate government and defence industry links, and identify technological hot-spots and research trends. Datenna provides a complete picture of China's industry and academic landscape, linking it to the Chinese government and defence ecosystem. This equips users with the necessary tools required to accurately assess national security risks, screen inbound and outbound investments, conduct rigorous due diligence on the export of dual-use goods and map China's technological developments.

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# China in the Arctic

*Strategic significance of the region and key players in the field of underwater acoustic*

## / Introduction

The Arctic holds a unique and critical position, drawing the attention of not just Arctic nations but also countries like China. Its appeal stems from its geographical location, acting as a bridge between Europe, Asia, and North America. Climate change has opened new maritime routes, and its vast reserves of minerals and resources offer economic opportunities. Additionally, the Arctic's uncharted territory is a frontier for scientific exploration.

Yet, the Arctic's extreme conditions present challenges, and effective monitoring is essential. The recent NATO Innovation Challenge, themed "Monitoring the Arctic from Space to Seabed," highlighted this importance, focusing on areas like communication, search and rescue, and preservation.<sup>1</sup>

China, though distant, recognizes the Arctic's strategic value. In June 2023, China conducted successful field tests of an underwater listening device for deployment in the Arctic Ocean, marking its entry into Arctic acoustic surveillance, despite technical challenges.<sup>2</sup>

This report delves into Arctic research technologies, assessing China's involvement. We scrutinize China's Arctic strategy, evaluating associated risks. Our focus is on presenting an overview of the Chinese presence in the Arctic and the technologies developed. Our research methodology employs a combination of qualitative sources, such as policies and white papers, with quantitative data from the use of the Datenna platform to reveal China's role in Arctic exploration and its technological advancements.

## / 1. Relevance of the Arctic region

The Arctic region, encircling the North Pole, lacks a single, fixed boundary definition due to its dynamic nature. Various criteria are used to delineate it, such as the area above the Arctic Circle, regions with July temperatures below 10°C, the northernmost tree line, and areas above 60°N. This extensive region includes parts of Alaska, the Northwest Territories, Greenland, Iceland, Fennoscandia, and significant portions of Northern Russia.<sup>3</sup>



Figure 1: the Arctic, according to the definitions indicated, source: Mineral sources in the Arctic, an introduction, Geological Survey of Norway

### 1.1 Arctic Governance and Frameworks

Unlike Antarctica, the Arctic lacks comprehensive treaties governing its affairs. Instead, a mix of legal instruments, including the Charter of the United Nations, the United Nations Convention on the Law of the Sea

(UNCLOS), and the Spitsbergen Treaty, along with general international law, regulate Arctic matters. The Arctic Council, comprising eight "Arctic States" (Canada, Denmark, Finland, Iceland, Norway, Sweden, the Russian Federation, and the United States), serves as a prominent intergovernmental forum.

## 1.2 Strategic Significance of the Arctic

The Arctic's strategic location at the crossroads of North America, Europe, and Asia is heightened by its rapid warming, occurring three times faster than the global average. This warming has led to ice melting, opening shorter shipping routes between the Far East and Europe, and elevating the Arctic's global geopolitical and economic importance.

The Arctic holds vast untapped resources, facilitated by retreating ice. Valuable deposits include phosphate, bauxite, diamonds, iron ore, gold, silver, copper, and zinc. The American Geological Survey estimates substantial reserves of oil and natural gas, making the Arctic a pivotal player in resource extraction and energy production on a global scale.<sup>4</sup>

## 1.3 Scientific Challenges and Technological Imperatives

Conducting research in the Arctic is hindered by remote, extreme conditions. Innovative technology is required for subsea exploration. Traditional underwater vehicles are limited due to diverse ice sheets. Accessing difficult locations, like under sea, is possible with the help of technology but due to the wide range of ice sheets, underwater vehicles can not surf the water surface to establish links with other air-space or offshore platforms. These difficulties make underwater acoustic technology an important, or often essential, means of information acquisition and transmission under

the ice cap in the Arctic.<sup>5</sup> These specificities are related to the adaptation of sonar technique equipment in an ice-covered environment. Due to the existence of an ice interface, the environment under ice brings new scientific problems to the physical model of sound propagation and new challenges to the application efficiency of sonar technology.<sup>6</sup>

