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Climate Change and the Arctic: A Study of Paradoxical Linkages in Complex Systems

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13.1 Introduction

Given that the Arctic region has only about four million human residents, little industrial activity other than operations associated with the exploitation of natural resources, and no large-scale agriculture to speak of, it may seem reasonable to conclude that the high latitudes of the northern hemisphere are relatively unimportant in terms of the global problem of climate change. Certainly, it is true that direct anthropogenic emissions of greenhouse gases originating in the Arctic are extremely modest, especially when calculated as a fraction of global emissions. Yet it would be a serious mistake to ignore the role of the Arctic in the dynamics of climate change as a global concern. There are at least three reasons why this is the case, all of them featuring what I will argue in this chapter are paradoxical linkages in complex systems with important implications for what goes on in the mid-latitudes.

Arctic processes play roles of fundamental importance in the dynamics of the Earth's climate system. This is not only a matter of incremental developments like the lowering of the albedo of the Earth's surface – that is, the measure of diffuse reflection of solar radiation by the Earth's surface – arising from the melting of sea ice and snow cover on land. It is also a matter of critical tipping elements in the climate system featuring Arctic processes. In addition, the impacts of climate change are showing up more rapidly and dramatically in the Arctic than anywhere else on the planet. Temperatures are rising in the Arctic today at a rate that is at least three times the global average. As a result, issues of adaptation to the impacts of climate change now top policy agendas throughout the Arctic, despite the fact that human activities in the Arctic are not major sources of greenhouse gas emissions. At the same time, the impacts of climate change in the Far North have increased the accessibility of recoverable reserves of Arctic hydrocarbons, opening up new opportunities for the exploitation of the region's large deposits of oil and especially natural gas and stimulating major international investments in systems for producing and shipping these energy resources to consumers in the industrialized societies of Europe and Asia. Notably, the development of Arctic hydrocarbons has become a cornerstone of the reconstruction of the economy of the Russian Federation following the 1991 dissolution of the Union of Soviet Socialist Republics, creating a national interest of vital importance to policymakers in Moscow.

In this chapter, I examine these roles of the Arctic in climate change, paying particular attention to paradoxical linkages that play out in complex systems. In the next three sections, I consider each of the mechanisms identified in the previous paragraph. With an understanding of these mechanisms in hand, I turn in the penultimate substantive section to an assessment of efforts to make use of international arrangements to address issues arising from the roles of the Arctic in climate change. Because the Arctic consists in large part of areas under the jurisdiction of leading states, such as Canada, Russia, and the United States, there is a sense in which the issues I identify are suitable for consideration in global arenas like the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and the Meeting of the parties to the 2015 Paris Agreement. Nevertheless, the Arctic has an intergovernmental body of its own known as the Arctic Council, established under the terms of a ministerial declaration in 1996 with a mandate to deal with matters of environmental protection and sustainable development of interest to the Arctic States.[1] Climate change has been a topic of primary interest to the Arctic Council from its inception through to the present time. The council operates under severe restraints with regard both to its authority to make decisions on matters of substance and to the availability of material resources needed to engage in programmatic activities. The current war in Ukraine has had a disruptive impact on the operations of the council. Nevertheless, the council has played a role of some importance when it comes to documenting what we now regard as the climate emergency and to identifying means to address the challenges of climate change. I explore ways in which the Arctic Council has been able to take steps that are relevant to the problem of climate change, despite the severe constraints under which it operates. I also note the adverse circumstances facing the Council today and what they mean for its work relevant to the problem of climate change. In the concluding section, I turn to the future, using the case of climate change and the Arctic as a vehicle for discussing ways to think about resilience and to respond to critical transitions in complex systems.[2] What are the options for those responsible for dealing with situations in which it is known not only that critical transitions will occur from time to time and that these transitions may feature non-linear developments of an abrupt character, but also that there is no way to produce confident predictions regarding either the exact timing or the precise form of these developments?

13.2 The Arctic in the Earth's Climate System

One way to think about the roles of the Arctic with regard to climate change is to focus on incremental changes in key variables that can be tracked quantitatively through the compilation of time-series data. A prominent example involves measurable increases in temperature at the Earth's surface. Temperatures in the Arctic have risen by 2–3°C in recent decades, whereas the global rise in surface temperatures stands at a little over 1°C.

[1] Arctic Council, Declaration on the Establishment of the Arctic Council, 19 September 1996. http://hdl.handle.net/11374/85.
[2] C. S. Holling, L. H. Gunderson, Resilience and adaptive cycles, in L. H. Gunderson, C. S. Holling (eds.), *Panarchy: Understanding Transformations in Human and Natural Systems* (Island Press, 2002), pp. 26–52; M. Scheffer, *Critical Transitions in Nature and Society* (Princeton University Press, 2009).

