

ARCTIC RESOURCE EXTRACTION IN THE CONTEXT OF CLIMATE CRISES AND ECOLOGICAL COLLAPSES

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Introduction

The Arctic land and resource rush has not been in the limelight of global research on new land grabbing (Kröger 2019), which focused first especially on the rising long-term leasing of plantation land in Africa, especially by Gulf and East Asian rising states, following the 2008 financial market crisis (Edelman et al. 2013). Since then, research on this new land rush has also looked at other contexts and states, and a variety of actors pushing for land grabs, such as different corporations, funds and other actors, especially in the Global South, but also in the Global North. The attention has expanded from farmland to mining, hydrocarbons, forestry, tourism, and other forms of land grabbing (see Chapter 1 in this volume; Neef 2021; Kröger 2013; 2020). The essential role of the establishment of extractive infrastructures and logistics has also been studied (Mezzadra & Neilson 2019; Tsing 2018); for example, the role of states and corporations that establish large pipelines and port complexes which allow for push and are essential for broader land grabs at the points of extraction (Pedlowski 2013). Also, the diversity of actors and processes which explain new land rushes has expanded, including the role of financialization and other actors than states and corporations that operate at global scales (see Chapter 1 in this volume; Cotula 2012; Sosa Varrotti & Gras 2021). However, even within this broader view of land grabbing as a global phenomenon, the Arctic has been mostly sidelined, although Arctic specialists, located in the Global North and having their own established research traditions, including natural resource management and extraction, have provided some new analyses (see Kröger 2019 for a review). Having said that, the situation of the Arctic still demands much more attention, and global land grabbing scholarship can help to provide an even more critical and global understanding of land rush dynamics.

This chapter merges specific Arctic studies and concepts with global land grabbing theories and knowledge, aiming to provide a contribution to both by emphasizing that the ongoing climate and ecological crises need to be incorporated fully into explanatory models. This is a pioneering proposition. In *The New North: The World in 2050*, Smith (2011) argues that the areas North of latitude 45 will in the future have much more strategic importance and an increased global role due to several trends. However, this book, like the bulk of

other existing studies, assumes that no major catastrophes, pandemics, or other shocks will occur, and thus provides an assessment which foresees, for example, that oil and gas extraction will continue to rise, and permafrost melting will most likely not be a major problem.¹ I question this approach here, based on the world-systemic approach, which analyzes how the world has already entered a period of chaos where epochal, abrupt, and unexpected changes, alongside agency, will explain many more future trajectories than the assumption that processes of change will remain stable (Wallerstein 2011). I merge this approach with the latest scientific knowledge on the dire situation of the permafrost thawing as well as other ecological and global climatic disruptions, and how they are already affecting the Arctic. In a decade, the body of knowledge on these tipping points and feedback loop events has increased, and some new Arctic social science is starting to emerge taking these issues seriously into account (such as Dodds & Nuttall 2019). There is now even more evidence that demands a thoroughly new approach to analyze likely futures, especially in the Arctic, and particularly in relation to the land and resource rush prognoses.

Through this approach, I will argue that the key concepts of “Arctic hype” and “Arctic paradox” need to be seen in a new light. These key concepts relating to Arctic politics are explored in the context of catastrophic changes, which are somewhat present in non-social scientific studies (which the first part of the chapter assesses), yet are practically absent from social scientific studies on resource rushes. I argue that due to the rapidly cascading global ecological crises, which will affect the Arctic faster than most places, it is much less likely that the foreseen “untapped potential” of resources will be available for extraction. In fact, the destruction of existing oil and gas pipelines, due to permafrost melting, and riskier sea routes and offshore extraction due to unexpected storms, may well prove to be much more vital processes in defining the contours of extraction than the will to extract. Thus, the “Arctic hype,” which refers to claims over-exaggerating the potential untapped resources and boon provided for global resource extraction by the Arctic (Finger & Heininen 2019), may be over, or face major narrative transformation. The “Arctic paradox” refers to the receding ice sheets and the opening of maritime passages, supposedly opening up possibilities for further extraction. Paradoxically, these ecological changes are caused partially by the increased extraction and its emissions and other disturbances in the environments. Hence, the “Arctic paradox” may also be under major narrative transformation. This is probable if the Arctic changes do not provide the possibility for furthering extractive capacities, but instead force existing investment projects to discontinue. This would mean shutting down extractive areas and depopulating those Arctic towns that have become exceedingly dangerous due to, for example, massive methane releases, and other changes forcing rapid changes in the lived environments of the Arctic. This kind of rendering of prior land uses, such as extensive reindeer herding, is already happening in some places, as the record snow cover in Lapland in 2020 showed. The Sámi people had great difficulties in their reindeer herding as the reindeer could not get at the lichen under the snow, and had to be feed-lot fed. These kinds of abrupt yet ever more typical weather disruptions affect existing livelihoods and lived environments, the kind of land uses, and the ways of life that are possible. Sámi spokespersons have said that if reindeer herding ends, that will be the end of their traditional culture, lifestyles, and languages. This chapter will explore these transformations in and through the Arctic in the interface of climate crises, ecological collapses, resource extraction and global land grabbing.