## / 2. China in the Arctic: policies and research funding allocation

### 2.1 China's Arctic Engagement

Over the past decade, China, although not an Arctic state, has displayed substantial interest in Arctic exploration due to its recognition of the region's multifaceted significance encompassing strategic, economic, and environmental dimensions. In response to these interests, China has formulated strategic initiatives designed to legitimize its presence in the Arctic. While these initiatives do not prescribe specific objectives, they serve as symbolic acknowledgments of China's Arctic involvement. Notably, references to the Arctic are embedded in various Chinese policy documents, including the 13th and 14th Five-Year Plans issued in 2016 and 2021, respectively.

China's broader national strategies encompass the "Polar Silk Road" (冰上丝绸之路), initiated in 2013 as part of the Belt and Road initiative, with the aim of establishing an Arctic route connecting China to Europe. Furthermore, in 2018, the State Council Information Office of China articulated the "China Arctic Policy," (中国的北极政策) positioning China as a near-Arctic state.

China's historical engagement with the Arctic is underscored by its adherence to the Spitsbergen

Treaty since 1925. This treaty grants China the right of access to specific Arctic areas and allows for scientific research, production, and commercial activities, including fishing and mining, under certain conditions.

Moreover, China secured observer status within the Arctic Council in 2013, aligning itself with the high-level intergovernmental forum composed of the eight Arctic states. In accordance with the United Nations Convention on the Law of the Sea and the Spitsbergen Treaty, China enjoys the right to engage in scientific research and freedom of navigation within the Arctic.

Civilian scientific exploration can however support the military presence in the region as highlighted by the Annual Report to the Congress of the US: "Civilian research could support a strengthened Chinese military presence in the Arctic Ocean, which could include deploying submarines to the region as a deterrent against nuclear attacks".<sup>7</sup> The link between the civil and military realms is the foundation of China's policy initiative of Military Civil Fusion (MCF). MCF emphasizes the convergence of military and civil resources, capabilities, and technologies, thus promoting the dual use of technologies with military applications for civilian purposes, ultimately enhancing high-tech production and applications.

It has also been suggested that China uses scientific collaboration as a way to acquire a foothold in the Arctic and thereby gain further strategic influence in the region.<sup>8</sup>

## 2.2 Quantitative Analysis of China's Arctic Research

Datenna's analysis of Chinese government funding for Arctic research from 2002 to 2020 reveals a total investment of 62.7 million EUR distributed across 596 research projects. Figure 2 illustrates a steady growth in Arctic-related

research projects from 2012 to 2017, coinciding with the release of China's Arctic policies. Understanding the distribution of research funding offers insights into China's commitment to the Arctic region.

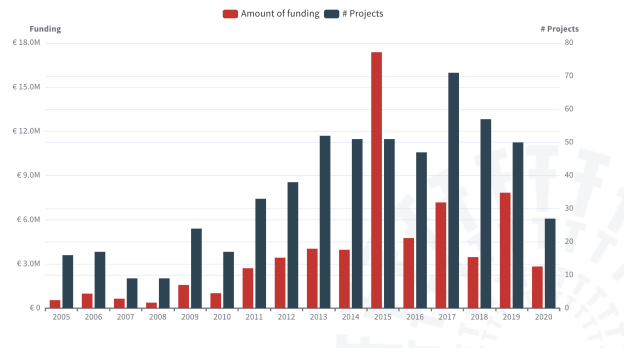


Fig 3: Funding for projects related to the Arctic (1986-2020)

Given the unique challenges of Arctic exploration, there are specifics that make the exploration of the Arctic more difficult. Due to the wide range of ice sheets, underwater vehicles can not surf the water surface to establish links with other air-space or offshore platforms, which makes underwater acoustic technology an important or even the only means of information acquisition and transmission under the ice in the Arctic.<sup>9</sup> Moreover, due to the existence of ice interfaces, the special marine environment under ice brings new scientific problems to the physical model of sound propagation and new challenges to the application efficiency of sonar technology.<sup>10</sup> This makes it of primary importance to develop specific tools that can be used in scientific exploration in such conditions.