This trend, observable in the divergence of the two trajectories starting in the 1990s, is expected to continue during the foreseeable future. In fact, the gap between the trend line in the Arctic and the global trend is growing. An assessment completed in 2021 by the Arctic Monitoring and Assessment Programme, a working group of the Arctic Council, confirms that temperatures are now rising in the Arctic at a rate that is at least three times the global average.[3]

A similar picture emerges from data documenting declines in the abundance and distribution of sea ice in the Arctic over the course of the last few decades. The extent of sea ice in the Arctic varies seasonally, reaching a maximum annually in March and a minimum in September. The extent of sea ice in the Arctic Basin has declined sharply since the 1980s. Most experts expect this trend to continue during the coming years, opening up the prospect that the Arctic will be largely ice-free for several summer months as early as the 2030s and 2040s.[4] Some have even begun to speak of a 'death spiral' of Arctic sea ice, anticipating a future in which what is generally regarded as a defining feature of the Arctic becomes a thing of the past.[5] Whether or not this development comes to pass, it is clear that the shifting ice regime in the Far North is a critical feature in the rise of what many now speak of as the 'new' Arctic.

What makes these Arctic developments critical with regard to the dynamics of the Earth's climate system is the operation of positive feedback mechanisms. Rising temperatures accelerate the melting of snow and ice exposing darker surfaces which have a lower albedo and absorb more solar radiation than snow or ice. This, in turn, drives temperatures higher, giving rise to the thawing of permafrost rich in carbon dioxide and methane and creating conditions conducive to the outbreak of massive fires in the high latitudes of the northern hemisphere. In central Siberia, known for its historically extremely low temperatures, the temperature reached an all-time high of 38°C in the summer of 2020, and there is no reason to treat this as a fluke. Similarly, the melting of sea ice produces great increases in expanses of dark seawater, which absorbs far more solar radiation than ice, giving rise to a continuing feedback loop and contributing to the general warming of the oceans.

While these incremental developments play a significant role in the dynamics of the Earth's climate system, there is another way to think about the role of the Arctic in the climate system that sharpens the paradoxical nature of this relationship and makes the idea of a global climate emergency even more compelling. The key idea here concerns tipping elements or mechanisms that could trigger what are known as critical transitions or bifurcations (in contrast to oscillations) producing fundamental shifts in the character of the Earth's climate system.[6] Experts have identified a number of these tipping elements, including some like transformative change featuring replacement of the Amazon rainforest with open savannah-like ecosystems that centre on developments occurring in the mid-latitudes. A striking feature of this line of thinking, however, is that several of the most

[3] AMAP, Arctic Climate Change Update 2021: Key Trends and Impacts. Summary for Policy-makers (2021). amap.no/documents/doc/arctic-climate-change-update-2021-key-trends-and-impacts-summary-for-policy-makers/3508.
[4] M. C. Serreze, *Brave New Arctic: The Untold Story of the Melting North* (Princeton University Press, 2018).
[5] P. Wadhams, *A Farewell to Ice: A Report from the Arctic* (Oxford University Press, 2017).
[6] T. Lenton, H. Held, E. Kriegler, et al., Tipping elements in the Earth's climate system. *Proceedings of the National Academy of Science USA* 2008, 105(6): 1786–1793; M. Scheffer, *Critical Transitions in Nature and Society.*

prominent tipping elements in the climate system involve Arctic or Subarctic processes.[7] These include the emergence of an ice-free Arctic Basin, the decline and eventual collapse of the Greenland ice sheet, die off in the vast boreal forests of Siberia and North America, and more or less drastic shifts in the Atlantic Meridional Overturning Circulation (AMOC) system. While it is notoriously difficult to assign probabilities to the likelihood of such occurrences, it is worth emphasizing the magnitude of the mechanisms involved. The Greenland ice sheet, for example, contains enough ice that its collapse would raise sea levels on a global scale by some 6–7 metres. Most assessments of the mass-balance of this ice sheet suggest that the melting of the Greenland ice sheet may take several centuries. There are good reasons to believe that the process is already underway, however, with evidence collected from ice-core drilling projects in Greenland indicating that sharp shifts in the condition of the ice sheet have occurred over remarkably short periods of time in the past.[8]

Evidence assembled in recent years reinforces this picture of the critical role of the Arctic in the Earth's climate system. It is now understood, for example, that there is more carbon dioxide locked in the permafrost of high northern latitudes than the total of all anthropogenic emissions of carbon dioxide since the beginning of the Industrial Revolution; the shallow coastal waters of Arctic seas are rich in methane clathrates.[9] The melting of permafrost and the warming of coastal waters could lead to a destabilization of these reservoirs of greenhouse gases and a resultant migration of some of them into the atmosphere. The mechanisms involved in these processes are subjects of considerable debate within the scientific community at the present time. There is certainly no justification for assuming that these greenhouse gases will migrate from terrestrial and marine systems to the atmosphere in a mighty flood. Still, continuing scientific research on the Earth's climate system is reinforcing the basic proposition that the Arctic plays a critical role in the Earth's climate system, despite the low level of anthropogenic emissions of greenhouse gases emanating from the region. Serious efforts to meet the goal of the 2021 Glasgow Climate Pact to limit temperature increases to 1.5°C relative to pre-industrial levels on a global basis must pay attention to the role of the Arctic in the Earth's climate system.

