Introduction

The Arctic is now experiencing some of Earth's most rapid and severe climate changes.[1] Some of the implications of climate change in the Arctic region are present, and more are yet to come. When we talk about the Arctic, one thing comes straight to mind: Ice. Changes in sea ice constitute a critical climate change indicator.[2] Over the next 100 years, climate change is expected to accelerate, contributing to significant physical, ecological, social, and economic changes, many of which have already begun. Nevertheless, these unprecedented climate trends are opening new opportunities. Whether a particular impact is perceived as negative or positive often depends on one's interests.[3] In other words, despite the massive impact on ice-dependent flora and fauna, reduced sea ice is likely to increase marine access to the region's resources, expanding shipping opportunities and possibly offshore oil extraction. At the same time, the new challenges that these activities will bring about as a new burden for the ecosystem cannot be overlooked.

Russia has recognised possible challenges but has also declared its potential economic benefits of climate change. A rapidly transforming Arctic relates to huge accessibility in the area, which is rapidly becoming a new frontier of strategic importance.[4] Given the current situation of the crisis with Ukraine and the sanctions imposed by western nations on the Russian Federation, the creation of new communication and trade channels appears – now more than ever – as a good opportunity for new stakeholders to expand their economic activities and, most importantly, an excellent chance for Russia to develop financially by taking advantage of its geopolitical position.

Despite the undoubted impacts on northern cities in Russia due to widespread permafrost thaw, the ice-free Northeast Passage tends to play a leading role in developing marine activities across Russia's Arctic coast. In recent years, the significance of its function as a pathway for transporting energy resources towards Europe to the West and towards Asian markets to the East has been emphasised due to the quick growth of oil and LNG (liquified natural gas) initiatives in West Siberia.[5]

China is already one of the most significant shareholders in the Arctic. Its presence there raises much suspicion and interest among both the Arctic States and the international academic community.[6] Although this topic is intriguing in various domains – legal,

historical, and geopolitical – this paper approaches the economic and political aspects of the two States' motives, analysing the current and future financial prospects of the Northern Sea Route (NSR) and the Sino-Russian collaboration in the Ice Silk Road (ISR) project. In addition, it highlights some of the features that make the NSR an eco-friendly alternative to the Suez Canal Route (SCR). However, at the same time, many concerns are highly related to the increased anthropogenic activities in the Arctic Russian region due to the Belt and Road Initiative (BRI).

Consequently, the first section presents the significance of the NSR for Russia and briefly explains its ambitions and policy regarding exploiting the NSR. The second section points out China's main drivers in its Arctic policy, while the third section provides information with respect to the Sino-Russian economic cooperation and the ISR project, with a particular interest in LNG and its value in the international market. The fourth section stresses the superiority of the use of the NSR compared to the SCR. Specifically, this part contains a number of references to surveys conducted in the period from 2003 to 2019, proving the beneficial use of the NSR at a macro level. However, the fifth section describes the NSR from a different perspective: that of a vulnerable and unique environment that Russia and China are called to protect albeit their financial ambitions. Moving further than that, the sixth section presents the main concerns regarding the intensification of industry and shipping in the region, while the eighth and last section refers to the absence of efficient monitoring centres in the NSR Arctic waters, which deters authorities from having a clear picture in terms of the impact that shipping and other activities in the sea have on the marine environment.

The Northern Sea Route: Legal status and the Russian Ambitions

The NSR is the shipping route along the coast of Siberia, running from the west of the Kola Peninsula through the Bering Strait in the East.[7] It is the shortest and most available sea route linking East Asia and Europe[8] (See Table 1). Specifically, this transport artery connects the Asian, Far Eastern and European ports of Russia and China and the deltas of the navigable Russian rivers into one shipping system.[9]

Table 1- A Comparison of the Two Shipping Routes for the Asian-Europe Trade[10]

Since 1930, Russia has used the NSR as a corridor for the transportation of goods and supplies to its isolated communities in the north.[11] This route has always been a vital communication pathway between the Russian Arctic communities and the rest of the country. The route was officially opened for international shipping in 1991, after Mikhail Gorbachev's Murmansk speech in 1987, in which he promoted international cooperation in the Arctic through shipping.[12] The route was subsequently promoted by the Russian Federation as an attractive sea lane for international shipping,[13] especially after several reports indicated severe reductions in sea-ice coverage in the Arctic Ocean that could eventually make regular international commercial shipping viable from a technical and economic point of view.[14]

