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Chill Out

Why Cooperation is Balancing Conflict Among Major Powers in the New Arctic

Andrew Hart, Bruce Jones and David Steven

PREFACE

he past sixty years witnessed episodes of major violence and periods of recession, but they did not see two ills that marred the previous century: great power war and global depression. This was in large part because during that period, American power underpinned an international system that managed great power tensions, limited conflict, and secured the global flow of trade, finance and energy. It did not do this alone: U.S. power was embedded in a multilateral architecture of alliances, institutions and informal arrangements that helped to mobilize broader action, promote values, and set rules of the game.

That international order and multilateral architecture faces multiple challenges: from the economic and diplomatic rise of new powers, who are challenging the terms of current arrangements; from a dimming of the vibrancy of the trans-Atlantic alliance; and from global challenges like climate change that create collective action hurdles that neither U.S. diplomacy nor multilateral institutions have yet mastered.

This is the backdrop to the Managing Global Order (MGO) project, which has three objectives:

- to chart and foster understanding of the changing global order, and the importance of an effective multilateral architecture;
- to identify key gaps in the provision of global order functions and in multilateral governance arrangements; and
- to facilitate more effective policy communication between those actors necessary to filling those key gaps: the United States and other established powers; the emerging powers; and senior officials in key multilateral institutions.

These objectives were in turn the backdrop to a challenge posed to us in 2010 by then Deputy Secretary of State James Steinberg. Where bilateral relations on security and economic issues had long been the bread and butter of American diplomacy, the new international realities increasingly require the United States to better understand how to foster and mange what Steinberg called "the infrastructure for collective action." His charge to the MGO program was to chart those issues where collective action was most needed and where the frameworks to generate it most absent. Among his top priorities was the Arctic.

This paper is our response. It is also a down payment on a broader analysis of the changing challenge of maritime security and the naval order, part of an ongoing MGO workstream. For sixty years, naval dominance has been the bedrock of American power projection and the place where U.S. hard power most directly protects a common economic good, freedom of trade and the free flow of energy. Will the high seas remain a domain of U.S. dominance? Become a terrain of acute competition for energy resources and regional security, between the U.S. and the rising powers? Or is there a prospect that regional and global multilateral architecture, formal and informal, can help to manage those tensions? The answer will be crucial to the overall balance between order and disorder in the international system. The evolution of arrangements to manage rising competition in the Arctic gives us some grounds for cautious optimism about that broader challenge ahead.

Dr. Bruce Jones, Director and Senior Fellow Managing Global Order he dialogue with the State Department, which, since Deputy Secretary of State James Steinberg's departure, has continued under the auspices of the Office of Policy Planning, has been made possible by a grant from the Carnegie Corporation of New York. The detailed research reflected in this paper is the first of a series of outputs from a research grant by the John D. and Catherine T. MacArthur Foundation for work on the geopolitics of energy and resource scarcity. We are grateful to both foundations. The authors also benefited from the generous support of the Norwegian Royal Ministry of Foreign Affairs for the Brookings Managing Global Order Project.

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INTRODUCTION

s the Cold War receded, so too did the strategic significance of the Arctic, once a zone of U.S.-Soviet contestation. In recent years, tensions have once again been rising. From the infamous planting of the Russian flag on the floor of the Arctic Ocean in 2007 to Secretary Clinton's appearance at the May 2011 Arctic Council ministerial, states have turned their attention to the North. The drivers of this shift are rapidly melting ice and the consequent prospects for the development of energy resources; its facilitators have been innovating in extraction technologies and marine transportation systems to move cargoes of hydrocarbons and hard minerals along previously inaccessible sea routes. Rising oil prices in 2004-2008 generated investment resources.

These changes have created a complex and, to some, worrying political picture. Many fear the Arctic will see an intensifying battle for sovereign control and commercial advantage. While such a view may be "more alarmist than alarming," insecurity in the far North has increased risks of political and military conflict and highlighted the need for a stable maritime security system to manage disputes and other security concerns.

The bleakest forecasts have overlooked positive developments in the region. Despite the Arctic's dangerous mix of great power competition, unresolved territorial disputes, and increasingly accessible oil and gas reserves, there has to date been little actual discord. Unlike in the South China Seas, which

faces a similar mix of uncharted energy resources and contested boundaries, Arctic states have pledged to solve disputes in an orderly process, managed the peaceful resolution of a major territorial conflict, and concluded a binding agreement to cooperate on search and rescue.

This is not to say there is no reason for worry. The most contentious issues are yet to be resolved. There is scope for strategic miscalculation, a loss of faith in multilateral processes that deliver unwelcome findings, or an environmental disaster triggering a spiral of mistrust.

The Arctic therefore emerges as a rich case study of current and potential areas of international cooperation and tension, with implications for energy security, global trade, global power politics, sustainable development, and climate change. In this paper, we first address the Arctic's growing strategic relevance and its potential conflict dynamic. Second, we offer background on the existing institutions and legal regimes, assessing their strength and effectiveness, and then reviewing recent negotiations. Finally, we examine ongoing risks in the region, assessing their likely scale and evolution.

We conclude that—for now—the prospects for continued cooperation outstrip the potential for conflict among Arctic states, and that the Arctic offers lessons, and even elements of a model, for tackling evolving challenges in other regions.

THE ARCTIC AS A SECURITIZED REGION

hough it is the smallest of the world's oceanic zones, it is easy to forget the massive scale of the Arctic region. Nearly the size of continental Russia, the Arctic Ocean covers roughly 5,427,000 square miles, while eight countries have territory in the Arctic circle (the United States, Canada, Russia, Norway, and Denmark, through Greenland, which are coastal states, plus Finland, Sweden, and Iceland).3 Due to climate change, the region's ice is melting, opening new shipping lanes and offering access to undiscovered oil, gas, and other mineral deposits.4 As Charles Ebinger has noted, "the rapidity of Arctic melt is no longer the phantasmagoria of futuristic movies but is occurring at a rate unfathomable just a few years ago."5

Throughout human history, the Arctic has seen only sporadic interest by the world's explorers and its most powerful nations.6 In the early 19th century, navigation of the Arctic became a major strategic objective for the British, with John Franklin and 128 men losing their lives in a doomed expedition that saw their ships stranded in the ice for 18 months. It was not until 1905 that the Norwegian explorer, Roald Amundsen, finally traversed the Northwest Passage, and there were no further successful crossings for another forty years.7 The potential for trans-Arctic aviation was recognized as far back as World War I, but it would not be until after the Cold War that a demonstration program of flights over the North Pole was launched.8

War, however, gave the Arctic new geopolitical significance. During World War II, allied Arctic Convoys undertook what Winston Churchill called "the worst journey in the world," with 1,400 merchant ships delivering supplies to the Soviet Union via Siberia. In the Cold War, the Northwest Passage was seen by the United States and Canada as a first line of defense against Russian attack. In 1957, three Coast Guard vessels became the first American ships to transit the Northwest Passage. Over the course of the Cold War, the Arctic became among the most militarized zones on the planet as both the U.S. and the USSR saw it as a strategic zone from which to launch nuclear attacks.