13.3 Adaptations to the Impacts of Climate Change in the Arctic

These observations set the stage for a discussion of a second major paradox involving complex linkages associated with climate change and the Arctic. Anthropogenic emissions of greenhouse gases originating in the Arctic are minuscule as a proportion of global emissions. But the Arctic is ground zero with regard to the impacts of climate change – the biophysical and socioeconomic effects of climate change are showing up sooner and more dramatically in the Arctic than anywhere else on the planet.[10] As a result, some

[7] T. Lenton, Arctic tipping points. *Ambio* 2012, 41: 10–22.
[8] J. Gertner, *The Ice at the End of the World* (Random House, 2019).
[9] NOAA, *Arctic Report Card 2019* (NOAA, 2019). www.arctic.noaa.gov/Report-Card.
[10] AMAP, Arctic Climate Change Update 2021: Key Trends and Impacts. Summary for Policy-makers (2021). amap.no/documents/doc/arctic-climate-change-update-2021-key-trends-and-impacts-summary-for-policy-makers/3508.

observers have taken to treating the Arctic as the canary in the coal mine when it comes to monitoring the onset of climate change on the planet and thinking about the challenges of adaptation. Although this image is somewhat distasteful in humanitarian terms, it does capture the sense of urgency regarding the status of the Arctic as the leading edge when it comes to recognizing and (hopefully) responding to the onset of climate change. Equally important from the perspective of policy is the fact that Arctic communities and all those concerned with the future of the Arctic must now turn their attention to matters of adaptation to conditions arising from the impacts of climate change. Of course, there is great variation from one subregion to another and even from one community to another within the same subregion when it comes to identifying and responding to the challenges of adaptation. Nevertheless, the Arctic today does offer an opportunity to begin to think rigorously about what is involved in efforts to adapt to the impacts of climate change and the relative merits of a variety of response strategies ranging from local initiatives to international measures.

For Arctic communities, the challenges of adaptation are associated with the biophysical impacts of climate change.[11] The recession of sea ice has increased the vulnerability of coastal areas to the impact of storm surges. As a result, many areas are now experiencing severe coastal erosion causing shorelines to move landward by many metres each year. Human communities dependent on resources derived from the sea (such as marine mammals and fish) are typically located in close proximity to the coast to afford easy access to the sea and to minimize the energy required to engage in harvesting and processing marine resources. The result, in a growing number of cases, is that the land on which coastal communities are located is literally collapsing into the sea. In some cases, there is room to adapt in a defensive fashion by constructing seawalls or relocating the most exposed houses and related facilities. For all this, more and more coastal communities are facing the necessity of relocating altogether, moving to higher ground and more defensible situations. Relocating entire communities, however, turns out to be extraordinarily challenging not only due to social differences within communities regarding specific options and political hurdles relating to the legal status of alternative sites, but also because the cost of relocating even small communities can easily run into tens or hundreds of millions of dollars. Not surprisingly, adaptation in such cases typically becomes a protracted process fraught with numerous pitfalls and obstacles to progress.

A somewhat similar picture emerges from a consideration of pressures to adapt to the impacts of thawing permafrost. Most infrastructure in the Arctic (such as buildings, roads, airports, pipelines, and utility systems) is built on frozen ground. So long as conditions remain stable, it is possible to take this fact into account at the design stage and to construct facilities that are compatible with these conditions. But the impacts of climate change are leading to rapid increases in the depth of the active layer of the permafrost in many parts of the Arctic, and it is difficult to predict what to expect in this regard over a period commensurate with the normal lifespan of most types of infrastructure. Already, reports of more or less severe damage caused by the thawing of permafrost are mushrooming, and the costs of

[11] NOAA, *Arctic Report Card 2019*; IPCC, *Climate Change 2021 – The Physical Science Basis: Summary for Policymakers* (IPCC, 2021).

developing effective solutions to this challenge are likely to be daunting. In all those cases where successful adaptation is likely to be beyond the means of local communities, complex questions concerning the roles and responsibilities of local, state/provincial/oblast, and national governments come into focus. At this stage, the way forward with regard to adapting to the impacts of permafrost thawing is anything but clear.

Other challenges of adaptation of a somewhat similar nature are coming into focus across the Arctic. Ice roads, which are critical for winter travel in many parts of the Arctic, are now useable for shorter and shorter seasons. Massive fires, attributable to higher temperatures and drier conditions, now rage out of control in large parts of Siberia, the Canadian Arctic, and Alaska. In areas that are rich in peat, these fires can continue to burn on a year-round basis, affecting tens of thousands of square kilometres. In other areas, acceleration in the pace of spring melting of snow and ice has led to the repeated flooding of major rivers, and the water released as a result of thawing permafrost has caused the water-logging of soils, interfering with normal activities in many human communities. Rising temperatures have made it possible for destructive insects (for example, the spruce bark beetle) to survive winter conditions and to thrive in the new climate regime. One result is the dieback of sectors of the boreal forest stretching across the Arctic and Subarctic, encompassing thousands of square kilometres. The impacts of these consequences of climate change are by no means uniform. But taken together, they add more layers to the challenges of adapting to the impacts of climate change facing human communities in the Arctic.