Legal Status

From a legal point of view, the NSR includes Russian internal waters, the territorial sea, the contiguous zone and the exclusive economic zone (EEZ), which extends 200 nautical miles from its coastal baselines. For that reason, Russia has accordingly established management and administrative systems in the area. Most importantly, Russia defines the NSR as a national marine route based on historical grounds.[15] In its Federal Law of 31 July 1998 N 155-FZ *On Internal Sea Waters, Territorial Sea, and Contiguous Zone of the Russian Federation*, it refers to the NSR as "the historically established national transportation lane of communication of the Russian Federation".[16] On that legal basis, Russia has made claims that straits along the NSR, such as the Kara Gate strait, the Vilkitsky Strait, Sannikov Strait, and Dmitry Laptev Strait, are internal waters and thus under Russia's absolute control (See Map 1). Therefore, according to Russia, no presumptive rights to navigate exist and foreign ships are required to ask for permission to enter and navigate the NSR's waters through those straits. Some other States and the European Union contest this position and argue that the aforementioned straits are straits used for international navigation, to which the regime of transit passage applies.[17]

Regarding the Russian EEZ within the limits of the NSR, requesting permission *prima facie* contradicts the freedom of navigation provided for in Article 87 of the UN Convention on the Law of the Sea (UNCLOS).[18] In this regard, any rights or jurisdiction exercised by the coastal State must be conducted with 'due regard' for the third States freedoms.[19] However, Article 234 of the UNCLOS provides that coastal States possess extensive

jurisdiction to regulate vessel-induced marine pollution in 'ice-covered regions' within their EEZ.[20] Russia ratified the UNCLOS in 1997. Since then, it has held the position that the NSR administration is justified by Article 234 UNCLOS regarding 'ice-covered areas' and for that has enforced extensive regulations in the region on the basis of its special climatic conditions and environmental fragility.[21] Consequently, according to international law, as well as customary law, Russia has the right to impose the necessary measures for ensuring marine environmental protection, safety of navigation, search and rescue operation as well as the appropriate infrastructure along the region.

As for the internal waters within the NSR, Russia's authority is based on its absolute sovereignty as the coastal State, as mentioned above. Responsible for managing and organising navigation of ships and icebreaking assistance in the waters of the NSR is now the State Atomic Energy Corporation, Rosatom, which recently replaced the Russian Ministry of Transport that was previously in charge.[22] Nonetheless, the Russian Ministry retains supervisory functions over Rosatom and approves plans for the development of the NSR marine infrastructure.[23]

However, in the zones of its territorial sea and the EEZ, where 'innocent passage' and 'freedom of navigation' are applied respectively, the interplay between Russian law on the NSR and international environmental law comes to the forefront.[24] This issue is discussed further below.

Map 1- Russian Straits along the NSR and Maritime Zones[25]

Russian Ambitions

In 2019, the Russian Federation approved the Plan for the Development of the Infrastructure of the Northern Sea Route until 2035.[26] The Russian efforts for the revival of the coastal zone of the NSR relate to new seaports, infrastructure renovation, and economic projects, thus the economic development of the area and especially that of the

remote arctic towns of the Russian north on the verge of extinction. That explains to a huge extent how important international transit through the NSR is for Russia.

The Russian government has repeatedly expressed its ambitions and expectations regarding the volume of transit through the NSR and has also declared its advantageous position in international shipping.[27] As Alexey Chekunkov, minister for the development of the Russian Far East and the Arctic, noted in an interview: "The Arctic is warming faster than the continent-this has a very negative potential, but also a very positive one."[28] The current government has laid out very ambitious projections for the future. According to the latest forecasts by Rosatom, Russia expects that the volume of cargo transportation along the NSR will surpass 270 million tons in 2035, while the plan for 2030 is 193 million tons,[29] which actually exceeds the previous goal of 150 million tons, [30] notwithstanding the crisis and the sanctions. To what extent those targets are realistic remains to be answered. Overall, Russia's Statements and official statistics for its financial gains have provoked reactions internationally among experts.[31]

The dependency of the Russian economy on natural resources explains the role of the Arctic region as a vital national interest. The country is seeking alternative financial inputs. Since the annexation of Crimea in 2014 and the beginning of the Ukrainian-Russian crisis, the western world has imposed a range of economic sanctions against the Russian Federation, radically weakening the Russian economy and isolating Russia itself from the political and economic agenda of the West. Those sanctions became much stricter with the perpetuation of this crisis after February 2022, with the result that Russia is increasingly focusing on the eastern market. China preserves close ties with the Russian Federation and chooses to follow a neutral position towards the Russian-Ukrainian military conflict since many interests are at stake. China knows that Russia is not easy to handle, and its efforts to thrive in the Arctic must be humble and diplomatic. The dynamics in the Arctic region have changed, and a peaceful international collaboration is recommended more than ever.