Once the Cold War ended, Russia and the U.S. drastically reduced their military capabilities in the Arctic, as the region once again faded—albeit temporarily-into strategic and military irrelevance.12 During the 1990s, the circumpolar states emphasized constabulary duties like protection of fisheries and the protection of the fragile Arctic environment, rather than military operations. This period was marked by growing cooperation on the Arctic.¹³ Russia worked with both the U.S. and Norway on decommissioning its nuclearpowered submarines, which had been a major part of the arms race in the Arctic. The Arctic Environmental Protection Strategy was agreed by the eight Arctic countries in 1991, one of the final international agreements to be signed by the USSR.14 In 1996, the Arctic Council evolved from

this strategy to "provide a means for promoting cooperation, coordination and interaction among the Arctic States."¹⁵

Melting ice, however, has given the Arctic new commercial relevance. Amundsen's route through the Northwest Passage was fully navigable for the first time in 2007, despite expectations that it would take decades of warming for multiyear ice to melt. It has now been open for each of the past five years, while a more northern route through the Northwest Passage, the Western Parry Channel, has been open for three of them. Of course, on this route there may still be significant, and hazardous, surface ice, causing some hesitation in calculations about prospective interests in investing in the Arctic routes.

The Northern Sea Route (or Northeast Passage), which runs along Russia's coast, has also become increasingly navigable. Tankers have used the route since 2009, with nuclear-power icebreakers escorting the first supertanker through the passage in August 2011, laden with natural gas for Southeast Asia.¹⁹ Vladimir Putin has described the route as "an international transport artery capable of competing with traditional maritime routes."20 The Russian government expects 64 million tons of cargo to be routed through this artery by 2020, with ships cutting two thirds from the journey time from Europe to Asia via the Suez Canal and reducing risks from piracy.²¹ This would represent significant traffic, although it would not put the Northern Sea Route in the same league as the Suez itself, which shipped ten times that volume of cargo in 2010.22

Shorter transit routes are only one potential prize in the Arctic Circle. In an era of growing resource scarcity, countries are looking covetously at the region's potential as a major supplier of energy. The Arctic already plays an important role in feeding the world's appetite for hydrocarbons. Onshore oil and gas has already been exploited by

the United States, Canada and Russia, with these fields accounting for over 15% of current petroleum production and almost 10% of the world's proven petroleum resource.²³ But offshore fields have even greater potential, especially those within continental shelves and under less than 500m of water. In 2009, the U.S. Geological Survey estimated that 30% of the world's undiscovered gas and 13% of the world's undiscovered oil lies hidden in the Arctic. However, it also underlined the uncertainties associated with an analysis that is based on 'scant information' and does not take into account the likely costs of exploitation in a harsh and inaccessible environment.²⁴

Russia stands to be the biggest winner if it succeeds in finding and developing the Arctic's energy. The USGS estimates that 70% of total Arctic gas reserves lie in Russian territorial waters. Gazprom is already investing heavily in developing its continental shelf and is experimenting with both fixed and floating ice-resistant production units.25 Prospects for aggressive development, however, are likely to be hampered by the developing global gas glut, with shale reserves cheaper to extract and much nearer to important markets.26 The United States also has important interests, with slightly under a third of the projected oil resource found in the Alaska Platform assessment unit,27 an area over which Canada also has a minor claim.²⁸ Exploitation of these resources is possible while energy prices are high, but the U.S. Energy Information Administration has warned that Arctic reserves will be more expensive, risky, and time consuming to develop than deposits elsewhere in the world.29 Private sector interest is increasing, however, with Shell describing its Alaskan offshore fields as having the same potential as the great oil discoveries of the 20th century in the Middle East.30

With so much at stake, interest in the Arctic is not only commercial, but once again strategic. While some scientists now predict the region

will experience largely ice-free summers within twenty years,31 in the short term, navigation will pass through a series of new maritime choke points in the Bering Sea and in Canada's waterways.32 Control of Arctic navigation confers important political, economic and military leverage. There are also concerns that competition for energy reserves will become militarized, with U.S. maritime strategy identifying the potential for "competition and conflict for access and natural resources."33 The United States and Canada have long clashed over the legal status of the Northwest Passage. Shortly after his election in 2006, the Canadian Prime Minister promised to "assert Canada's jurisdiction over the islands, waterways and resources in the Arctic,"34 and argued that sovereignty had to be earned by "having planes in the air, ships in the sea and, most importantly, boots on the ground."35 Canada's Arctic Foreign Policy of 2011 takes a similar, if somewhat less confrontational, line.36

Russian sabre rattling has aroused the greatest fears. In 2007, Russian explorer and Presidential Envoy for the Arctic, Artur Chilingarov, led an expedition that planted a flag on the Arctic sea bed. He told the media that "the North Pole is an extension of the Russian coastal shelf."37 In 2008, the head of the Russian navy saw the potential for a future "redistribution of power [in the Arctic], up to armed intervention."38 A year later, Russia's new Arctic policy underlined the importance of securing sovereignty over the country's strategic resource base in the region and of ensuring 'exclusive' control over the Northern Sea Route.39 Reacting to the building ill-will, the Center for a New American Security quipped that "the only thing in the Arctic melting faster than the northern ice cap is the international comity."40

