Climate Change and the Politics of Military Bases

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Abstract

How does climate change affect the politics of military bases? The United States alone has hundreds of overseas bases that require continuous coordination with host governments. I argue that climate change can create knock-on environmental problems associated with a base's infrastructure or waste. Those knock-on problems create a mix of subnational, international, and transnational political contestation that raises the political costs of overseas bases and could even rupture an international relationship. I probe the plausibility of the theoretical framework using new evidence from Greenland. Between 1953 and 1967, the US Army maintained secret bases in Greenland as precursors for a nuclear ballistic missile complex. The bases were eventually abandoned, leaving considerable waste behind. Climate change is now poised to remobilize these pollutants into the surface water, creating a risk for human settlements. The case could be the proverbial canary in the coal mine for future politics surrounding overseas military bases.

Climate change affects international politics and institutions in multiple ways (Newell 2008; Bäckstrand 2008; Andonova et al. 2009; Keohane and Victor 2011; Green 2013; Green and Colgan 2013; Jinnah 2014; Bulkeley et al. 2014; Hadden 2015; Biermann and Boas 2010; Andonova and Mitchell 2010). Scholars are particularly interested in the ways it might influence conflict and security affairs (Busby 2008; Hendrix and Salehyan 2012; Reuveny 2002; Barnett and Adger 2007; Homer-Dixon 1999). Policy makers, too, are concerned. The Department of Defense is one of the few parts of the US government that prominently recognizes the reality of climate change (US Department of Defense 2015; US Navy 2010, 2011). Yet, while policy makers are coming to grips with the physical effects of climate change that are presently foreseen, there are likely unforeseen effects yet to emerge. Moreover, the politics associated with even the anticipated environmental impacts are far from clear, leaving an important question: how

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does climate change affect the politics of military bases, especially those located overseas?

The question has both scholarly and policy significance. The United States alone has hundreds of overseas bases that require continuous political coordination with host governments. Climate change is poised to interact with the infrastructure and waste associated with many of those bases. The US military bases in Diego Garcia and Guam, along with domestic bases like the one at Norfolk, Virginia, are likely to be affected by climate change in the future. Bases on low-lying islands like Diego Garcia and the Marshall Islands are especially vulnerable.

This article develops a theoretical framework—albeit not yet sufficiently advanced to be a proper theory—that can provide insight into the likely political trajectory of military bases affected by climate change. Security scholars have long argued that the politics of military bases are complex and have important consequences for international relations (Lutz 2009; Cooley and Nexon 2013; Yeo 2009, 2011; Holmes 2014; Kawato 2015). There is, in addition, an environmental politics literature that examines wastes generally and of military bases specifically (Wegman and Bailey 1994; O'Neill 1998; Brunner et al. 2004). But less attention has been paid to the relationship between climate change and military bases. This theory-building article seeks to address that gap.

My central argument is that climate change can create knock-on environmental problems associated with a military base's infrastructure or waste that disrupt the international politics that govern the base. Any cleanup costs or compensation related to the knock-on environmental problems create an unfunded liability for the host country, the country operating the base, or both. This liability creates a mix of subnational, international, and transnational political contestation that raises the political costs of overseas bases and, in an extreme case, could rupture the international relationship that allows such bases to operate. Indeed, the political contestation generated by knock-on environmental problems appears to represent a new pathway leading from climate change to disputes or contentious politics. Researchers have already identified and debated several such pathways (Depledge 2007; Andonova et al. 2009; Harrison and Sundstrom 2007; Levin et al. 2012; Raleigh et al. 2014; Hendrix and Salehyan 2012; Barnett and Adger 2007; Borgerson 2008; Markowitz 2016) but have paid relatively little attention to how climate change interacts with preexisting local environmental hazards of a kind likely to be associated with military bases.

I probe the plausibility of the framework using new evidence from Greenland. Between 1953 and 1967, the US Army maintained various clandestine bases in the Greenland ice sheet as precursors for a larger ballistic missile complex (Petersen 2008; Weiss 2001; Christensen 2009). The largest of these bases was Camp Century. Though its public face was a science station, its secret task was to explore the feasibility of deploying up to 600 medium-range ballistic missiles with nuclear warheads, constantly moving around a 4,000-km-long

railway cut into the Greenland ice sheet. Project Iceworm, as it was known, was never completed. The bases were eventually abandoned with minimal decommissioning, under the explicit assumption that perpetual snowfall would entomb them in perpetuity, leaving large quantities of waste buried in the ice sheet (Clark et al. 1962; Colgan et al. 2016). This waste includes tens of thousands of liters of diesel fuel, a substantial but unknown quantity of polychlorinated biphenyls (PCBs), and a reportedly small volume of low-level radioactive waste. Climate change is now poised to ensure these pollutants are eventually remobilized into the surface water, creating a future risk that they will spread and enter the food chain in the nearest human settlements.