China's Interest in the Arctic

The Arctic includes the northernmost parts of Europe, Asia, North America, and the Arctic Ocean, in which the littoral States, and other States, share maritime rights and interests under the provisions of international law. Although non-Arctic States do not have territorial

sovereignty in the Arctic region, they are entitled to rights such as scientific research, navigation, overflight, fishing, or the right to lay submarine cables and pipelines, in their exercise of the freedom of the high seas, as well as the rights concerning exploration and exploitation of resources in the Area, following the UNCLOS.[32]

China is self-defined as a "near-Arctic State".[33] Being directly affected by the impact of climate change and other environmental transformations taking place in the Arctic region is presented as one of the reasons why China applied for observer status with the Arctic Council in 2006. However, its interests in the Arctic go further than that and include access to Arctic natural resources and the Arctic Sea routes.[34] China's primary goal is to reduce its reliance on energy supplies from the Middle East. Nevertheless, its ambitions to harvest these resources alone are limited because, for the most part, these resources are in the sovereign territory or broad continental shelf of Arctic coastal States.[35] Consequently, China needs to develop cooperation with the Arctic States through bilateral treaties and energy agreements to achieve its aspiring goals. China's investment in 2013 in the Russian Yamal LNG Project is a vivid example of its intervention in the Arctic. What is more, the Chinese banks are among the financiers for the realisation of the second large LNG project in the Russian Arctic, namely the Arctic LNG-2 project, which is currently operating.[36]

Moreover, China's interest in shipping routes across the Arctic, such as the use of the NSR, is an alternative to the so-far maritime routes through the Suez Canal or the US-monitored Malacca Strait. This issue is discussed further below.

The publication of China's 'Vision for Maritime Cooperation under the Belt and Road Initiative' in June 2017 adds a new 'blue economic passage' to the existing 21st Century Maritime Silk Road, the ISR, linking China and Europe via the Arctic Ocean. China's white paper about Arctic policy clarifies that it is ready to participate in the development of the Arctic and that its ambitions about the Arctic shipping routes would benefit all the Arctic States. Undoubtedly, these ambitions mainly focus on exploring and exploiting oil, gas, mineral and other non-living resources and investments in clean energy resources, such as geothermal and wind power, towards its low-carbon development and eco-friendly policy. One example is China's particular interest in Iceland's know-how in the field of geothermal energy, which could replace up to 25% of China's coal needs.[37] In addition, China has sought to participate more actively in Arctic governance and has contributed

disproportionately more to research, even than the littoral States themselves, due to its vast economic power.[38] Under the guise of environmental issues, China relies heavily on the concept of the common heritage of humankind.[39]

Having a clearer view of China's motives, the reader can now gain profound knowledge of Sino-Russian Cooperation and the ISR project. Russia is seeking investment to develop the immense infrastructure along the NSR, and China seems to be its primary source of capital. The two countries, taking advantage of each other's needs, have significantly expanded their cooperation, especially in the energy sector, since 2014.[40]

Energy Cooperative Partnership – The LNG Market

The ISR (also known as the Polar Silk Road) aims to promote economic development in the Arctic Region. Both Chinese and Russian companies are eager to increase oil and natural gas exploration in the area. China, specifically, presents a 'win-win' approach, which will share benefits with all Arctic States and other international stakeholders, presenting the exploration and production activities as the future of the Arctic. As it points out in its white paper, 'China hopes to work with all parties to build a "Polar Silk Road" through developing the Arctic shipping routes.'[41]

In terms of the Sino-Russian cooperation, the two countries have developed strong financial ties for the future. In early 2022, they announced their strategic partnership by promoting their cooperation, among others, in politics, economy and finance.[42] More recently, the two States introduced a development plan for bilateral economic and trade cooperation by 2030 in eight key directions, including the fields of 'green sustainable development' and the energy sector setting as a goal the consolidation of their 'all-round energy cooperative partnership' and the preservation of energy security among them and internationally.[43]

The tightening energy alliance between the two States is particularly evident in the field of energy supply and specifically the LNG trade. China has become Russia's main foreign partner in LNG production projects in the Arctic. At the same time, the production of hydrocarbons is essential for the realisation of the ISR since it provides the primary economic source for developing the infrastructure on the NSR and the respective Russian coastline.[44] According to statistics, there was a significant rise in dry cargo transportation

through the NSR during the construction of the LNG facilities and port at Sabetta between 2015-2017.[45] In parallel, LNG cargo increased slightly from 2013 to 2017 and went up rapidly in 2018 as the Yamal project became operational.[46] This mega-project has increased Russian LNG production by 70.1 %, ten times the 2017 rate.[47] Generally, the interaction between the extraction industry and the use of NSR as the main sea route is self-evident. Specifically, the Russian Arctic's construction and operation of natural resource projects are expected to be the key factor for increasing NSR traffic in the following years. Apart from the Yamal LNG project – whose future development is crucial for the continuation and evolution of the NSR – other ventures such as the Novy Port project, Norilsk Nickel's or the giant gas LNG-2 project have generated high expectations for the upcoming years.[48]

Through LNG technology, natural gas is contained in tankers and transported directly by sea.[49] The development of the NSR offers Russia the opportunity to acquire a higher position as an exporter in the international market. As it was reported, Russia was the world's fourth-largest exporter of LNG in 2021, exporting 40 billion cubic meters to LNG markets.[50] On the other hand, China was the world's largest importer of LNG in 2021, keeping Russia one of its main suppliers.[51] As mentioned above, China is trying to alter its energy policy by following a low-carbon and eco-friendly direction, and natural gas is an alternative to burning coal. East countries tend to present the highest trends concerning imported hydrocarbons and oil, with a specific interest in LNG.