A military reaction to increased tensions is now well underway. Although the classified nature of many decisions hampers observers from making a sound assessment of the evolving military

balance, each of the five major Arctic States (U.S., Canada, Denmark, Norway and Russia) is either rebuilding its Arctic capabilities or planning to do so in the near future.⁴¹ In September 2011, Russia announced plans to deploy two brigades to the Arctic.42 It has also ordered three nuclear and six diesel ice-breakers.43 Russia has fired cruise missiles over the Arctic, resumed regular patrols of the region for the first time since the break-up of the USSR, and announced plans to augment its naval surface capabilities and its submarine force.44,45 Canada is buying 65 F-35 Lightning II fighter aircraft in part to defend its Arctic sovereignty. 46 It is also expanding its Arctic fleet, building a flagship icebreaker that should be launched in 2017,47 and developing ground satellite stations to enhance its surveillance of the region.⁴⁸ Denmark is establishing an Arctic Command that will eventually deploy F-16 aircraft to Greenland, while Norway has recently moved its military headquarters to a disused Cold War base in the Arctic49 and, in building five frigates equipped with the Aegis combat system, has undertaken its largest ever military expenditure.50

The United States is a partial exception to the build-up. It has been dubbed the "reluctant Arctic power," based on the fairly low priority it has given its commercial and geopolitical interests in the region, its hesitance in confronting rapidly changing strategic realities, and its reluctance to respond to military build-up by other Arctic nations.⁵¹ The U.S. lacked any formal Arctic strategy until 2009, when the Bush administration published a National Security Directive a few days before President Obama's inauguration. The directive identified "broad and fundamental national security interests in the Arctic," while emphasizing U.S. vulnerability to terrorism in the region.⁵² Later in 2009, the Navy published an Arctic Roadmap which was intended to plug a gap until the preparation of the 2014 Quadrennial Defense Review (QDR).53 While its dominant submarine fleet allows the U.S. the luxury of holding back,54

U.S. ships are able to operate only in the marginal ice zone and with limited range.⁵⁵ The U.S. has only one deepwater port in the Arctic basin, at Dutch Harbor at the end of the chain of Aleutian Islands.

American ice-breaking capability is especially limited. The U.S. has just three polar-based ice-breakers. The two heavy ice-breakers are more than thirty years old and have both recently been out of commission.⁵⁶ One is now being

decommissioned and the other refurbished in an attempt to extend its life by five to seven years.⁵⁷ The only modern ice-breaker is used mainly for scientific research. As a result, the U.S. Coast Guard has very little, if any, capacity to fulfill its mission to provide assured access to Arctic waters for the military.⁵⁸ The U.S. may be able to travel over and under the ice, but remains unable to cut *through* it until it matches the investment being made in ice-breaking by other Arctic nations.

THE GEOGRAPHY OF RISK IN THE ARCTIC

Geography is the key to grasping the emerging risks in the Arctic.

The major territorial issues in the Arctic involve disputes over areas geographically beyond each state's legally recognized exclusive economic zone (EEZ). The most coveted prize is the Lomonosov Ridge, which stretches from the north of Greenland across the Arctic Ocean to Siberia and which Russia, Canada and Denmark all argue is a natural extension of their continental shelf. EEZs are territorial zones that extend up to 200 nautical miles (370 km) from a country's coastline, as codified in the 1982 UN Convention on the Law of the Sea (UNCLOS). States are eligible for limited extensions of their EEZ if they can prove their continental shelf extends past the original boundaries. Each Arctic state now claims additional territory beyond its EEZ in order to secure additional energy resources, and because these boundary claims overlap, this creates potential for conflict. As countries file, or prepare to file, UNCLOS submissions, some observers have warned of a new 'land rush' in the Arctic, or-in more inflammatory terms—an Arctic 'land grab'. 59 Not all territorial disputes in the region involve states' quests to expand their EEZs, of course. The U.S. and Canada are at odds over a small slice of territory each claims is in its existing EEZ, and Denmark and Canada over Hans Island, just north of Greenland. However, these disputes are well established and are unlikely to escalate, at least absent a major energy find.

Transshipment disputes have a different dynamic from territorial disputes. By definition, EEZs confer exclusive rights to exploitation of mineral resources. In contrast, a number of nations have an interest in navigating the Arctic, whether or not these waters fall under the control of a single nation. The U.S. and Canada disagree whether the Northwest Passage constitutes an international strait or forms part of Canada's internal waterways.60 Canada does not want to block international navigation, but wishes to ensure all shipping is on its own terms. In contrast, the United States, and other users of the strait, argue that the Northwest Passage should be subject to international regulation.61 Similar issues are at stake in the Northeast Passage, with Russia robustly asserting its sovereignty. While it has resolved a long running conflict with Norway in the Barents Sea (discussed further below), Russia is adamant that any claim to the Northern Sea Route will be interpreted as a challenge to its national security.62 Russia insists ships submit an application to be guided through its waters, charging them a set —and high—ice-breaking fee. 63 Even China is nervous about power this confers on Russia.64

Territorial and transshipment disputes both create potential for a classic security dilemma. While any state must expect to lose from conflict in the Arctic, it is still rational for governments to re-arm due to uncertainty about the intentions of others and to maintain the option of exerting unilateral control over contested boundaries should this be-

come necessary.65 Furthermore, a military presence tends to increase the value a country places on its interests in the region. This dynamic creates a heightened risk of miscalculation and selffulfilling prophesy, with the potential to trigger a crisis, low-level conflict, or even a war. Perceptions of Russian unpredictability are an important accelerant. Its history of militarizing the Arctic during the Cold War heightens concerns about its future intentions, as has its more recent use of energy as a tool of political coercion. Other states have found it difficult to discern offensive or defensive intentions from Russia's military capabilities. For example, are conventional land-based military units better at taking or defending territory up North? What about naval resources? Do ice-breaker fleets enable Russia's navy a greater advantage on offense, even if they are necessary for search and rescue, and for transshipment? A lack of consensus on such questions inevitably increases the potential for negative spirals.66

Tensions over resources are yet to multiply risk in the way some observers expect. Resources have the greatest potential to drive conflict when they lie in contested territory. However, overlaying a map of undiscovered energy with a map of territorial disputes reveals that the vast majority of undiscovered reserves (85-90% as a rough estimate) are in the non-disputed EEZs of Arctic nations. This creates an important check on aggressive behavior. On the conomic viability of Arctic reserves has also played a moderating role, given technical obstacles and the high risk premium of any investment in exploitation, and

the incentives for states to collaborate given the financial and technological obstacles to operating in the region. Indeed, Russia's heightened interest can be explained, in part, by the fact that, alone among the five Arctic coastal states, its investment decisions are primarily state rather than market-controlled. A similar dynamic is at play for transshipment. Over the next twenty years, and however fast the ice melts, Arctic navigation will continue to be seasonal, hazardous, and unpredictable—all factors that mitigate the benefits of faster routes to Asian markets. As a result, initial excitement about Arctic navigation is giving way to a more sober assessment of the commercial opportunities that the Northwest Passage and Northern Sea Route will provide.