I will first explain the key biophysical changes in which the land and resource rush in the Arctic is currently situated, to emphasize that these issues should not be studied as

happening in some sort of vacuum where capital investments can freely flow to places around the world. The environmental, technical, political, and economic difficulties of extraction are reviewed. These include studies on infrastructural damages and costs, which are mostly neglected by government policies, but are starting to be taken more seriously by would-be investors. After this, the social responses and resistance to Arctic resource grabbing are explored, and the varied forms and trajectories that Arctic regions are likely to experience are assessed. The study is primarily based on a literature review that unites different strands of scholarship to make a transdisciplinary argument, while basing this knowledge on personal field research on mining and other types of resource frontiers globally and in Finland. The conclusions connect the current situation to a demand for incorporating politics at the current tipping points and also connect ecological crises much more closely to existing social scientific and other studies on global land grabbing and other issues.

The Difficulties of Resource Extraction Amid Climate Catastrophes

Global temperature rises have led to a rapid increase in permafrost temperatures around the world, and this has caused fast-expanding permafrost thawing especially in the Northern Hemisphere (Biskaborn et al. 2019). The degradation of the permafrost system has been dramatic between the 1970s and 2018 for example in the Western Russian Arctic (Vasiliev et al. 2020). This thawing of the permafrost has already passed a tipping point and will continue for hundreds of years even if the emission of greenhouse gases by humans were immediately halted (Randers & Goluke 2020). The methane and other greenhouse gases that the Arctic thawing is now releasing will further accelerate this process, making developments in the near decades unstable for an assumed continuation of extraction. Scientists have warned that this process will be further increased as there are very few signs of decreasing emissions; instead the focus has shifted toward net-zero targets in the distant future and dubious offsetting schemes and other false solutions to address the climate crisis (e.g. <https://www.climatechangenews.com/2020/12/11/10-myths-net-zero-targets-carbon-offsetting-busted/>). The potential of carbon that will be emitted from permafrost thawing is massive, estimates running from 260 to 360 billion tonnes of carbon, a considerable part of which will thaw abruptly and not gradually, these abrupt emissions greatly increasing the release projections (Merritt et al. 2019). Just a tiny fraction of this emission potential would have catastrophic impacts (Smith 2011).

There are a few studies which have started to incorporate the aforementioned situation into their prognoses, although the vast majority, based on my review, suggests that most analyses are oblivious to these facts, or ignore them. Hjort et al. (2018) claims to be the first study detailing the fundamental infrastructure which is at risk across the Northern Hemisphere permafrost area due to climate changes. They argue that by 2050, about 69% of the pan-Arctic infrastructure that is essential to human life in these conditions, including housing, transport, and industry facilities, will be in areas of high potential for permafrost thaw near the surface. They also note that even if the Paris Agreement target is reached, most Arctic infrastructures would be at risk. This includes such central extractive infrastructures as the 1,590-kilometer Eastern Siberia–Pacific Ocean oil pipeline, 1,260 kilometers of gas pipelines originating in the Yamal-Nenets region, and 550 kilometers of the Trans-Alaska Pipeline System (Hjort et al. 2018). This suggests that especially hydrocarbon extraction will become extremely difficult, too costly, or socio-environmentally hazardous,