Northern Sea Route and Suez Canal Route: Environmental and Economic Cost

The pivotal role of the NSR is based on the fact that it crosses the Russian coast and precisely the Kara Sea, the Laptev Sea, the East Siberian Sea, part of the Chukchi Sea and part of the Bering Strait.[52] Once the transport infrastructure is modernised, the competitive value of the route is estimated to increase. According to the table provided (see above Table 1), the navigation distance from the Northwest European port to East Asia via NSR is approximately 36% shorter compared to the Suez Canal.[53] Additional benefits refer to the transportation cost, time, and fuel consumption, notwithstanding the reduction in piracy incidents. However, the constraints concerning this vision are still at a high level, and the complete substitutability of the Suez Canal seems a distant dream. Specifically, the ice thickness is a determining factor for shipping activities in the Arctic. Moreover, the

extreme geographical remoteness of the area, in combination with the lack of necessary infrastructure, search and rescue (SAR) capabilities, the extreme weather conditions – with temperatures reaching -50°C and the crucial problem of visibility due to the darkness for a significant part of the year, they are all severe impediments to the evolution of the ISR project.[54] Nonetheless, the NSR – and the Northeast Passage as a whole – has a strong possibility of becoming a seasonal complement to the SCR or a solution to the 'Malacca dilemma'.[55]

Considering the above, the collaboration of Russia and China in the Arctic, aiming to exploit the NSR, seems reasonable and profit-making. China appears to be a major stakeholder in the Arctic, but not the only one. Other countries, such as Japan and South Korea, realising the area's prospects, have prompted and encouraged Russia to continue the realisation of this project, mostly financially. Nevertheless, the significance of the NSR and the Northeast Passage is not restricted to its financial perspective. The area is of high importance relating to its strategic geographic position which leads to complex diplomatic relations and geopolitical contests in the international scene.

Yet, the environmental and financial feasibility of the NSR compared to the SCR has provoked much discussion in the international community. According to research reviewing container shipping that took place in 2011,[56] the environmental costs of the NSR tend to be higher than those of the SCR due to small ship size and low load factor.[57] On the contrary, the results of another analysis show that shipowners who will opt for the use of the expensive marine gasoil (MGO) will benefit from using the NSR.[58] Another survey conducted in 2011 by Schøyen and Bråthen confirms the thesis above, that the NSR turns out to be a more environmentally-friendly route than the SCR. A vessel sailing between Norway and China via the NSR reduces about 3 270 metric tons of CO2 emissions in comparison to shipping via the SCR. They claimed the emission-saving potential of the NSR is even higher for the vessels using LNG fuel.[59]

Figure 1 – LNG shipping. Total Fuel Consumption via NSR and via SCR[60]

According to Figure 1, the NSR demonstrates a 52% increase in fuel efficiency owing to the shorter distance it covers. Based on the fuel consumption in Figure 1, the total CO2 emissions are measured for the round voyage between Hammerfest and Tobata, as presented in Figure 2.[61]

Figure 2 – LNG shipping. Total CO_2 emissions via NSR and via SCR.[62]

Figure 2 illustrates that navigating the NSR round trip from Hammerfest to Tobata results in lower CO2 emissions compared to the same journey via the alternative route through the Suez Canal. Specifically, the LNG carrier traveling between these ports emits 9,731 tons less carbon dioxide when taking the NSR route, making it 52% more efficient than the Suez Canal route in terms of emissions.[63]

On the other hand, the NSR has the following drawback in comparison to the SCR. Shipping through some of its areas requires an icebreaker escort for the overwhelming majority of vessels (except for vessels of the ice-class Arc9) for most of the year.[64] In the Rules of Navigation in the Water Area of the NSR, it is described as 'icebreaking assistance' and it is implemented in order to prevent sinking, oil spills, and other accidents. Whatever the benefits, icebreaking services create additional pollution and severe environmental repercussions to the marine and ice conditions.