In conclusion, it is clear that the geography of risk is shifting rapidly due to climate change, with the loss of ice proceeding more rapidly than many had predicted. Each Arctic state has had to react to these changes and to the uncertainty about how other states will react to new opportunities and threats in the region. Much popular analysis, however, neglects factors that are slowing transformation in the Arctic (the expense and riskiness of resource extraction and navigation) or making it easier to manage (the relatively small resource endowment that lies in contested territory). The Arctic's commercial potential is still heavily discounted—in other words, providing time for states to resolve strategic challenges. As a result, they have become more willing to explore what help, if any, the multilateral arena can provide.

GOVERNING THE ARCTIC

nternational governance in the Arctic is far from settled, with various overlapping groupings and legal frameworks vying for influence (figure 1). The pace of change has accelerated as states make greater demands on the multilateral system. To date, at least, the fear of conflict has tended to push states towards cooperation, rather than away from it. With the hardest challenges yet to be addressed, however, the jury is still out on the long-term potential of the multilateral system to manage heightened risk in the Arctic over coming decades.

Of the strategic groupings in the Arctic, the smallest, and least formal, is the Arctic Five, which brings together states (Norway, Russia, Canada, the U.S. and Denmark) who have asserted a predominant role in addressing both territorial disputes and natural resource development issues, and have tended to exclude the non-coastal Arctic states (Iceland, Sweden and Finland), as well as extra-regional actors with an interest in energy development (including India). Its most significant accomplishment to date is the Ilulissat Declaration (discussed below). Canada hosted the last Arctic Five ministerial meeting in March 2010, placing an emphasis on the importance of cooperation through "relevant international bodies and mechanisms."68 The meeting also called for a mandatory regime for international shipping in Arctic waters. Canada is eager to formalize the Arctic Five, but the United States seems less enthusiastic, with Hillary Clinton concerned that exclusion of other Arctic states, and of representatives of indigenous peoples, risks exacerbating tensions in the region.⁶⁹ Extra-regional states, such as the EU, are also unhappy at the exclusive nature of this grouping and have advocated establishing a comprehensive regime along the lines of the Antarctic Treaty system.⁷⁰

The Arctic Council is a larger and more formal body, bringing together eight Arctic countries (the Arctic Five plus Finland, Iceland, and Sweden) in an intergovernmental forum. Led by a rotating chairmanship, it has been convened twice a year since it was established in 1996. Six indigenous organizations are included as permanent participants of the Council. Permanent observers (France, Germany, Poland, Spain, the Netherlands, and the United Kingdom) play a role, although their rights are poorly defined. China is considered an 'ad hoc observer.' While India is reported to have applied for observer status, it is unclear how hard it is pursuing its application. Some influential Indian commentators have argued that rather than accepting the role played by the Arctic states, India should ask for a greater role for the broader international community, on the template of the Antarctic Treaty.71 The European Union's application to become a permanent observer was blocked in 2009 by Canada in response to the European Union's ban on the importation of Canadian seal products.72 Within the EU, some states—notably France—have expressed impatience with the extent of the role the Arctic Council is playing in the region's governance. Its

formal mandate, however, is limited to environmental protection, sustainable development, and information sharing, and it cannot directly address traditional security concerns in the way the Arctic Five can. Its most salient achievement to date is the May 2011 Nuuk Agreement (discussed more below), which *inter alia* established that the Arctic Council would have a secretariat in Tromso, Norway by 2013.

There are therefore three overlapping sets of actors vying for influence in the Arctic:

 The Arctic Five has the most latitude to confront security dilemmas, but is an ad hoc body that is not clearly supported by the United States.

- The Arctic Council has a wider and more formal membership, but is limited in its scope. Sweden, Finland and Iceland—excluded from the Arctic Five—are keen to ensure the Council's role remains undiluted.⁷³
- Extra-regional states, including China, the EU, and India, are keen to protect commercial interests in the Arctic. Some have observer status on the Arctic Council, but it is unclear what sort of influence, if any, this confers. These states tend to advocate a more inclusive approach to governance in the Arctic.

The essential legal framework is provided by the UN Convention on the Law of the Sea, which was

FIGURE 1: INSTITUTIONAL PRESENCE

	Arctic Five	Arctic Council Full Member	Arctic Council Observer	Outside Institutional Framework, but have Growing Interests
U.S.	Х	Х		
Russia	Х	Х		
Norway	Х	Х		
Denmark	Х	Х		
Canada	Х	Х		
Sweden		Х		
Finland		Х		
Iceland		Х		
France			Х	
Germany			Х	
Poland			х	
Spain			Х	
UK			Х	
China			(X)	Х
European Union				х
Japan				Х
India				Х
S. Korea				Х

negotiated between 1973 and 1982.⁷⁴ The element of UNCLOS most salient to the Arctic is the rules it establishes for the delineation and extension of a country's EEZ. Areas beyond EEZs are considered the high seas, unless states make a claim for further territory through, for instance, demonstrating the extension of their coastal shelves beyond the delineated EEZ. If they do not claim this territory, but want to exploit natural resources then they must rely on rules and procedures laid out by the International Seabed Authority. Claims for additional territory are handled by the UN Commission on the Limits of the Continental Shelf (CLCS, see below).