One notable consequence of climate change in many parts of the Arctic is an accumulation of shifts in the distribution, abundance, and condition of populations of fish and game. Commercially important stocks of fish are moving to the north as in the case of pollock in the Bering Sea, to the north-east as in the case of cod in the Barents Sea, and to the west as in the case of mackerel in the Norwegian and Greenland Seas.[12] Species of wildlife that are important to subsistence harvesters, like marine mammals dependent on sea ice (such as polar bears and walrus) and terrestrial mammals subject to food shortages and insect infestations (like reindeer and caribou), are experiencing increased stresses that reduce their value to human users. There are bright spots in this picture. Cod stocks in the Barents Sea, for example, have held up well so far, despite the fact that the physical features of the Barents Sea ecosystem are changing rapidly. Nevertheless, the overall effect of these changes affecting fish and game is to make life for many Arctic residents riskier and more uncertain.

Of course, climate change is not the only type of change affecting the well-being of the Arctic's human residents. As Arctic residents know well and as numerous analysts have documented in detail, social change has been a major feature of life in the Arctic for a long time.[13] Communities that were largely 'off the grid' in the not so distant past are now fully connected with the outside world through modern forms of transportation and advanced information and communication systems. Even so, the challenges of adapting to the impacts

[12] O. S. Stokke, A. Østhagen, A. Raspotnik (eds.), *Marine Resources: Climate Change, and International Management Regimes* (I.B. Tauris, 2022).

[13] AHDR, Arctic Human Development Report (SDWG, Arctic Council, 2004). http://hdl.jhandle.net/11374/51; AHDR, Arctic Human Development Report: Regional Processes and Global Linkages (Nordic Council of Ministers, 2014).

of climate change have intensified social change in the Arctic, making it increasingly difficult for individuals to flourish and maintain a sense of well-being in today's world. Developments involving reductions in the relevance of traditional knowledge, shifts in gender roles, and increases in dependence on outside sources of support have all had the effect of eroding established ways of life without offering a straightforward or easily adoptable alternative. Under the circumstances, it is not surprising that there is an association between the onset of climate change and social problems including suicide among young people, substance abuse, and domestic violence in many Arctic communities.

These observations should suffice to make it clear that adaptation to the impacts of climate change in the Arctic, which are largely attributable to non-Arctic drivers, is a multidimensional challenge with no easy solutions. What works in one part of the Arctic may prove irrelevant or outside the bounds of the possible for one reason or another in other parts of the region. Clearly, there is no substitute for unified and energetic community responses to the challenge of adaptation. Reports from case after case show sharp differences between communities in which coherent community-wide efforts to tackle issues arising from the onset of climate change have arisen and others in which the challenge of adaptation has fed internal differences and intensified pathological behaviour on the part of individuals. But it is equally clear that it is inappropriate to leave Arctic victims of climate change to fend for themselves, scrambling to find workable responses on a community-by-community basis in the absence of external assistance. So far, debates about policy issues relating to climate change at the international, national, and even subnational levels have focused largely on issues of mitigation in contrast to adaptation. In the final analysis, of course, mitigation in the sense of finding ways to reduce (or even reverse) emissions of greenhouse gases is essential. But in areas like the Arctic where the impacts of climate change are upon us, there is no excuse for failing to devote greatly increased imagination, energy, and resources to addressing the challenge of adaptation. There is a lot to be learned in this regard from the experience of the Arctic where efforts to cope with the impacts of climate change are today's realities rather than tomorrow's worries.

13.4 Energy from the Arctic

The preceding discussion opens the way to a consideration of another paradoxical consequence of complex linkages involving climate change and the Arctic, a consequence that some regard as a type of adaptation to recent developments but that others see as a dramatic step in the wrong direction in terms of coming to terms with the global challenge of climate change. The point of departure here is the fact that the impacts of climate change on the Arctic have increased the accessibility of the region's natural resources and made it easier and more cost-effective to deploy innovative methods of moving these resources to southern markets. The Arctic has significant deposits of numerous resources, including iron ore, lead, zinc, copper, gold, diamonds, uranium, and rare Earth elements. But the critical concern with regard to the role of the Arctic in climate change arises from the fact that the region has massive recoverable reserves of fossil fuels, as well.

There is nothing new about the attractions of Arctic oil and gas. In the 1980s, some two million barrels of oil pumped from fields located on Alaska's North Slope flowed through the Trans-Alaska Pipeline each day. The North Slope also has a very large gas cap, although efforts to find ways to market this resource profitably have met with repeated failures. Norway is a petro-State, dependent upon the production of offshore oil and gas for its remarkable economic prosperity in recent decades. Starting with the development of fields located in the North Sea, Norwegian interest in the development of hydrocarbons under its jurisdiction has shifted northwards in recent times. Norway is now offering leases to companies interested in exploiting deposits of oil and gas in the Barents Sea.