The Environmental Aspect of the Northern Sea Route

Apart from its strategic and economic significance, this area consists of a fragile environment that is at risk.[65] Climate change is not the only threat. The increased economic activities also jeopardise its balance and are likely to lead to irreparable damages, both to the Arctic environment and its Indigenous Peoples.[66]

As mentioned above, the NSR covers a vast area of the Arctic Ocean. Its marine environment is home to numerous mammal species that migrate south to spend the

wintertime and move north again during the spring.[67] During this time, they reproduce and give birth to their young. Important wintering areas for mammals such as bowhead, beluga, narwhal, and walrus are the northern Bering Sea, Hudson Strait, Davis Strait and the south-eastern Barents Sea. They then head north through the Bering Strait and the Chukchi Sea and north and east into the Kara and Laptev Seas from these areas. These regions are also home to different kinds of seabirds and other marine birds. The spring migration period must not overlap with the shipping period. In the Fall, the opportunities for interaction between ships and migrating species are increased. However, the continuously changing and over warming Arctic conditions are likely to extend the shipping season, resulting in the disturbance of the reproductive and breeding season of many species.[68] Additional to the already existing climate change threat, to which these species already struggle to adapt, the rise in shipping activities presents a further risk to their survival.[69]

Interfering with any ecosystem means fracturing natural processes. However, it should be explained why this region, as part of the Arctic Ocean, is so fragile. The first reason could be 'limiting factors'. Low water temperature and a short period of photosynthetic activity of producers are the limiting factors for marine ecosystems. Under those circumstances, biodiversity is significantly limited. The low level of salinity in coastal zones limits the number of species too. That means that food chains in the Arctic are short. Therefore, the extinction of one species (because of pollution) may easily ruin the whole food chain. Low temperatures of salt water and even temperatures below zero increase the effect of toxic substances. Organisms are particularly sensitive to both anthropogenic impacts and climate change. In essence, toxic pollution, for instance, oil spills, is twice as severe in the Arctic than in any other region of the world. All in all, due to the lack of diversity, the Arctic ecosystems are not able to resist external influence in a proper way. In case any biological species disappear, there may not be a species that is able to replace it or them in the food chain.

China's growing interest in the ISR project has undoubtedly opened new business opportunities. On the other hand, it has provoked fear and concern about this kind of activity's social and environmental impacts.[70] In its white paper in 2018, China gives special attention to the environmental issues in the Arctic. Among other things, it States that 'it follows international law in the protection of the natural environment and ecosystem of the Arctic and conservation of its biological resources and takes an active part in

addressing the challenges of environmental and climate change.' Additionally, concerning the marine environment, China 'supports the Arctic coastal States in their efforts to reduce pollutants in the Arctic waters from land-based sources…and works with other States to enhance control of the sources of marine pollution such as ship discharge, offshore dumping, and air pollution.' As for the exploitation of oil, gas, mineral and other non-living resources 'it requires its enterprises to observe the laws of the relevant States and conduct risk assessments for resource exploration.'[71]

First and foremost, as mentioned in Section 1, the internal waters and territorial sea of the NSR are subject to national regulations. The main legal instrument is the "Rules of Navigation in the Water Area of the Northern Sea Route"[72] which 'ensure the safety of navigation' and 'prevent, reduce and control pollution of the marine environment from ships'. They specifically contain the process for organising the navigation of ships, issuing certificates of the right to ice pilotage, regulations on navigational and hydrographic support and other provisions relating to ship [73] Thus, a potential vessel navigating through the parts of the NSR in these maritime zones has to follow the Rules of Navigation and request permission for sailing.

Regarding the parts of the NSR beyond its full sovereignty, such as the EEZ, Russia has sovereign rights on its natural resources and jurisdiction in terms of the protection and preservation of the marine environment. Under the provisions of Article 234 of UNCLOS, Russia has the right to apply a special environmental regime in light of the special climatic conditions.[74] Importantly, international instruments applicable to the NSR are the International Convention for the Protection of Pollution from Ships, as modified by the 1978 Protocol (MARPOL 73/78)[75] and as amended by the Polar Code which entered into force in 2017 and the International Convention for Safety of Life at Sea (SOLAS),[76] as also amended by the Polar Code.

In addition to that, Russia is a party to several environmental protection treaties such as the United Nations Framework Convention on Climate Change;[77] the Kyoto Protocol of 1997 to the Climate Convention;[78] the Convention on Biological Diversity,[79] and without doubt the general provisions of the UNCLOS regarding the States Parties' duties to engage in international and regional cooperation for the protection and preservation of the marine environment.[80]

The rupture of Arctic regional cooperation, following Russia's attack on Ukraine, is expected to have catastrophic results on the environmental integrity of the Arctic ecosystem. The other seven Arctic States had initially announced the pause of the Arctic Council's activities[81] and later the continuation of some projects without Russian involvement.[82] The absence of scientific data exchange and research communication among the Arctic States could lead to an unclear image of monitoring assessments regarding environmental processes in the whole Arctic and culminate in huge gaps in the climate change policy in the North and internationally.