UNCLOS ensures freedom of the high seas and passage through territorial seas, so long as such activities are not "prejudicial to the peace, good order or security of the coastal State."⁷⁵ The Convention also set out the concept of 'transit passage', which governs movement through territorial straits that are used for international navigation.76 Canada argues that the Northwest Passage should not be treated as an international strait, with its claim resting on the argument that ice has largely prevented international navigation.⁷⁷ Canada therefore has a strong incentive to resist unauthorized crossings, which helps establish the precedent that the waters are indeed functioning as an international strait.78 The United States takes the reverse position. It would also like to see the Northern Sea Route treated as an international strait, with Russia regarding this designation as unacceptable.79 The legality of the Russian position may be challenged by its determination to promote the Northern Sea Route to international shipping (albeit under tight restrictions).80

To date, 156 countries and the European Union have ratified UNCLOS. The United States, however, is not part of this group, despite being a signatory. U.S. ambivalence towards UNCLOS became clear during the Reagan administration, which came to office to find a nearly-completed treaty that it felt was antithetical, in some respects,

to U.S. commercial interests.81 It objected most strongly to conditions attached to the exploitation of energy and minerals in international waters, with President Reagan instructing his administration to comply with all aspects of the treaty apart from the provisions on deep-sea mining. The first Bush and Clinton administrations successfully negotiated changes to this article. The Clinton, second Bush, and Obama administrations have all argued for ratification. Behind the scenes, the U.S. military, and its navy in particular, has also supported the treaty, in the belief that the United States will be marginalized as key territorial disputes are settled.82 However, ratification continues to founder on Republican fears that, by embracing UNCLOS, the U.S. risks "creating—and confronting—a UN on steroids."83 UNCLOS, of course, also has implications that stretch far beyond the Arctic, with some of the treaty's opponents arguing that ratification will enable China to exclude the U.S. from its EEZ and thus to challenge its naval dominance.84 Given partisan division in the U.S., the case for the treaty is far from made.

The UN Commission on the Limits of the Continental Shelf is also important in providing legal guidance in the Arctic. Operational since 1997, the Commission's genesis lies in UNCLOS Article 76, which states that

"Information on the limits of the continental shelf beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured shall be submitted by the coastal State to the Commission on the Limits of the Continental Shelf set up under Annex II on the basis of equitable geographical representation. The Commission shall make recommendations to coastal States on matters related to the establishment of the outer limits of their continental shelf. The limits of the shelf established by a coastal State on the basis of these recommendations shall be final and binding."85

CLCS's stated purpose is "to facilitate the implementation of the United Nations Convention on the Law of the Sea in respect of the establishment of the outer limits of the continental shelf beyond 200 nautical miles." To resolve disputes, Annex II of UNCLOS states the specific functions of the commission as the review of data presented by the state and the provision of "scientific and technical advice" as requested during the preparation of this information. The state of the state and the provision of the preparation of this information.

The scramble for territory in the Arctic has, in part, been motivated by the need to acquire data to submit boundary claims to the CLCS. After ratification of UNCLOS, a state has ten years to submit continental shelf claims, although this timeline has been less than rigorously followed. Since Canada signed in 2003, it has until 2013 to submit its claims.⁸⁸ Russians first submitted claims to the Lomonosov Ridge in 2001, but the UN refused to rule, extending the deadline to allow for further, more conclusive, research.⁸⁹ Thus, the Russian 'flag planting' expedition was primarily designed to collect data, with the flag itself a publicity stunt that the Russian government has subsequently been keen to downplay.⁹⁰

The CLCS can offer advice and recommendations only. It does not make legal rulings, nor does it have a mandate to settle disputes.91 Its effectiveness is therefore in doubt, especially as it is yet to be tested, with its most significant ruling—on Russian claims to the Lomonosov Ridge—delaying resolution to a later date. In contrast, its ruling on Norway's continental shelf, issued in 2009, was relatively uncontentious.92 Beyond this, a major unresolved issue surrounds ambiguities in UN-CLOS over the definition of what actually constitutes a continental shelf, with Article 76 defining the term using legal criteria mixed with imprecise scientific language.93 This lack of precision increases the likelihood of boundary disputes, both before and after a CLCS ruling.

There are also procedural issues that hinder the emergence of a final and binding determination of EEZ extensions. When the CLCS issues a ruling, it only becomes binding if a state chooses to accept it. There is also nothing to prevent states from making new or revised submissions, further delaying any resolution.94 Additionally, it is only under the narrowest of circumstances that a CLCS recommendation may become subject to review by an outside appellate body, should its competence or impartiality be questioned.95 Furthermore, the Commission may not be requested to appear before any court or tribunal as either a party or expert in and of itself because its limited mandate means that it "lacks the legal personality" to do so. Thus, any judgment a court or tribunal makes in response to a CLCS recommendation is itself nonbinding on the CLCS, and would not necessarily compel the CLCS to review its own findings.96 Meanwhile, the opacity of the CLCS process, and UNCLOS more generally, risks undermining the legitimacy of any finding, with states under no obligation to reveal the scientific basis of their claim, nor the Commission publicly to explain its reasoning in accepting or rejecting a claim.97

In sum, the legal system designed to govern the continental shelf exhibits shortcomings that should breed caution about its future capacity. The definition of a continental shelf is far from clear. The forum for addressing territorial claims has a weak mandate, with states able to choose whether to accept or reject CLCS rulings, and may be too opaque to command legitimacy. It is relatively unproven in the Arctic, although it has demonstrated some successes elsewhere (Tonga, New Zealand and Fiji, for example, settled a boundary delimitation dispute using the CLCS mechanism).98 As figure 2 shows, the burden on CLCS and UNCLOS will increase as a growing number of claims are submitted. The next decade will demonstrate whether it has ability to cope with the pressure this will create.

FIGURE 2: ARCTIC STATE SUBMISSIONS TO CLCS⁹⁹

Submission	Date	Recommendation Adopted on	
Russian Federation	20 December 2001	27 June 2002 ¹⁰⁰	
Norway - in the North East Atlantic and the Arctic	27 November 2006	27 March 2009 ¹⁰¹	
Iceland - in the Ægir Basin area and in the western and southern parts of Reykjanes Ridge	29 April 2009	No Decision	
Denmark - in the area north of the Faroe Islands	29 April 2009	No Decision	
Norway - in respect of Bouvetøya and Dronning Maud Land	4 May 2009	No Decision	
Denmark - Faroe-Rockall Plateau Region	2 December 2010	No Decision	

NEGOTIATIONS IN A CHANGING ARCTIC

ecent years have seen a number of important cases in which states have signaled their preference to resolve Arctic issues without relying on unilateralism or coercion.