as the constant thawing will require re-building the pipelines. As the costs of merely trying to upkeep the existing industrial structures, buildings and essential logistics of extraction are extremely high, there will be fewer funds for expansion projects. For example, Streletskiy et al. (2019) estimate that by 2050, Russia will need to spend over 100 billion USD to sustain its existing infrastructures that will be damaged by thawing. Producing cheap commodities that rely on massive infrastructures, such as hydrocarbons, is thus likely to be hard, even impossible. Moreover, the situation will become even worse due to the currently rapidly decreasing funding given to hydrocarbon expansion projects, and the massive and rising costs, and lowering returns, that the pumping of oil and gas in the Arctic would produce. Similarly, slurry pipelines for pumping minerals with water are likely to be unfeasible in the Arctic. A more likely, and less costly, outcome in the worst thawing regions is for the people now living in extractive towns' old buildings which are collapsing to be moved to other regions, where upkeeping infrastructure will be less costly, and where the rapidly cascading effects and risks of thawing are less likely. This suggests that very large areas of Siberia and North America would become more akin to wasteland than usable targets for land grabbing, as investing would be far too risky and short-lived.

These barriers set by climatic catastrophes are not limited to land, but also affect the seas. Coastal and offshore operations will suffer from increasing storms and drifting ice, which already make the situation so perilous that, along with other factors such as the unavailability of funds, or close enough ports, make other Arctic seas except the Norwegian-controlled Barents Sea highly unlikely, even impossible sites of expanding drilling (Eliasson 2017). The melting perennial and multi-year Arctic ice will not only raise sea levels, but will lead to extinctions of microorganisms dependent on ice. This will lead to dramatic existential problems for Arctic life, including the many fishing and hunting dependent populations (Dodds & Nuttall 2019).

These prognoses make it clear that not only will forecast expansions into permafrost and ice cover areas be much more difficult than expected, even impossible, but that the existing logistics and extraction operations relying on steady ground are also likely to be damaged. Those who have invested in Arctic extraction and exploitation permits, leased land and extraction rights, or have already invested in infrastructures and operations, are going to face rising and unexpected risks. As Francis (2018: 17) notes in her *Scientific American* climate change special issue article, which showcases how the Arctic is changing much faster than predicted, coming closer to tipping points with feedback loops, it is time to “prepare for the unexpected.”

Neglect of the Climate Crisis in Arctic Government Policies

Despite the above and other scientific studies and local peoples' complaints, which clearly point toward the necessity to take future and already happening crises seriously, governments interested in the Arctic or situated there are mostly going in the opposite direction in their policies. Newlin et al. (2021) note how extremely ill-equipped current Russian regional governments are to respond to the above challenges, due to lack of funds: they are already in heavy debt and falling into bankruptcy. In this haphazard situation, ecological catastrophes such as leakages from pipelines and factories into rivers and elsewhere have increased, as environmental regulations and infrastructural investments are overlooked. The time of cheap commodities seems to be thus already ending, as Moore (2015) has generally noted, and as I can confirm from my studies about the Arctic and the case of the Finnish

mining boom, where costs of investing and operations have exceeded the returns in the key expansion projects (Kröger 2016). However, governments across the Arctic still seem to push the Arctic land and resource rush further. There are major Arctic pulp investment, mining, tourism, and wind energy booms currently in Finland, and some of these booms are also present in Norway, Sweden, Iceland and Greenland. Instead of investing in alternatives, Russia is focusing heavily on increasing its capacity of hydrocarbon power production (Newlin et al. 2021). The actual and political costs of these moves, which tie the energy matrix for years to come to fossil fuels, will increase.

There also seem to be diverging resource grabbing trajectories between the Arctic regions. The EU (2020) estimates that North America will not engage in large-scale Arctic oil extraction as it has also less costly and smaller-scale options. The EU (2020) Arctic Policy paper suggests that it is much more likely that Norway and Russia will continue their Arctic oil extraction expansion, due to sunk costs in Norway, that being possibly the easiest option seen for GDP growth in Russia by its current decision-makers. Staalesen (2020), assessing the Russian energy and climate policies, shows how climate change is recognized in Russia, but basically nothing has been done to prepare for it: instead, expanding hydrocarbon extraction is framed as essential and no alternatives are seen as viable. This has made many, including Sukhankin (2020), who wonders about the Russian 2035 coal strategy (which foresees major expansion), ask “Why does Russia ignore this rapidly shifting reality?” This refers to Russia merely preparing to adapt to some climate changes, but not combating them (Staalesen 2020). Tynkkynen (2018) assesses the reasons for this. According to him, the Russian state has a specific, hydrocarbon giant rhetoric directed toward domestic audiences, which makes the negative effects of climate change social taboos. This rhetoric also exaggerates the economic potential of Arctic industrialization and downplays the dependence on just hydrocarbons. The practice of compensating Indigenous people for pollution and loss of habitat in a way that merely seeks to stifle criticism is another example of the balancing act by the Russian state to keep the constructed hydrocarbon identities alive, argues Tynkkynen. The longer this hydrocarbon rhetoric continues, the more likely the aforementioned predictions on the magnitude and timing of planetary catastrophes due to climate disruptions will become.