The centre of attention regarding the exploitation of the Arctic's oil and gas, however, lies in Russia. Even during the USSR era in the 1970s and 1980s, Russian developers extracted large quantities of natural gas from massive fields (for example, Urengoy and Yamburg) located in north-western Siberia, using some of the gas to fuel domestic industries and shipping sizable quantities via pipeline to consumers in western Europe. What is new in this regard is the opening of massive new reserves of natural gas further north on the Yamal and Gydan Peninsulas, the growing engagement of key private firms (such as Novatek) as well as state-owned firms (chiefly Gazprom and Rosneft) in the production of energy from the north, the development of technologies allowing for the shipment of liquified natural gas both eastward and westward in state-of-the-art tankers along the Northern Sea Route (NSR), and the participation of foreign enterprises such as France's TotalEnergies and the China National Petroleum Company (CNPC) based in the People's Republic of China (PRC) as key investors in the production and shipment of Russia's Arctic natural gas.[14]

With the completion of the new Port of Sabetta on Ob Bay and the delivery of the first of a fleet of Arc-7 liquified natural gas supertankers built by the Republic of Korea's (ROK) Daewoo Shipbuilding and Marine Engineering Company, shipments of Yamal natural gas produced by Novatek got underway in 2018–2019. Making use of the NSR, it is now feasible to ship natural gas to consumers in Asia during the summer months and to consumers in Europe during the rest of the year. These markets are subject to many forces that make predictions about future trends difficult, including the impacts of the current Russian war in Ukraine. But there is no doubt that the extraction and shipment of Arctic natural gas has developed into a critical component of Russia's economic strategy in the post-Soviet era and of Russia's campaign to achieve international recognition of its role as a great power under conditions prevailing in the early twenty-first century. One knowledgeable Russian analyst observed in 2019 that '[t]his sector generates about [15] percent of Russia's current GDP, and this share is projected to increase'.[15] Among other things, this means that Arctic gas is a critical contributor to the Russian government's revenue stream. At present, the coalition between the country's political leaders and its industrial leaders in support of the continued growth of this sector remains solid.

[14] T. Mitrova, Arctic resource development: economics and politics, in R. W. Corell, J. D. Kim, Y. H. Kim, et al. (eds.), *The Arctic in World Affairs: A North Pacific Dialogue on Global–Arctic Interactions: The Arctic Moves from Periphery to Center* (Korea Maritime Institute and East–West Center, 2019), pp. 205–224.

[15] Ibid., p. 205.

Novatek is presently hard at work adding to its capacity to produce natural gas on the Yamal and Gydan Peninsulas, with additional projects slated to come on stream during the 2020s, and Gazprom and Rosneft are exploring the scope of recoverable reserves of natural gas in adjacent areas of the Kara Sea. Reliable estimates now suggest that Russia's Arctic reserves taken together are large enough to justify comparison with the massive reserves of the Middle East and the Gulf of Mexico. What is more, continued development of these reserves fits well with Russian plans for the growth of ship traffic using the NSR and dovetails with the PRC's interests in raising its profile as a 'near Arctic state' and as a player to be taken seriously in thinking about the future of Arctic affairs. Russia's interest in engaging in bilateral economic co-operation with the PRC grew rapidly in the wake of Russia's 2014 annexation of Crimea and invasion of eastern Ukraine 2014, and the resultant imposition of sanctions on Russia by the United States and a number of European states. The 2022 invasion has likely accelerated this development. For its part, the PRC has created an investment mechanism known as the Arctic Silk Road Fund and taken steps to integrate its emerging interest in the development of Arctic resources into its comprehensive Belt and Road Initiative.[16] Whatever the consequences may be in the realm of climate change, geopolitical forces continue to stimulate both Russia's commitment to the extraction of Arctic hydrocarbons and a willingness on the part of China and Russia to make common cause in exploiting the natural resources of the Arctic. Others, like the Japanese and the South Koreans, have demonstrated a willingness to become active players in this enterprise; even those European States that have taken the lead in efforts to promote decarbonization as a response to the problem of climate change have been unable to reduce the role of Russian natural gas in fuelling their economic systems. The current Russian War in Ukraine Russian may alter this picture significantly. So far, however, natural gas continues to flow from Russia to Europe, and European payments are helping to shore up the Russian economy.

The paradoxical nature of these developments is glaring. The Arctic plays a critical role in the Earth's climate system, and the challenge of finding ways to adapt to the impacts of climate change is a matter of extreme urgency to Arctic communities. However, at the same time, the impacts of climate change have increased the accessibility of the Arctic's natural resources; they have played a key role in making the production and shipment of energy from the North profitable. Russia is a signatory to the 2015 Paris Agreement and has promised to reduce its emissions of greenhouse gases by 30% from 1990 levels by 2030. As chair of the Arctic Council during the 2021–2023 biennium, Russia announced a commitment to the pursuit of sustainability and indicated that efforts to combat the problem of climate change constitute a significant priority in its Arctic policy.[17] A focus of particular interest appears to be an effort to alleviate negative impacts of climate change in the Russian Arctic. Yet there is a pronounced disconnect between the two domains. Work proceeds at a vigorous pace on efforts to expand the production and shipment of Arctic natural gas, even while the Russian leadership expresses concerns about the problem of

[16] J. Yang, H. Tillman, Perspective from China's international cooperation in the framework of the polar Silk Road, in R. W. Corell et al. (eds.), *The Arctic in World Affairs*, pp. 275–292.
[17] Arctic Council, Russia's Chairmanship Programme for the Arctic Council 2021–2023 (2021). oaarchive.arctic-council.org.

climate change. It remains to be seen when and how policymakers will seek to come to terms with this contradiction.