Polar acoustic research in China is still nascent but warrants attention considering China's strategic interests in the Arctic. In examining institutions involved in underwater acoustics within Arctic exploration, the Institute of Acoustics, CAS emerges as the primary recipient of government funding in this field, accounting for approximately half of the total funding.



Northwestern Polytechnical University and Harbin Engineering University occupy the second and third positions, with other significant contributors including Ocean University of China, Southeast University, and Shanghai Jiao Tong University.

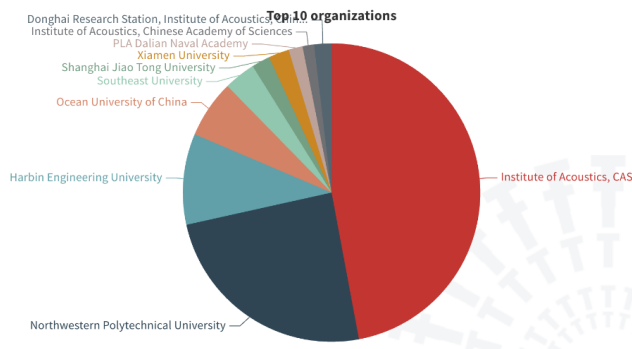


Figure 2: most active institutes and universities within the subfield of "Underwater acoustics and ocean acoustics and aerodynamic acoustics"

### 3. Key Players

#### 3.1 Institute of Acoustics, Chinese Academy of Sciences

The Institute of Acoustics (IOA) of the Chinese Academy of Sciences (CAS) (中国科学院声学研究所), established in 1964, was founded in response to the nation's strategic imperative for acoustics research. The primary areas of IOA's research focus encompass underwater acoustics, underwater acoustical detection, environmental acoustics, and noise control technologies. Significantly, IOA plays a direct role in Arctic affairs, exemplified by Dr. Wu Yuquan's leadership of the acoustic observation group during the 9th Arctic Research Expedition in 2018.<sup>11</sup> Additionally, the institute is engaged in an ongoing study concerning "Progresses and advances in Arctic underwater acoustics research," a topic slated for further examination in the research project section.

In alignment with the Belt and Road Initiative, IOA has initiated a total of eight international cooperation projects, involving countries such as Russia, Portugal, and Norway aimed at exploring acoustical environmental characteristics in the Arctic, Atlantic, and other maritime regions.<sup>12</sup>

#### Research Projects

IOA's research endeavors in the field of underwater acoustics are exemplified by the following table:

Title	Funding	Year
Study on the extraction of green function in ocean noise and its application in the inversion of environmental parameters	€83.2K	2019
Study on the spatial and temporal characteristics of environmental noise in typical sea areas of the South China Sea and its production mechanism	€83.2K	2019
Study on the distortion mechanism and non-distortion extraction of inversion results of seafloor sound attenuation coefficient	€32.5K	2019
Study on the influence of the seafloor terrain on T-phase excitation and transmission	€32.5K	2019
Submarine scattering excites VLA interface wave mechanism	€33.8K	2019
Direct extraction method seafloor reflective coefficient based on the vertical correlation function in the marine environment	€39K	2019
Study on the calculation and propagation mechanism of the whole wave field of the irregular seafloor environment	€28.6K	2019
Study on intensive parameter model and inverse problem of low frequency reverberation in shallow water	€91k	2018
Study on acoustic scattering characteristics of fish in dense state	€83.2K	2018
Research on coupling modeling of ocean model and underwater acoustic propagation model based on internal wave and Vortex	€83.2K	2018

Of particular note is the project titled "Research on detection technology of underwater acoustic



cognition network” (水声认知网络探测技术研究), which distinctly contributes to the advancement of underwater acoustic cognitive network detection technology. This project focuses on designing active sonar signals for underwater acoustic cognitive networks and associated technologies such as underwater acoustic communication and networking, integral to distributed cognitive networks. It supports node layout and collaborative strategies for distributed cognitive networks, enhancing cognitive networked detection capabilities.

IOA's research expeditions, spanning from November 2010 to December in the Bohai Sea (Huanghua, Hebei province) and in June 2012 in the South China Sea, include comprehensive oceanographic surveys and acoustic modeling. These activities mirror the institute's operations in the South China Sea, where an in-depth understanding of the region's waters is vital for the effective operations of the PLA Navy.<sup>13</sup> It is pertinent to note that China's polar programs and South China Sea research initiatives fall under the Ministry of Natural Resources purview.