Norway has recently succeeded Russia in the chairmanship of the Arctic Council and it appears to be promoting an open dialogue with the Russian authorities for the sake of the climate, the environment and sustainable development,[83] considering that Russia covers more than 50% of the Arctic Ocean coastline.[84] The Norwegian chairmanship, as well as the rest of the Arctic States and permanent participants of the Arctic Council acknowledge that contact with Russia is still necessary for the continuation of the Council's important work and had decided to follow an 'inclusive process' especially regarding the sharing of scientific data and environmental monitoring in the region.[85]

Environment at Stake

It is undeniable that climate change in this area has caused significant physical, ecological, sociological, and economic consequences. The main concerns primarily revolve around the effects of long-distance transportation of pollutants through air and sea, as well as specific human activities, such as shipping. These activities, as mentioned above, involve disrupting traditional animal migration routes, introducing oil and chemical spills into the sea, and encountering unexpected repercussions of climate change, such as the melting of ice cover. Reversing many of these effects will require an enormous amount of time and effort. The aftermath of global warming has profoundly affected the physical, chemical, biological, and human aspects of Arctic ecosystems. The damage inflicted is widespread and accelerating. In fact, global warming has triggered a chain reaction of changes in the physical landscape of the Arctic environment, especially the Russian Arctic coasts, including the melting of sea ice, rising sea levels, reduced surface reflectivity (albedo), coastal erosion, and intensified ocean warming.[86] Further industrialisation of the area along the NSR will undoubtedly lead to irreparable environmental catastrophe. The respective challenges are analysed

below in more detail.

Different Types of Contamination

Apart from the shipping itself, many other risks are inherent in marine activities: sinking, waste, noise pollution, pollution by diesel engines of ships and pollutant emissions. All of them can cause irreparable damage.

According to Southampton Solent University, about half of all ship disasters end up with ship sinking. Sinking inevitably leads to an oil spill.[87] According to the International Tanker Owners Pollution Federation data throughout the period from 1974 to 2007, the frequency of oil spills has significantly decreased.[88] The average number is from three to six spills per year. However, considering the Arctic and the NSR special climate conditions, the likelihood of ship accidents is significantly higher, mostly due to the distance from rescue facilities.

Oil spills are one of the most harmful and disastrous outcomes of shipping. What makes them more dangerous is the element of unexpected and accidental. The release of oil and toxic chemicals in the ecosystem is a severe threat, and some arctic animals are particularly sensitive to oil because 'it reduces the insulating properties of feathers and furs', a phenomenon that leads quickly to hypothermia and, finally, death.[89] The unpredictability of these chemicals, concerning their special properties and their reaction to contextual environmental conditions, constitutes another significant factor that leads to uncontrollable circumstances. Another problem that exacerbates oil spills in the Arctic is the complexity of responsive measures to pollution accidents. The recovery of oil and oil products is hampered by the ice cap and remote locations. Oil spills can also occur during subsea oil exploration and production on offshore platforms.

Undoubtedly, regular shipping discharges are also hazardous. Efforts have occurred to regulate these toxic wastes in the seas, though not always with adequate results.[90] There are several groups of waste that shipping produces, including household water, sludge from wastewater treatment and solid waste.[91] With the development of cargo turnover and shipping along the NSR, the volumes of discharges of wastewater, garbage, food waste, as well as oily mixtures will inevitably increase. The Arctic is considered to contain some of the

last physically undisturbed marine spaces on Earth.[92] That is why its protection from incidents like this should be a priority in the Arctic States' policies.

Drilling activities can also lead to oil pollution in marine and land ecosystems. The infrastructure of the energy industry, such as pipelines and extraction facilities, is a matter of great concern for economic aspects and environmental risks. Moreover, oil spilling tends to be more menacing in ice-covered areas than in open waters. The combination of low temperatures and the persistence of oil in the environment has still unknown results on the ice biota.[93]

Additionally, a type of pollution that the increase in cargo turnover brings on is pollution by diesel engines of ships. Annex VI of the MARPOL 73/78 Convention controls emission parameters: the content of nitrogen oxides and sulphur.[94] However, there are two significant limitations: On the one hand, there are not enough monitoring centres to ensure that all ships meet the requirements. On the other hand, not all shipping companies are willing to switch from cheaper diesel fuel to better quality or replace diesel fuel and fleet fuel oil with biodiesel and liquefied natural gas in order to comply with the environmental regulations. The latter problematic aspect constitutes the dilemma over money and environmental safety.

Last but not least, air pollution affects both the Arctic itself and the whole world's environment. Sea transportation emits 1 billion tons of CO2 annually, which makes up nearly 3% of the entire global emissions. The Arctic emission of CO2 from shipping appears as about 1% in 2004.[95] The growing shipping activities in the Arctic will impose a great burden on the environment as a result of the black carbon (BC) and other pollutant emissions from heavy fuel oil (HFO) combustion. Ships contribute to global climate change and health impacts via the emission of air pollutants such as carbon dioxide (CO2), nitrogen oxides (NOx), methane (CH4), carbon monoxide (CO), sulphur oxides (SOx) and various species of particulate matter including organic carbon (OC) and black carbon (BC).