These kinds of moves suggest that technological lock-ins are being built, based on existing grabbing trajectories, such as in the Norwegian focus on offshore drilling and the so-called blue economy of extracting everything from the seabed that is possible. The propensity of such sunk costs tends to be for invested-in projects to be continued, even if they would be highly problematic, unprofitable, or destructive. This is because someone has already invested in them and wants – or even needs – to make money to pay debts, or to continue resource grabbing in other places. Yet, at some point in the near future, it is likely that this situation of ever-expanding resource frontiers for at least the past 550 years, will come to loggerheads with the harsh realities. This is expected to happen faster in the Arctic than elsewhere, as the temperature rises there are two to three times higher than elsewhere, and the natural conditions are much more fragile. Francis (2018: 52) calls the Arctic the “canary in the coal mine” for the whole earth. While there are more natural resources in the Arctic than in many other places, these are not available for extraction in sensible terms.

Besides natural barriers, there are also particular international politics which strongly impact the pace and style of extraction. Leroux and Spiro (2018) note the crucial importance of inter-state competition: if one starts to extract, others can make use of the solutions and technologies, and have the impetus to invest as well. The Russian will to expand

hydrocarbon extraction has been greatly affected by Western sanctions, without which it has proven to be impossible for Russian operators to expand oil operations in the Arctic, as this would require extensive technological developments and Western funds (Morgunova 2020). Nationalist agendas, such as Russia's 2007 planting of its flag by submarines on the ocean floor of the North Pole, seem to have slowed down a joint capitalist rush to the Arctic. Inter-state rivalry between some Arctic nations, visible in the race for who gets to first claim and grab sea areas has, curiously, been an impediment to starting offshore and port-expanding projects in the same manner as forecasted earlier. In this setting, imposing greater environmental regulation has been interpreted by other would-be Arctic extractive nations as a sign that a country would not be so interested in expanding to the Arctic – something that Leroux and Spiro (2018) argue has deterred expansion thrusts. But national thrusts of expansion remain. Besides Russia, Morgunova (2020) explains that the will to expand into the Arctic, and citizen support for this, is high also in Norway. This makes Norway the most likely candidate for being the first nation to start Arctic extractive operations, as it has funds, making what happens in Norway and its initial operations extremely important for the whole region's future.

Market and Social Responses to Worsening Extraction Possibilities

While governments are trying to promote Arctic resource rushes, global markets and investors have already started to look in other directions. The drastic decrease in oil prices in 2020, linked to COVID-19 pandemic politics, and to Russian and Saudi Arabian maneuvers to make use of a multiple global crisis to push oil prices down (as they can sustain lower prices longer than other oil producers, thus capturing markets in the end), and the rising flow of investments to so-called renewables instead of hydrocarbons, have dramatically lessened the likelihood of Arctic offshore oil investments. Carayannis et al. (2021) estimate that in this current situation, oil and gas companies are unable to utilize their unique competencies, and that only one or two large projects may materialize in the Arctic. Considering this slowdown of investments from the viewpoint of Leroux and Spiro (2018), who emphasize that not investing does not cause leakage to other regions, but in fact creates a strong regional policy of not engaging in extraction, COVID-19, low oil prices, and the shift to renewables investments that have taken place in the past two to three years, give some hope in the timeline. Since the longer the perilous investments that would increase emissions are postponed, the harder and less likely it will become for companies to realize them.

This consideration of timelines is essential and suggests that the currently budding resistance to Arctic resource extraction projects is essential and well-timed and would need to be supported and expanded in scale and scope. The Arctic context is changing so rapidly that even a few years can show the instability of this setting for investments – in which case the would-be investors, at least those losing money, should in fact be grateful for the current resistance against their ill-thought moves to expand extraction. Shell had to pay a heavy prize of several billion USD when abandoning its Alaska offshore oil exploration, amid rising Greenpeace and other global protests against these moves. Other companies are likely to take note of the risks of consumer boycotts as well, as even one oil leakage in the Arctic seas would be devastating for the fragile environments and the people relying on them. Such an accident would signify a drastic end to the extraction pushes, but hopefully Norway or other actors are not going to test their luck so far as to realize those risks.