The disconnect between economic development relying on the consumption of fossil fuels and the recognition of the role of the Arctic in climate change is not exclusive to Russian policymakers and analysts. It is a striking feature of numerous conferences and workshops on Arctic issues occurring in a variety of venues that participants are able to move directly from a session highlighting the onset of the climate emergency in graphic terms to another session focusing on the ins and outs of plans for the production and shipment of Arctic energy resources. What has emerged in this regard has the attributes of a dialogue of the deaf. Members of the two communities are perfectly civil to one another as they move from session to session and converse in the corridors of Arctic venues. But they do not hear one another when it comes to thinking through the implications of the discourses that underlie the development of their ideas. Apparently, one way to respond to paradoxical linkages in complex systems is to compartmentalize thinking in a manner that marginalizes the sources of the difficulties and makes the consequences invisible, at least in the short run.

13.5 The International Relations of Climate and the Arctic

Are there institutional arrangements available to address the paradoxical linkages associated with climate change and the Arctic? The Arctic lacks a comprehensive international regime similar to the Antarctic Treaty System under which the 'Parties commit themselves to the comprehensive protection of the Antarctic environment … hereby designate Antarctica as a natural reserve, devoted to peace and science' and adopt rules calling for the demilitarization of Antarctica and the prohibition of '[a]ny activity relating to mineral resources, other than scientific research'.[18] But this does not mean that there is a vacuum with regard to arrangements designed to respond to needs for governance relating to matters of importance to the Arctic. In the years since the close of the Cold War, in fact, the Arctic has emerged as a focus of attention among a sizable collection of players interested in promoting co-operative responses to an array of Arctic issues.

The most prominent element of the resultant complex of arrangements is the Arctic Council established under the terms of a 1996 ministerial declaration as a high level forum to 'provide a means for promoting co-operation, co-ordination and interaction among the Arctic States, with the involvement of the Arctic indigenous communities and other Arctic inhabitants on common Arctic issues, in particular issues of sustainable development and environmental protection in the Arctic'.[19]. In many respects, the council is a weak mechanism. It is grounded in the provisions of a ministerial declaration rather than an international legally binding instrument. The council has no authority to make binding decisions, although it has on several occasions provided a convenient venue for informal consultations on the content of provisions to be included in formal agreements. And the council lacks

[18] Protocol on Environmental Protection to the Antarctic Treaty, opened for signature 4 October 1991, entered into force 14 January 1998.
[19] Declaration on the establishment of the Arctic Council, Ottawa, 1996.

a source of material resources that would allow it to engage in programmatic activities that could make a significant difference with regard to matters like adaptation to the impacts of climate change in the Arctic.

Still, it would be a mistake to regard the council as ineffectual when it comes to responding to the issues relating to climate change and the Arctic discussed in the preceding sections of this chapter.[20] The Arctic Council's working groups, which have established a reputation for producing scientifically sound products, are able to engage in activities involving monitoring and assessment to track the course of climate change in the Arctic and to document trends with regard to the onset of climate change in the high latitudes of the northern hemisphere. Because the council has strong links to diplomatic establishments (the Senior Arctic Officials are representatives of the foreign ministries of the member States), it is able to communicate findings relating to climate change and the Arctic to international bodies concerned with climate change like the Conference of the Parties of the UNFCCC and the Intergovernmental Panel on Climate Change (IPCC). This has given rise to the idea that the council can play the role of what some analysts call an Arctic messenger, delivering news regarding the dramatic development of the impacts of climate change to audiences in a position to absorb the relevant information and to integrate it into their efforts to address the problem of climate change.[21] What is more, the council has a category of Observers, which has grown to include 38 non-Arctic states, intergovernmental organizations, and non-governmental organizations. Today, all the major emitters of greenhouse gases are either members of the council or Observers, and major intergovernmental bodies like the United Nations (UN) Development Programme, the UN Environment Programme, the International Maritime Organization, and the World Meteorological Organization are included in the ranks of intergovernmental observers. This provides the council with what may be thought of as convening power. While the council lacks the authority to make formal decisions, Arctic Council gatherings bring together representatives of most major actors concerned with climate change and provide them with opportunities to engage in off-the-record interactions about ways to address various aspects of the challenge of climate change.

What roles have these institutional mechanisms been able to play in dealing with the concerns discussed in the preceding sections of this chapter? In 1999, the Arctic Council acting in conjunction with the International Arctic Science Committee launched an initiative known as the Arctic Climate Impact Assessment (ACIA) that eventuated in a landmark report including a summary for policymakers delivered at the council's 2004 Ministerial Meeting in Reykjavik, Iceland. ACIA explored the critical role of the Arctic in the Earth's Climate System and assembled for the first time a body of clear evidence concerning critical feedback mechanisms and the role of the Arctic as ground zero regarding the impacts of climate change.[22] The Arctic States worked hard to communicate ACIA's findings to global forums like the Conference of the Parties of the UNFCCC – indeed, several of the council's

[20] T. Barry, B. Daviðsdóttir, N, Einarsson, O. R. Young, How does the Arctic Council support conservation of Arctic biodiversity? *Sustainability* 2020, 12(12): 5042; M. Smieszek, *Informal International Regimes: A Case Study of the Arctic Council*. (University of Lapland, 2019).

[21] D. P. Stone, *The Changing Arctic Environment: The Arctic Messenger* (Cambridge University Press, 2015).