Icebreaking

Icebreakers are pivotal for both the development of the NSR and the accomplishment of the ISR project. This technology gives access to ice-covered areas in the seas and facilitates

shipping activities by providing the security, maintenance, and information necessary for the realisation of every venture. Icebreakers are characterised by resilience, and their contribution to the Arctic waters is immense. According to the Arctic Marine Shipping Assessment in 2009, Russia owns eight out of ten of the most powerful icebreakers in the world, thus being the world's largest and most dominant fleet.[96] Most of them operate in the NSR and are powered by nuclear power engines. For the needs of the Yamal LNG project only, the energy companies established a new breed of vessel, the LNG icebreaker tanker, technologically designed to transport LNG during the whole year without the assistance of icebreakers.[97] China launched its domestically built icebreaker, Xue Long 2, shortly after its first official Arctic policy in 2018 and recently revealed details for its first heavy polar icebreaker.[98]

Nevertheless, the activity of icebreakers in the Arctic waters disturbs in many ways the functioning of the ecosystem and puts at stake both the wildlife and the local communities. Either private or governmental, icebreakers are inherently noisy and create stressful conditions, especially for marine mammals. The latter are susceptible to behavioural changes and implications on hearing ability and uttering of sounds because of icebreakers' underwater noise-producing activities. The icebreakers interfere severely with the regional ecosystems. The whole procedure on the ice-covered waters is harsh and complicated, resulting in violent habitat transformations, which need years to recover and restore completely. These 'artificial open water channels' are a considerable threat to the polynyas, the natural open water areas surrounded by ice home to numerous species. Polynyas constitute a vital source for the ecosystem and provide heat and moisture in the atmosphere, indispensable conditions for the flora and fauna of the area. Consequently, the icebreakers may create misleading circumstances for species and finally lead to their death.[99]

Permafrost Conditions: The Real Challenge for Arctic Russia

Climate-induced permafrost changes are detrimental to almost all structures in northern lands and may render many of them useless. Almost 60% of Russia's territory is covered by permafrost.[100] In Arctic Russia, soil instability provokes huge uncertainty relating to Russia's ambitions in the Arctic. The challenges are numerous, including not only an environmental catastrophe but also vast financial costs. The Yamal Peninsula, for instance,

faces significant threats due to unprecedented environmental conditions with respect to permafrost alterations, which apparently ended up in severe further implications.[101] Coastal erosion, as an outcome of permafrost implosion, also causes loss of land and threatens ports along the NSR.

Conversely, as it turns out, the areas with the greatest industrial development and the most specialised and heavy equipment are those susceptible to greater permafrost degradation.[102] The incidents taking place in the regions of Norilsk and Komi are great examples of this phenomenon. The 'World's Largest Arctic Oil Spill' took place in May 2020, near the city of Norilsk after a diesel oil tank collapsed.[103] The contamination of the whole area, including marine and land ecosystems, was inevitable. Investigators of the case believe that the detrimental incident was a result of melting permafrost. One year later, in May 2021, a pipeline in Russia's north-western region of Komi – operated by Russian oil producer Lukoil – leaked 100 tons of oil, affecting natural habitats and populated areas.[104] Even if the above incidents had not occurred in the Arctic waters, they are related to the increased industrialisation in the Russian Arctic zone – highly connected with the use of the NSR – with further consequences in the marine environment.[105] Permafrost thawing is a threat to the extraction industry in the Arctic and vice versa. Despite the essential risk assessments before the realisation of a project, natural phenomena are unpredictable, as climate change has multilateral effects occurring at any time. Consequently, it goes without saying that the emerging of new industrial activities in North Russia, as well as the expansion of the already existing, highly related to the opening of NSR, jeopardise the balance of innumerable natural habitats in the area and generate high levels of risk for the small communities and their subsistence activities.

Monitoring in Arctic waters

One major problem that arises concerning growing shipping activities in the Arctic is the lack of monitoring centres in Arctic waters. Permanent and accurate monitoring of the water's condition is the first step to decrease the potential harm shipping can cause. The enhancement of such installations before increasing shipping activities should be a Russian priority. The pause of the Arctic Council's operation until the Chairmanship's handover to Norway on the 11th of May 2023 and the absence of Russia's broad participation were also inhibiting factors in terms of effective monitoring in the area. The Chairmanship of Norway,

as Norway has acknowledged, is marked by ‘difficult and challenging time for international cooperation’.[106]

Another obstacle in studying the relationship between the surge in NSR traffic and water pollution levels is the significant financial investment required. This is compounded by the challenging Arctic environment, time constraints imposed by freezing conditions, and the limited infrastructure in remote areas. Conducting appropriate research demands substantial financial resources. Additionally, the window of opportunity for surveys is restricted by the freezing of the route, and there are only a limited number of vessels capable of navigating the NSR throughout the year.