Arctic Social Scientific Contributions to Global Land Grabbing Studies

The aforementioned discussion has focused on the biophysical changes which strongly suggest that future resource rushes in the Arctic will not take place in the way fathomed thus far. The bulk of global and Arctic resource extraction has focused on hydrocarbons. This energy sector is also the most important due to the pivotal role it has played and continues to play in emissions. There are, however, also other important sectors that are also causing climatic and ecological impacts, and are involved in land grabbing across the Arctic. Hydrocarbon projects have been placed on Indigenous lands and periodically put Indigenous and conservation areas at risk, as studies in Alaska and Russia (Kumpula et al. 2011) have shown. Wilson and Stammeler (2016) have introduced a special issue around Arctic extractivisms, arguing how extractivist logics have pushed many locals into supporting extractivist projects. However, there are variations to this, and since 2016, there has been significant mobilization against extractivism in the Arctic, for example among the Sámi (Kuokkanen 2019). Locals have engaged in such acts of resistance as countermapping their territories against mining projects' mapping of "resources," and in emphasizing the place-specific, unique qualities which cannot be compensated if destroyed by open-pit mines (Lassila 2018; 2020). In comparison to the Global South, with its heavily oppressive and violent politics and contexts of extraction, the Arctic setting does seem to offer some more room for agency by locals and would-be resistance against extractive projects, even in Russia according to Stammeler and Ivanova (2016). Yet, here as elsewhere, this resistance does not surge automatically as a response to grievances but needs to be built by active agency and specific resistance strategies (Kröger 2013; 2020).

While I have argued here that much of the Arctic land and resource rush remains at the level of hype and will not be realized due to the climate and ecological collapses, there are several existing and new projects in parts of the Arctic that are currently expanding. These include mining projects to secure rare earth and other minerals for the transition to battery-based electric vehicles as a supposed solution in a move away from hydrocarbons. The moves to expand wind energy have been heavily criticized for the damage it causes, and because it leads to land grabbing of Indigenous land in the Global South (Dunlap & Jakobsen 2020). Lapland is now starting to experience these conflicts related to wind farm expansion plans. Resistance experiences of what works in the Global South, where people have already experienced heavily violent extractive expansions and learned how to resist them (see Kröger 2020), could be used by the Arctic populations to resist land grabs in their region. In fact, this is already happening, as the Arctic is becoming increasingly global, and connected to all sorts of global politics and interactions (Finger & Heininen 2019).

Unequal economic and ecological exchange are also affecting local communities and even states targeted for new resource extraction in the Arctic. For example, Finland has the world's most pro-corporate royalty and mining revenue distribution regime in the world (Kröger 2016). Most of the increased interest in the Arctic as a massive untapped source of resources and energy comes from outside of the region, which has led scholars to see the Arctic scramble as a sort of continuation of resource colonialism (Gritsenko 2018). In this game, argues Markowitz (2020), those states which have most abundant resources, and have tied their economies to resource rents, are the most likely to project power to grab further resources in the Arctic. Markowitz (2020) thus emphasizes that this is not an all-out competition for the Arctic resources – which he, as is the convention, sees mostly as being made more available and not less available by climate change (unlike what I have argued

here) – but state reactions vary. This kind of setting of divisions between elites (of different countries) does offer greater possibilities for those seeking to resist extractive projects (Kröger 2020).