[22] ACIA, *Arctic Climate Impact Assessment* (Cambridge University Press, 2005).

working groups (such as the Arctic Monitoring and Assessment Programme, the Working Group on the Conservation of Arctic Flora and Fauna) have continued to track the accelerating impacts of climate change in the Arctic. This experience reflects both the strengths and the weaknesses of the Arctic Council in addressing climate change and the Arctic. There is general agreement that the compilation of evidence regarding the role of the Arctic in the Earth's climate system and the proactive efforts of the council to play the role of the Arctic messenger in this domain have made a difference. But at the same time, the experience with ACIA and a series of follow-up reports documenting trends during the years from 2004 to the present makes it clear that the ability of the council to make a difference in this realm is limited to providing early warning regarding emerging concerns and assembling evidence for participants in other arenas to use in support of their efforts to forge agreement on stronger measures needed to come to grips with what is now widely seen as a global climate emergency.

Given the character of the challenges of adapting to the impacts of climate change, it may seem that the Arctic Council as a body dedicated to international co-operation and interaction among Arctic states regarding Arctic issues with the participation of Indigenous peoples and other Arctic residents would be an important mechanism for tackling this challenge. And several of the council's working groups, including the Sustainable Development Working Group and the Working Group on the Protection of the Arctic Marine Environment, have taken an interest in issues associated with the impacts of climate change on Arctic communities and ecosystems. Nevertheless, several factors have limited the performance of the council in this realm. At the national and international levels, policymakers have devoted their attention largely to issues of mitigation in the sense of measures designed to reduce emissions of greenhouse gases in contrast to adaptation in the sense of finding ways to adjust to changes resulting from the impacts of climate change. Local variations in the impacts of climate change and in the feasibility of implementing various response strategies limit the ability of an international body like the Arctic Council to contribute effectively to crafting effective adaptation strategies. More specifically, successive chairmanships have imposed their own priorities on the agenda of the Sustainable Development Working Group, a situation that has made it difficult for this working group to engage in longer-term efforts to address questions involving adaptation strategies. Still, this does not mean that there is no role for the council to play in promoting successful adaptations to the impacts of climate change. Among other things, the council provides a venue in which key players concerned with adaptation can meet at regular intervals to engage in both on-the-record and off-the-record consultations about the merits of a variety of adaptation strategies and to launch joint initiatives to raise the profile of this concern on policy agendas inside and outside the Arctic.

Perhaps counterintuitively, the Arctic Council has not been able to play a significant role with regard to the paradoxical linkage underlying the region's growing role as a source of hydrocarbons to fuel industrial systems. There are several reasons for this. As the prior discussion makes clear, the development of Arctic energy has assumed a critical role in the political economy of the Russian Federation. Unless and until this situation changes, it would be unrealistic to expect Russia to pay attention to the views of other members of the

Arctic Council regarding the perils of aggressive measures to produce and ship Arctic hydrocarbons. What is more, the bilateral co-operation between Russia and the PRC in this realm fits comfortably into the approach to Arctic issues that the PRC favours as a non-Arctic State limited to observer status in the Arctic Council. Likewise, India, Japan, and the ROK, which are also Arctic Council Observer States, have interests in the development of Arctic hydrocarbons as a measure to provide assurance in the event of disruptions in the supply of hydrocarbons from other areas like the Middle East. It is possible that the Arctic Economic Council, a body that is formally independent but closely aligned with the Arctic Council, could play a constructive role in this realm. For example, the Arctic Economic Council has promoted the idea of an Arctic Investment Protocol, a measure intended to encourage the application of principles of responsible investment with regard to Arctic initiatives. But there is no doubt that the ability of the Arctic Council to make a difference regarding the exploitation of the Arctic's reserves of fossil fuels is severely constrained.

At this juncture, the operation of the Arctic Council is suffering from the disruptive impacts of the war in Ukraine. In the immediate aftermath of the 2022 Russian invasion, the western members of the council suspended their participation in the activities of the council.[23] The effect was to produce a halt in the operation of the council, including in the activities of its various working groups. As the war has dragged on, it has become increasingly clear that this situation is untenable. The Arctic itself remains a zone of low tension. Addressing key issues, including climate change as a prominent example, requires communication and collaboration on a circumpolar basis. Under the circumstances, interest is rising in working out what the members have described as 'necessary modalities' for resuming the work of the council in a number of areas. As of the time of writing (June 2022), however, the way forward remains unclear. In this regard, the political convulsions triggered by the war in Ukraine have cast a shadow over efforts to deal with the roles of the Arctic in climate change as they have over many other efforts to come to terms with the climate emergency in international settings.

13.6 Managing Paradoxical Linkages in Complex Systems

There is nothing unusual about the occurrence of paradoxical linkages in the world of complex systems of the sort under consideration in this chapter.[24] Hyperconnectivity, including what analysts of complex systems call telecoupling, is a prominent feature of such systems. The facts that greenhouse gases emitted in the mid-latitudes produce dramatic consequences in the high latitudes and that the impacts of climate change in the Arctic trigger feedback mechanisms whose consequences are felt on a global scale are entirely compatible with the behaviour of a complex system like the Earth's climate system. Similarly, non-linear changes are regular occurrences in complex systems. An important case in point regarding climate change and the Arctic centres on the transition between

[23] Joint Statement on Arctic Council Cooperation Following Russia's Invasion of Ukraine (3 March 2022). state.gov/joint-statement-on-arctic-council-cooperation-following-russias-invasion-of-ukraine.