Considering the geopolitical situation and the ‘pause’ of cooperation between western States and the Russian Federation, keeping track of the NSR operation would be unfeasible for the rest of the member States of the Arctic Council. For instance, without Russia’s participation in the Arctic Monitoring and Assessment Program (AMAP) the data from the Russian sections of the NSR would not be published and provided to the public. Instead, the decision about disclosure falls on Russia.

A few years ago, when studying the level of pollution of Arctic waters, the main focus was on the complexity and high cost of monitoring due to the harsh conditions of the Arctic. Now the focus has shifted to the actors responsible for the environmental costs of increasing navigation along the NSR. Thus, for the global community, the problem of monitoring the state of Arctic waters has shifted from the area of responsibility of engineers, biologists and chemists to the policy-makers.

An extensive system for monitoring the Arctic waters in the Russian Arctic zone was created in the 1980s. At the current stage, the system is not operational, first, because most of the points failed in the 1990s due to the lack of proper maintenance. Secondly, they are not able to collect up-to-date data due to obsolescence and the need for different types of data.[107] Since 2021, Roshydromet (the Federal Service for Hydrometeorology and Environmental Monitoring of Russia) has been working under the program ”Modernization and Development of the Hydrometeorological Network for Monitoring the State of the Environment in the Arctic Zone of the Russian Federation” of Subprogram 4 ”Organization and Support of Work and Scientific Research in the Arctic and Antarctic” of the State

program “Environmental Protection”.108 The study claims a tendency to switch to anchored buoy stations and drifting profiler buoys as the most effective data collection tool. This method could be described as trustworthy, considering that the Roshydromet institute is involved with the implementation of a hydrometeorological network for monitoring the state of the environment in the Arctic zone.

Taking into account the Russian orientation towards the introduction of a system of drifting buoy profilers and the successful Chinese know-how, we could assume that the Russian project ‘Modernization and Development of the Hydrometeorological Network for Monitoring the State of the Environment in the Arctic Zone of the Russian Federation’ and the fruits of this program will be part of the success of the Sino-Russian cooperation.

Conclusion

A physically changing Arctic causes severe changes in the governing powers and dynamics in the region. The ice-free Arctic Sea offers China the once-in-a-lifetime opportunity to express its economic ambitions, and Russia welcomes the significant financial investment from China, especially given the sanctions impeding investments from other partners. As part of the BRI megaproject, the two countries consider the ISR as the new corridor towards geopolitical success and financial prosperity, mainly through the lucrative LNG market. China is one of the many players in this geopolitical game. The cold Arctic is a hot topic[108], and the strategic and economic future of the area requires peaceful collaboration and a balance in the presence of powers. Nevertheless, the energy footprint of the accelerated activities in the Russian Arctic region is still under investigation. Despite the fact that the NSR constitutes a feasible supplement to the current SCR – with many surveys supporting its positive environmental outcomes – the long-term effects are still unknown.

China’s political agenda for the Arctic region seems quite promising, if not well-structured for diplomatic purposes. In any case, it can be said with confidence that some key points relating to the fragile and unique Arctic ecosystem are to be examined more carefully and with greater awareness. China’s ‘green economy’ is inherently not compatible with the oil and gas extraction industry and the drainage of lands, especially in the delicate Arctic environment. The above-mentioned threats to the Arctic ecological processes along the NSR

are only a few examples of the ISR project's current or potential repercussions on the environment – part of the BRI project. It is easy to realise that environmental degradation takes a backseat when geopolitical and economic profits are the main leaders in the anthropocentric scene. Climate change impacts are intensified with such a massive intervention. The effects are chained and interconnected, and a more efficient monitoring system is highly recommended. Nevertheless, it is argued that Russian political factors for years have not seemed willing to recognise the environmental implications of climate change in the region, facing this argument as a covered western effort to mitigate its geopolitical aspirations.[109]

Yet, the Ministry of Economy of Russia recognised that the Yamal 'construction boom': '…was in large part caused by one-off factors and is not sustainable'.[110] The Yamal LNG project led to a sudden rise in Russian income, which is of primary importance for the development of the area. The current Arctic LNG-2 project is expected to have similar results. However, these business plans constitute short-term solutions and not a panacea for Russia's damaged economy, while they pose an ecologically unique area under severe threat. The warnings relating to climate change effects are finally not a political trick against Russian ambitions, especially when the ground literally collapses beneath their feet. The future of the Russian Arctic remains to be seen, given its exclusion from the western markets. In any case, a stronger monitoring program in the Russian Arctic waters seems to be the most viable solution for the prevention and timely response to a great number of perils that the advancement of the NSR might cause.

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