The Ilulissat Declaration was signed in May 2008 by the Arctic Five states. Though it is a brief seven paragraphs and nonbinding, it sends a strong signal that signatories will abide by the existing legal framework to address boundary claims in the Arctic. 102 The Arctic Five commit themselves to "orderly [emphasis added] settlement of any possible overlapping claims" and underline their opposition to the development of a "new comprehensive legal regime to govern the Arctic Ocean." 103 In effect, the declaration self-selects the signatories as stewards of the region, with major issues of hard security falling under their remit. While lower order security issues have been considered by the Arctic Council, a binding mechanism to deal with peace issues is a political non-starter for either the United States or Russia. The declaration's primary catalyst was the planting of the Russian flag on the seabed floor, and the subsequent recognition by signatory states of the need to address perceptions of increasing conflict in the Arctic. According to the analysis of a U.S. State Department official, "The A-5 [Arctic Five] clearly hoped that their reaffirmation of UNCLOS would quell the perception that the Arctic had become a new wild west." 104

The Arctic Five demonstrates the important role middle powers can play in triggering collective

action. Denmark has played a strong facilitating role in the body, with Danish PM Per Stig Moller gathering the four other countries in Greenland in 2008. It is unlikely that either the United States or Russia could have acted as convener, especially while tensions between the two countries were inflamed before the 'reset' in the bilateral relationship. As chair, Denmark helped limit the new grouping to just five countries. It also remains committed to maintaining the Arctic Five as the primary body for determining the most contentious continental shelf issues.105 In 2008, Sweden organized a competing and more inclusive meeting in Ilulissat, with the EU, but that meeting did not have nearly the impact of the Arctic Five meeting. 106 Canada hosted the second Arctic ministerial meeting and has a similar commitment to the forum. The Arctic Five's future now rests on the ability of the middle powers in the group to continue to bring the United States and Russia to the table, and to persuade them of the long-term relevance of this informal body.

Bilateral diplomacy has also seen a new willingness to address long-running disputes. Perhaps the most important example is the Norway-Russia Barents Sea Treaty. During a state visit to Norway in April 2010, Russian President Dmitry Medvedev announced an agreement on the delimitation of the maritime zones in the Barents Sea with the Norwegian Prime Minister, bringing an end to a nearly forty-year dispute. Negotiations had been underway since the 1970s, with the

Norwegian Prime Minister describing the dispute as "the most important outstanding issue between Norway and Russia."109 Because of the economic importance of the Barents Sea fishery, the two countries agreed a temporary 'gray zone' in which each country had sovereignty over its own trawlers. A broader agreement, however, had proved elusive. The new treaty, which has now been ratified by both countries, solidified an amended but mutually accepted line. According to one observer, "this [treaty] is historic in several ways. Not only does it establish a stable and secure Arctic boundary, it... provides a framework of cooperation and a stable political environment in which the Barents Sea's continental shelf hydrocarbon resources can be increasingly exploited."110

As well as renewed fisheries cooperation, the Barents Sea Treaty includes a swap of EEZ rights (from Norway to Russia) and a commitment that transboundary energy reserves will be exploited as a single unit. 111, 112, 113 This builds on the precedent set by Norway and Iceland in 1981, which established a joint development zone in a disputed area roughly the size of the state of Pennsylvania.114 Within the development zone, the two countries made a commitment to joint exploration of energy resources in the area, with each country entitled to a quarter share of any revenues from oil or gas extracted from the others' EEZ.¹¹⁵ Norway, Iceland, Denmark and the Faroe Islands, meanwhile, have used a series of bilateral negotiations to prepare the ground for a multilateral solution. They have set out a joint approach to delimiting their continental shelves under UN-CLOS. Through this agreement, the states agree to make a coordinated application to UNCLOS and to establish parallel bilateral agreements to confirm any UNCLOS ruling.116

The Arctic Council, meanwhile, demonstrates both the strengths and weaknesses of negotiations within a formal forum. Its most recent ministerial was held in May 2011 in Nuuk, and stated the

next set of cooperative arrangements to address lower order security concerns. Two key documents were signed.117 The Nuuk Declaration set out the first legally binding agreement under the auspices of the Arctic Council—the Search & Rescue Agreement—and established a permanent secretariat. The second, the "Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic, laid out the specifics of how search and rescue will work. The agreement divides the Arctic into a series of zones of national responsibility in which different states would have operational lead. States are to respond to requests for help from any ship regardless of nationality or condition, and are also to assist each other, to the extent possible, when requests are made. Additionally, the document notes that, despite dividing the Arctic into different zones, "the delimitation of search and rescue regions is not related to and shall not prejudice the delimitation of any boundary between states or their sovereignty, sovereign rights or jurisdiction"-an effort to prevent this agreement from being a stepping stone to a unilateral assertion of sovereignty in disputed territory.118 These agreements have the potential to act as precedents for a similar approach to be taken for cooperation on climate and environmental issues, freedom of passage, the protection of indigenous rights, and minimum standards for oil and gas exploitation.

Again, middle powers have played a role in pushing cooperative responses, with the Governments of Norway and Denmark facilitating agreement within the Council. Norway acted as Chair of the 2009 ministerial, which, through the Tromso Declaration, 119 approved the establishment of a task force to develop and complete negotiation of an international instrument on cooperation on search and rescue in the Arctic. Denmark will be followed in the chair by Sweden, which has promised to make prevention and response to oil spills its main priority. 120 The United States, in particular, appears to be increasing its commitment

to the Council, arguing that the body sends "a strong message that in the post-Cold War world, the Arctic is a region of cooperation, not conflict" and that it also demonstrates that Russia and the United States are prepared to work together as key

actors in helping to propel cooperation on important issues.¹²¹ The Council's capacity will be further enhanced once the Secretariat starts work in 2013, while any expansion in the number and status of observers could also increase its legitimacy.

RESPONDING TO ARCTIC RISK

s growing multilateral momentum demonstrates, the Arctic is a zone neither of pure competition or cooperation, but is instead a mix of both. On balance, however, nationalistic pressures are being contained more effectively than has been assumed in many popular accounts. As climate change has multiplied stakes in the region, Arctic nations have tended to show increased willingness to work together, actively seeking to quell fears about territory annexation, unilateral resources grabs, and domination of key maritime chokepoints.

It is perhaps unsurprising that a series of informal and formal multilateral processes have emerged to help states address boundary issues in an orderly way and to keep the commercial environment stable and accessible. States have a strong interest in a stable Arctic. Energy extraction and Arctic navigation are already subject to substantial environmental, technological and economic uncertainties. In contrast, geopolitical grandstanding is a preventable source of distraction. There is little reason for complacency, however. While some of the new cooperative arrangements are imaginative in conception, they remain limited in scope and contentious issues are yet to be tackled. In the future, the key risks are as follows:

General political miscalculation. Despite a willingness to cooperate, states still remain uncertain about the future intentions of others, particularly Russia.¹²² Governments have little incentive to sig-

nal their willingness to forgo an attempt to dominate the region. 123 Indeed, they have incentive to overstate their resolve in the hopes that bluffing will cause others to back down.124 In the future, small naval skirmishes could become commonplace, as appears to be happening in the South China Seas. A deterioration in U.S.-Russia relations would make this more likely, especially given Russian proclivity to use its energy reserves to shape a more favorable political environment in its near abroad. Domestic politics are also a potential complicating factor. In countries where the Arctic is important to national identity, political pressure at home is more likely to lead to governments miscalculating abroad. U.S. suspicion of multilateral governance, and of UN-CLOS in particular, could also lead to others placing less truth in institutional responses.