### *Patents*

IOA's patent analysis underlines a concentration of technologies geared towards submarines and underwater robots engineered to withstand extremely low temperatures, rendering them suitable for Arctic exploration.

### *Procurement Activities*

The institute's procurement records indicate a commitment to research and development in ocean and underwater acoustics, with a focus on defense-related projects. These procurements signify both intent and capability to bolster

military applications within the PLA and Navy. In 2021, IOA secured a contract to supply projects related to underwater acoustics to the Chinese People's Liberation Army.

In terms of the Chinese People's Liberation Army's activities in the Arctic, scholars have raised concerns regarding the strategic implications of the People's Liberation Army Navy (PLAN) missile or attack submarines operating in the Arctic Ocean.<sup>14</sup> Furthermore, IOA's 2021 win of a contract for Navy research on noise acoustic characteristics prediction is noteworthy.

### *Investments*

IOA's investments primarily revolve around technology and acoustics, reflecting its commitment to enhancing technological capabilities. While the majority of investments align with the institute's area of expertise, they also underscore its integral role in China's defense industry. Notably, IOA's extensive investments, while not explicitly linked to Arctic activities, emphasize the institute's commitment to research, development, and the potential for commercial applications in this field.

## **3.2 Harbin Engineering University**

Harbin Engineering University (HEU) (哈尔滨工程大学), a member of the "Seven Sons of National Defence" consortium, collaborates closely with the Chinese People's Liberation Army (PLA) to develop technology with military applications. These universities play a pivotal role in supplying university graduates to Chinese defense state-owned enterprises, with three-quarters of such graduates in 2019 originating from the Seven Sons institutions. Importantly, a significant portion of their research budgets is earmarked for the development of military-related products.

Notably, HEU has drawn attention for its alleged involvement in the development of weapons of mass destruction and has been blacklisted by the Ministry of Economy, Trade, and Industry (METI) of Japan.

### Arctic Engagement

HEU has extended its interests into the Arctic domain. In collaboration with the Russian Northern (Arctic) Federal University, HEU established the Arctic Blue Economy Research Center (ABERC) in 2018. The center's mission encompasses the provision of comprehensive, policy-relevant economic information concerning international collaboration, economic development, sustainability in the Arctic, shifts in China's Arctic policy, and their impacts on stakeholders in the Northern regions. Additionally, ABERC monitors developments along the Russian Arctic coast and coastal waters.<sup>15</sup>

### Research Projects

A significant research project of note is "Research on Cooperative Positioning Technology of Multi-Underwater Vehicles in Polar Regions" (区多水下航行器协同定位技术研究), funded by the National Natural Science Foundation of China (NSFC) with EUR 80,600 allocated to Yu Wei.<sup>16</sup> This project focuses on the crucial importance of the polar region in China's future development, particularly in underwater topography surveying, naval mine detection, coastal anti-submarine measures, and relay communication. Unmanned underwater vehicles play a pivotal role in accomplishing these tasks, with potential

theoretical and military significance for China's navy.

Title	Funding	Year
Research on the bionic directional detection method and mechanism of small targets under water multi-delivery mechanism	€80.6K	2018
Theoretical analysis of underwater acoustic field Gao Jie and high ladder azimuth estimation method small aperture vector linear array	€85.8K	2017
Study on robust adaptive beamforming method of guided self-correction in passive sonar	€26K	2016
Study on the application of time frequency characteristic and warping transform method in shallow sea sound field	€117K	2015
Study on target azimuth estimation technique of acoustic vector circular array phase modal domain under elastic cylindrical shell barrier	€39K	2015
Study on High frequency acoustic scattering characteristics of target newar stochastic fluctuation interface	€32.5K	2015
Research on high-speed underwater acoustic communication technology based on generalized multicarrier m-element CSK spread spectrum	€ 39K	2014
Coherent structure and signal processing of shallow sea sound field	€104K	2014
Theoretical study on dynamic magnetic broadband ultra low-frequency underwater sound source	€32.5K	2013
Study on nonlinear acoustic properties of water-saturated granular media	€109.2K	2013

### Patents

HEU holds patents relevant to unmanned subglacial devices, multi-underwater unmanned vehicles, and underwater communication technologies, particularly in challenging polar conditions.