[24] M. Scheffer, *Critical Transitions in Nature and Society*; O. R. Young, *Governing Complex Systems: Social Capital for the Anthropocene* (MIT Press, 2017).

circumstances in which it is possible to protect communities from the effects of climate change and situations in which there is no realistic option other than the wholesale relocation of communities. Another centres on the prospect that temperature increases attributable to activities in the mid-latitudes may trigger large-scale releases of carbon dioxide and methane now locked in permafrost and methane clathrates. In effect, such systems generate critical transitions that are known to occur from time to time but whose actual occurrence generally takes people by surprise because these events involve a form of complex causation that is difficult – often impossible – to grasp in a manner that allows for meaningful prediction.[25]

Are there insights from the case of climate change and the Arctic that will command the attention of those who have a more general interest in managing paradoxical linkages in complex systems? Many – perhaps most – people are fearful of critical transitions or bifurcations, especially when they involve non-linear and surprising shifts for which those affected are unprepared. As a result, they are apt to make heroic efforts to shore up existing systems and to ward off dramatic state changes in these systems, even when the performance of the systems leaves a lot to be desired in terms of a broad range of evaluative criteria. Undoubtedly, this is a major source of the fashionable interest today in the idea of resilience construed as the ability of a system to adjust its internal workings to address a range of pressures or threats without experiencing major changes in its defining features or attributes.[26] Resilience, on this account, is a good thing – policymakers are well advised to study the determinants of resilience and to invest both political capital and material resources in actions aimed at enhancing the resilience of biophysical, socioeconomic, and what are now often described as socioecological systems.

Thinking about climate change and the Arctic, however, raises questions about the adoption of this line of thinking as a dominant perspective in a world of complex systems. For one thing, as the discussion of the role of the Arctic in the Earth's climate system makes clear, there are many settings in which critical transitions will occur from time to time, although it is impossible to predict when they will occur with any precision and to anticipate the nature of the chain reactions that will unfold once key thresholds are breached. What is more, the performance of many systems leaves a great deal to be desired, even though those who occupy privileged positions in existing systems can be expected to make every effort to defend or shore up these systems in the interests of maintaining their positions. Conditions prevailing in many Arctic communities are anything but ideal. While it is extremely difficult to generate consensus regarding the choices involved in relocating a community in response to the impacts of climate change, there are cases in which a new start made possible in the course of relocation can provide an opportunity to address a sizable range of problems in a constructive manner. And there are cases in which key features of prevailing systems are part of the problem rather than part of the solution when it comes to dealing with systemic challenges like climate change. The paradoxical linkages underlying growth in the production and shipment of the Arctic's hydrocarbons, for example, have the effect of reinforcing

[25] V. Smil, *Grand Transitions: How the Modern World Was Made* (Oxford University Press, 2020).
[26] C. Folke, Resilience: The emergence of a perspective for social–ecological systems analyses. *Global Environmental Change* 2006, 16: 253–267; Holling and Gunderson, Resilience and adaptive cycles.

a system that must give way to some more appropriate alternative in order to come to terms with the challenge of climate change. It is hard to defend initiatives aimed at increasing the resilience of this system in a setting in which finding ways to come to terms with the climate emergency has emerged as one of the twenty-first century's grand challenges of planetary governance.[27]

What are the policy implications of this line of thinking? Needless to say, it makes sense to monitor complex systems closely to identify tipping elements and to evaluate whether they are approaching thresholds where the probability that critical transitions will occur increases. But it is unrealistic to expect that we can acquire the capacity to forecast the occurrence of bifurcations with any confidence. What this means is that we need to create systems that are agile in the sense that they have the capacity to act quickly and decisively take advantage of windows of opportunity that arise when non-linear processes destabilize entrenched arrangements and make it possible to introduce major changes that would be impossible under normal conditions.[28] Just as there is an important distinction between what Kahneman and others have called thinking fast and slow, there may well be a similar distinction between acting fast and slow.[29]

With regard to climate change and the Arctic this means developing systems that can respond promptly to the collapse of sea ice, growing indications of instability in the Greenland ice sheet, and increased releases of carbon dioxide and methane from thawing permafrost. It also means putting in place mechanisms that are capable of taking decisive action once it becomes clear that there is no alternative to relocating Arctic communities in the face of the growing impacts of climate change. Developing a capacity to act fast is difficult in human systems featuring a multiplicity of players with divergent interests and the existence of numerous institutional checks and balances that serve to slow down processes of making and implementing social choices. But finding ways to enhance this capacity without falling into the trap of authoritarianism may turn out to be the key to success in a world in which paradoxical linkages in complex systems constitute a central feature of the policy landscape.

[27] O. R. Young, *Grand Challenges of Planetary Governance: Global Order in Turbulent Times* (Edward Elgar, 2021).
[28] Young, *Governing Complex Systems*. [29] D. Kahneman, *Thinking Fast and Slow* (Farrar, Straus, and Giroux, 2011).