The lack of a crisis management mechanism. The Arctic Five grouping is willing to tackle resource and boundary issues, but is untested in a crisis. There is no mechanism to bring together ministers at short notice, for instance. Indeed, it is unclear when, and whether, ministers will next meet. The Arctic Council is formally constituted and will soon have a secretariat, but it does not have a mandate in areas most likely to trigger a crisis. Bilateral diplomacy could provide a solution, perhaps with the mediating intervention of a third power. Alternatively, an independent task force could be convened, as happened after the Cheonan incident off the coast of the Korean peninsula. These mechanisms are untested, however, and it

remains unclear how states would limit cycles of mutual recrimination in the case of a major environmental disaster (an Arctic Deepwater), an aggressive attempt to protect commercial interests, or a serious naval incident.

An unfavorable CLCS ruling. Russia will soon file with CLCS new evidence on its continental shelf claim, and many other Arctic states are preparing to submit new applications (the U.S., as a non-ratifying state, remains excluded). Should Russia receive an unfavorable ruling, some fear that it will assert unilateral control of the Lomonosov Ridge. Alternatively, it could keep making revised submissions to the CLCS in an attempt to ensure that the issue drags on indefinitely. In the short term, this would reduce the likelihood of conflict, but over time it could discredit multilateralism. Russia, of course, is not the only state that might refuse to accept a CLCS finding. Unclear guidelines, weak enforcement, and a lack of transparency all make it possible that the CLCS/UNCLOS process will face breakdown at some stage.

A major future energy find in an area where boundary claims are outstanding. We have argued that rational Arctic states do not now have fundamental conflicts of interest, especially as most of the energy reserves are believed to lie in uncontested areas. A major energy find in the Lomonosov Ridge could change this dynamic. However, it is uncertain whether there will be a clear incentive to own all or even most of the new found energy. Energy can be a divisible good and joint development arrangements are very common, as

the Russia-Norway Barents Sea agreement has shown. Russia's behavior, however, remains hard to predict, as its energy investments are not fully subject to market forces, and it remains intent on using energy to consolidate its status as a major power. If shale gas challenges its role in energy markets, it could be tempted to act aggressively to recoup losses, in a "gamble for resurrection", leading to a possible crisis scenario. 125

Deepening environmental crisis. Many states continue to focus primarily on opportunities in the Arctic, but these only exist due to the global threat from climate change. Environmental risks are likely to intensify, possibly rapidly, with impacts on a global, rather than a regional, scale. Complete deglaciation of the Greenland ice sheet would lead to a sea level rise of 7 meters, although this is unlikely to happen quickly (centuries to millennia). Similarly, hydrate destabilization is a potentially significant source of new emissions (and potentially a new energy source if methane hydrates can be exploited).126 Black carbon (or soot) plays an important role in accelerating ice melt, linking the fate of the Arctic to development patterns in Asia's populous cities. 127 Oil spills and pollution from shipping both have the potential to damage the Arctic's fragile environment. Environmental threats have high salience for publics, especially in Western countries. An environmental disaster, or dramatic evidence of intensifying environmental change, could exacerbate ill-will between states, especially if one, or more, Arctic country becomes typecast as an environmental 'villain'.

Conclusion

ver the coming decades, risk in the Arctic will continue to intensify, although there could be a pause if the region experiences a run of cold summers, if resources prove hard to extract at a reasonable cost, or if global economic malaise drives down the oil price to a level where the Arctic's resources have no hope of being competitive. Recent years, however, have already heightened states' sensitivity to the challenges a changing Arctic poses. Sufficient momentum has been created that the impetus to explore routes for cooperation, or to unleash unilateral and coercive responses when cooperation fails, is likely to remain strong in the short to medium term.

So far, the Arctic has defied the predictions of pessimists who expected the region to become a focus for unchecked commercial and strategic competition. Given this success, can it offer some lessons for deconfliction, the management of tensions, and perhaps even cooperation in other regions where energy or resource competition has the potential to create geopolitical friction?

Hardest will inevitably be the South China Seas. At one level, that terrain has a similar mix of uncharted energy resources, ill-defined boundaries, and great power security tensions. In the Arctic, the Ilulissat Agreement has set a precedent for states to apply the provisions of the Law of the Sea, despite the U.S. not ratifying that agreement. Such an approach will not easily be followed in the South China Seas, given the intensity of boundary disputes and long running tensions over Taiwan. However, some of the second-order mechanisms that have emerged in the Arctic could provide lessons towards the reduction of conflict and crisis containment in that more volatile region.

In the Arctic, states are recognizing the need for new types of cooperation to address fast-changing challenges. The United States and Russia are, of course, playing a central role, but middle powers have demonstrated their potential as conveners and pioneers of new approaches. Perhaps most importantly, the assumption of inevitable conflict in the region has been successfully challenged. In an unstable world, and one where many global arrangements are straining to adapt to changing power dynamics, we could do worse than learn lessons from what the Arctic states are trying to achieve.