### Procurement Activities

HEU has actively participated in over 50 tenders related to China's defense industry. These

tenders reflect the university's research efforts, connecting them to China's defense sector.

### *Investments*

HEU has made substantial investments, particularly in underwater technology and shipbuilding. These investments not only underscore the university's leadership in these fields but also its deep integration into China's defense industry. For instance, Harbin Chuanda Engineering Technology Design Research Institute, wholly owned by HEU, controls multiple companies engaged in military procurement or registered as military suppliers. One such company, Harbin Ship Marine Information Technology, won a procurement contract in 2022 to supply the Chinese People's Liberation Army with underwater acoustic navigation and positioning modules.

## **/ Conclusion**

This Datenna report offers a comprehensive exploration of China's Arctic presence and its technological development for scientific endeavors in this region. The Arctic's strategic significance, marked by its geographical location and resource wealth, underscores the need for exploration. However, the challenging Arctic conditions necessitate the development of specialized tools like underwater acoustic technology.

Chinese interest in the Arctic is growing, as evidenced by increased funding for the region. To provide a detailed overview of underwater acoustic research in China, the report focuses on two key academic institutions: the Institute of Acoustics of the Chinese Academy of Sciences and Harbin Engineering University. Both institutions are actively engaged in government-funded research projects, reflecting China's commitment to technological self-sufficiency.

Additionally, their involvement in patents, procurements, and investments demonstrates their deep integration into China's defense industry.

Despite progress, polar acoustic research in China is still in its early stages, highlighting the need to track its development closely. The dynamic nature of scientific research necessitates regular updates to capture evolving developments in this vital field.

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- <sup>1</sup> NATO Information and Communication Agency, "Join the NATO Innovation Challenge 2023: Monitoring the Arctic from Space to Seabed", 10 May 2023.
- <sup>2</sup> South China Morning Post, "China plans massive listening programme at the North Pole after declaring success in Arctic test of underwater device", 9 July 2023.
- <sup>3</sup> Rognvald Boyd, Terje Bjerkgård, Bobo Nordahl and Henrik Schiellerup, "Mineral sources in the Arctic, an Introduction", Geological Survey of Norway
- <sup>4</sup> U.S. Department of the Interior U.S., The U.S. Geological Survey (USGS) "Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic Circle", 2008
- <sup>5</sup> 14th International Conference on Theoretical and Computational Acoustics, Beijing
- <sup>6</sup> 14th International Conference on Theoretical and Computational Acoustics, Beijing
- <sup>7</sup> Department of Defence, "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China, 2019"
- <sup>8</sup> Jana Robinson, "Arctic Space Challenge for NATO Emerging from China's Economic and Financial Assertiveness", The Journal of the JAPCC, Spring/Summer 2020, pp. 35-42.
- <sup>9</sup> 14th International Conference on Theoretical and Computational Acoustics, Beijing
- <sup>10</sup> 14th International Conference on Theoretical and Computational Acoustics, Beijing
- <sup>11</sup> IACAS Participated in China's 9th Arctic Research Expedition, [http://english.ioa.cas.cn/es/201810/t20181028\\_200531.html](http://english.ioa.cas.cn/es/201810/t20181028_200531.html)
- <sup>12</sup> Institute of Acoustics, About us, <http://english.ioa.cas.cn/au/bi/>
- <sup>13</sup> CSIS, Hidden Reach
- <sup>14</sup> Rob Huebert, "Mahan and Understanding the Future of Naval Competition in the Arctic Ocean," Canadian Naval Review 14:3 (Winter, 2019) and Anne-Marie Brady, "China as a Rising Polar Power: What it means for Canada," Macdonald Laurier Institute (December 2019)
- <sup>15</sup> UArctic.org, Arctic Blue Economy Research Center has been established at Harbin Engineering University, <https://www.uarctic.org/news/2018/11/arctic-blue-economy-research-center-has-been-established-at-harbin-engineering-university/#>
- <sup>16</sup> NSFC, the National Natural Science Foundation of China, in accordance with the Government's plans for the development of Science and Technology, is responsible for directing and coordinating funding to support research

## Disclaimer

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