The most likely outcome for the 2020–2030 period is that the earlier melting of the Arctic Ocean will result in increased shipping, due to the vastly faster and thus cheaper sea route to China. China will most likely try to exert more influence and control, but Russia has the highest interest in seeking rents from controlling the shipping lanes, and extracting more minerals, whose loading might become easier at some port sites. These mine-port complexes would, however, need to be located somewhere else than in fragile and thawing permafrost areas, or otherwise these will be literally sunk costs rather than profit-making enterprises. Some inland mines may expand, but hydrocarbon expansion projects beyond what Russia and Norway are preparing are unlikely, and even the proposed plans might very well be unrealized. Greenland may see some mines opened, although its earlier hopes of getting independence by a mining boom have been set aside recently as local resistance to uranium and other destructive mines has risen, and locals have come to understand that the dozens of planned mega-mining projects would destroy existing lived environments. This said, there has been a notable and quantifiably massive increase in Arctic mining, which has caused the amount of waste and side rock to increase tenfold between 2005 and 2010 in Finland for example (Kröger 2016). Nunavut in Canada has also seen expansion projects, for example, for massive iron ore mines in the Baffin Island. Alaskan communities and conservation sites are at constant risk, as the policies of President Trump showed: if a similar candidate comes to power, things might change rapidly for Alaska, with regional impacts for the Arctic. Policy studies have therefore recommended making more lasting national and international laws to ensure the major planetary benefits that a healthy Arctic has been providing (Carson 2019). These include the reflection of sunlight by snow and ice cover, whose melting should be prevented, but is now being exacerbated by flaring in gas and oil refineries in the Arctic regions, and black smoke from other burning processes (Isomäki 2009). However, there are not many drastic changes to these industrial activities currently underway, as many think, there is still plenty of time in the future to mitigate the damages. However, if these activities continue unabated for too long, the potential changes might come too late to have significant impact. That is, the ecological degradation might be too severe for reversal if proactive action is not taken. French (2019) argues that because of the Arctic and other tipping points, it is unlikely that there will be a chance of continuing in the old way of first doing and then learning from one's mistakes, but the paradigm should change into building on the burgeoning knowledge on the high risks of extraction and only then exploiting (within environmental boundaries).

Concluding Remarks

The most important contribution that the addition of the Arctic to the bulk of knowledge brings is that the Arctic is not merely just one more case of where land rushes have risen. There are myriad opportunities to draw broader theoretical and empirical understandings on the phenomena included and related to global land grabbing due to the unique dynamics in the Arctic; including, the Arctic's natural conditions, the changes in Northern polities, the particularity of international relations, and the rapidly changing interrelations between climate, ecological crises, and ecological collapses. The climate is warming two to three times faster in the Arctic than the global average. Permafrost melting is making extraction

of minerals and fossil fuels much more difficult, risky, and even impossible, as infrastructures that have been built with great sunk costs are deteriorating and spreading pollution into the Arctic areas, especially in Russia but also elsewhere. The rapidly advancing climate catastrophe can already be observed, firsthand, in the Arctic. This can provide insights into what kinds of dynamics can be expected elsewhere. The Arctic is likely to see rapid collapses of extractive infrastructures amid high hopes for expanding them. The coming climate catastrophe is largely neglected in current Arctic policies. Yet, other-than-human agency can fast and abruptly change the contours of resource and commodity frontiers. Such drastic events may offer space for positive and fast political responses.

If the Arctic reaches its tipping points, such as runaway permafrost thawing, there is no return to the Holocene's stable climatic (and thus political) conditions (Francis 2018). I argue that the whole social scientific apparatus needs to dramatically shift to incorporate the politics at these tipping points, as the current way of treating the global climate crisis still shows a continued rise in emissions. But how long can this continue, when major tipping points are reached and start to show their impacts? Will these tipping point politics have radically different ways of doing politics and understanding the role of other-than-human nature and its role in affecting political possibilities? I argue that these tipping points need to be further incorporated into analyses and policies beforehand to prevent them from materializing.

This chapter has offered an example of how to incorporate existing climatic forecasting research with social scientific studies, in this case, the current state and future outlook of a land and resource rush and grab in the Arctic along the lines of what has happened in the 2000s in the Global South. I have argued that this land and resource grab is less likely in the Arctic, given the rapidly changing climatic conditions such as permafrost thawing and the overall unpredictability and ecological instability of the region, which make much of the extraction projects in future decades more of a hype than a reality. While the 2005–2020 period did see a notable and major expansion of resource extraction and land grabbing in many parts of the Arctic, as elsewhere around the world (Kröger 2019) due to the global commodity boom, this tendency is likely to be at least attenuated, if not reversed, given the rising costs, risks, and instabilities of Arctic resource extraction.

Note

- 1 There is a specific chapter in Smith (2011) looking also at much more negative, abrupt possibilities, such as faster permafrost and Greenland ice melting. These are, however, sidelined as less likely, due to the modeling approach which requires knowledge about whether, how and when these events would occur (which Smith claims was not robust enough in 2010), and the common and conventional perspective which wants to assume continuity over disruptions.

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