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- ⁹⁷ Ron McNab, 'The Case for Transparency in the Delimitation of the Outer Continental Shelf in Accordance with UNCLOS Article 76', Ocean Development & International Law, Vol. 35, Issue 1, January 2004: p.1, available online at http://connection.ebscohost.com/c/articles/11985611/case-transparency-delimitation-outer-continental-shelf-accordance-unclos-article-76
- ⁹⁸ Mel Weber, 'Defining the Outer Limits of the Continental Shelf in the Arctic Basin: The Russian Submission, States' Rights, Boundary Delimitation and Regional Cooperation', *The International Journal of Marine and Coastal Law* 24, 2009: pp. 653-681.
- 99 Source: CLCS Website http://www.un.org/depts/los/clcs_new/clcs_home.htm
- 100 CLCS recommended that Russia submit additional information before issuing its findings. It is believed that Russia will soon submit this.
- ¹⁰¹ There is no data available to indicate how CLCS ruled in this instance. Closest document is: CLCS 19th Session. Minutes, available online at http://daccess-dds-ny.un.org/doc/UNDOC/GEN/N07/322/77/PDF/N0732277.pdf?OpenElement
- ¹⁰² Brooks B. Yeager, 'The Ilulissat Declaration: Background and Implications for Arctic Governance', prepared for the Aspen Dialogue and Commission on Arctic Climate Change, November 2008.
- 103 'Ilulissat Declaration', Arctic Ocean Conference, Ilulissat, Greenland, 27-29 May 2008.
- John Bellinger, 'Treaty on Ice', New York Times, 23 July 2008. Additionally, it should be noted that unlike his first term, Bush's second term was actually quite multilateralist, having learned the lesson at least somewhat that unilateral or aggressive moves caused serious political blowback. "Going multilateralist" in the Arctic thus fit in with broader trends in U.S. foreign policy strategy during 2005-2009. For example, See Daniel Drezner, 'The New New World Order', Foreign Affairs, March/April 2007.
- Denmark, Greenland and the Faroe Islands, Kingdom of Denmark Strategy for the Arctic 2011-2020, Ministry of Foreign Affairs Denmark, Department of Foreign Affairs Greenland and Ministry of Foreign Affairs Faroes, August 2011.
- Nikolaj Petersen, 'The Arctic as a New Area for Danish Foreign Policy: The Ilulissat Initiative and its Implications', in Nanna Hvidt and Hans Mouritzen (eds.), Danish Foreign Policy Yearbook 2009, DIIS, Copenhagen, 2009.
- As background, the root of this disagreement stemmed from Article 6 in the 1958 Continental Shelf Convention, in which both states were parties that stipulated that the boundary would be a median line unless there were "special circumstances". Both states later became parties to UNCLOS, making its articles 74 & 83 the applicable law instead. But both states argued that these new provisions upheld their reading of Article 6 in the 1958 convention. See, Tore Henriksen and Geir Ulfstein, 'Maritime Delimitation in the Arctic: The Barents Sea Treaty', Ocean Development & International Law 42, 2011: pp. 1-21.
- ¹⁰⁸ 'Joint Statement on Maritime Delimitation and Cooperation in the Barents Sea and the Arctic Ocean', available online at http://www.regjeringen.no/en/dep/ud/whats-new/news/2010/statement_delimitation.html?id=601983

- Office of the Prime Minister, 'Treaty on maritime delimitation and cooperation in the Barents Sea and the Arctic Ocean signed today', Government of Norway, 15 September 2010, available online at http://www.regjeringen.no/en/dep/smk/press-center/ Press-releases/2010/treaty.html?id=614254
- ¹¹⁰ Lawson W. Brigham, 'Russia Opens Its Maritime Arctic', *Proceedings*, U.S. Naval Institute, May 2011: pp. 50-54.
- ¹¹¹ Durham University, Maritime jurisdiction and boundaries in the Arctic region, International Boundaries Unit, 6 October 2011, available online at http://www.dur.ac.uk/resources/ibru/arctic.pdf
- 112 Brigham, 2011, op cit.
- ¹¹³ 'Norway hails Barents treaty OK by Russian Duma', Reuters, 26 March 2011, available online at http://www.reuters.com/article/2011/03/26/barentstreaty-idUSLDE72P0HY20110326
- ¹¹⁴ Durham University, 2011, op cit.
- ¹¹⁵ The Governments of Iceland and Norway, 'Agreement between Iceland and Norway on the Continental Shelf in the area between Iceland and Jan Mayen', 22 October 1981, available online at http://www.nea.is/media/olia/JM agreement Iceland Norway 1981.pdf
- Ministry of Foreign Affairs, 'Agreed Minutes on the Delimitation of the Continental Shelf beyond 200 Nautical Miles between the Faroe Islands, Iceland and Norway in the Southern Part of the Banana Hole of the Northeast Atlantic', Government of Norway, 21 September 2006, available online at http://www.regjeringen.no/nb/dep/ud/dok/lover_regler/retningslinjer/2006/Agreed-Minutes.html?id=446839
- 117 Documents available online at http://www.arctic-council.org
- ¹¹⁸ Arctic Council, 'Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic', Arctic Council, April 2011, available online at http://arctic-council.npolar.no/accms/export/sites/default/en/meetings/2011-nuuk-ministerial/docs/Arctic SAR Agreement EN FINAL for signature 21-Apr-2011.pdf
- ¹¹⁹ Jesper Hansen, 'The Tromso Declaration Signed', Arctic Council, 30 April 2009, available online at http://arctic-council.org/article/2009/4/the_tromso_declaration_ratified
- 120 'New Arctic Council Agreement will Improve Rescue Efforts in the Arctic', Arctic Council, 12 May 2011, available online at http://arctic-council.npolar.no/accms/export/sites/default/en/meetings/2011-nuuk-ministerial/docs/Press Release Arctic Council Nuuk Ministerial Meeting.pdf
- ¹²¹ David Gollust, 'U.S. Calls Arctic Council Meeting 'Historic', Voice of America, 10 May 2011, available online at http://www.yoanews.com/english/news/US-Calls-Arctic-Council-Meeting-Historic-121560049.html
- 122 One should be aware that Russia may also be quite concerned about the intentions of the U.S. and its traditional allies too.
- ¹²³ James Fearon, 'Signaling Foreign Policy Interests', *Journal of Conflict Resolution* 41, February 1997: pp. 68-90; James Fearon, 'Domestic Political Audience Costs and the Escalation of International Disputes', *American Political Science Review* 88, September 1994: pp. 577-592.

- ¹²⁴ James Fearon, 'Rationalist Explanations for War', *International Organization* 49, Summer 1995: 379-414.
- 125 There is an important point to be made from the political psychology literature that deals with such losses. As prospect theory has shown, people become more risk-acceptant as they believe themselves to be in the domain of losses.
- ¹²⁶ J. B. Smith, et al., 'Assessing dangerous climate change through an update of the Intergovernmental Panel on Climate Change (IPCC) "reasons for concern", *Proceedings of the National Acad*emy of Sciences, 18 March 2008, Vol. 106, No. 11.
- ¹²⁷ D. Shindell & G. Faluvegi, 'Climate response to regional radiative forcing during the twentieth century', *Nature Geoscience*, 31 March 2009, Vol. 2

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