For the nexus of climate and security studies, this case is important for two reasons. First, there is direct causality between climate change and military affairs. Studies of other climate-related security issues, such as those linking climate change to armed conflict via changing agricultural patterns, are forced to address myriad intervening factors and causal identification challenges (Raleigh et al. 2014; Meierding 2013). By contrast, the Iceworm locations are uninhabited, which means that the causal effect of climate change can be isolated from other factors and forecast with relatively high scientific certainty. Its ultimate effect on future military cooperation is unknown, but political contestation is already occurring. In 2017, Greenland's prime minister fired the foreign minister, Vittus Qujaukitsoq, when they disagreed about the forceful approach Qujaukitsoq was taking with Denmark and the US about their responsibility for the Iceworm waste (Breum 2017).

Second, the Iceworm case is important because of the lessons it provides for other overseas military bases and sites and the potential precedent set as the US responds (or not) to the environmental challenges (Lutz 2009; Cooley and Nexon 2013; Yeo 2011; Holmes 2014). In this sense, the Iceworm case could be the proverbial canary in the coal mine for future politics surrounding military bases and sites. Military waste left at various Pacific Islands is especially problematic. The US military left radioactive waste at Johnston Atoll, the Marshall Islands (Runit Island), and elsewhere during the Cold War. Other toxic materials are also present at these and other sites, such as Orote Point (Guam), Ulithi Atoll (Micronesia), the Solomon Islands, and Midway Island.[1] The rising sea levels associated with climate change elevate the risk that toxic materials left on low-lying coral islands such as these will be remobilized into the ocean. Other countries, especially those located in the Pacific, could object strongly to a US denial of responsibility. The US Geological Survey is currently studying these potential climate change risks, but at present, their full extent is unknown.[2]

1. There are people (and military bases, such as Bucholz Airfield in the Marshall Islands) in relative proximity to some of these sites.
2. Author communications with Dr. Jeff Burgett, June 16, 2017, and Dr. Curt Storlazzi, July 6 2017. See also Storlazzi et al. (2011).

Theoretical Framework

It is now widely recognized that climate change will have some foreseeable effects on military bases (Floyd 2008; Busby 2008). The US Navy, for instance, has identified effects, such as rising sea levels, that could negatively affect quays and melting polar ice that could open new navigable sea-lanes (US Navy 2010). Typically, these issues are seen mainly as challenges for the country that operates the base. The US Department of Defense has published various planning documents that purport to identify how climate change will affect its military bases and what actions ought to be taken in response (US Department of Defense 2015; US Navy 2010, 2011).

Less attention, however, has been paid to four issues: (1) the unanticipated consequences of climate change for the international politics and law that govern overseas military bases, (2) time-inconsistency problems associated with how climate change affects a military base, (3) the knock-on environmental problems that climate change could generate by interacting with local pollution and/or infrastructure, and (4) the mix of subnational, international, and transnational political contestation generated by the effects of climate change. For climate change scholars, many of these issues will not be surprising, once articulated. Yet among military planners and thinkers who are most likely to be responsible for managing the climate change effects on military bases—these issues are underappreciated (US Navy 2010, 3, 8, 16).

Three key assumptions assist in developing this theoretical framework. First, climate change is a complex, multifaceted phenomenon, which includes changes in temperature, sea levels, precipitation, and storm patterns. Second, these changes will vary in magnitude and character across the globe, meaning that the environmental impact of one military base will not necessarily be repeated at others. Third, climate change interacts with the local environment and infrastructure in unpredictable ways, owing to the complexity and path dependency of those interactions.

I also note two characteristics of climate change problems: unanticipated consequences and time inconsistency of preferences. Military bases located where climate change is acute (e.g., polar regions, coastal areas) are likely to face unanticipated local effects, such as the exposure of pollution previously thought to be buried or sequestered, problems with sewage flows, and the structural weakening of buildings or infrastructure. It is common for overseas military bases to be governed by a treaty or some other agreement between the host country that owns the land or has nominal jurisdiction over it and the operator: the country operating the military base (Yeo 2011; Holmes 2014). Unanticipated effects could disrupt the international politics that govern the military base. Second, time inconsistency of preferences is likely between current policy makers and those who built or planned the base. Scientists' understanding of climate change has developed over time. It also takes time for scientific understanding to be translated into policy preferences. These temporal processes mean that

there is always a gap between the preferences of past and current policy makers (Hovi et al. 2009; Urpelainen 2012). Yet the international agreements that govern overseas bases are written at a particular point in time and only infrequently updated. From these assumptions and characteristics, two propositions can be deduced about how climate change affects the politics of overseas military bases (some of which will also apply to other military sites and domestic bases). These propositions are hypotheses that are not yet fully testable, because climate change is still unfolding, but ought to be testable at some point in the future.

The first proposition is as follows:

> **P1.** If climate change interacts strongly with a military base's infrastructure or wastes, it will create knock-on political problems that are distinct from those associated with climate change per se.

Typically, analysts view climate change as affecting the global commons, generating a collective action or public goods problem (Keohane and Victor 2011). Yet climate change can also generate local environmental problems. Specifically, the direct environmental components of climate change (shifts in temperature, sea levels, precipitation, and storms) interact with local conditions to generate new environmental problems (e.g., toxic water). I hypothesize that these knock-on environmental effects are, in the context of an overseas military base, likely to generate knock-on political problems about whether and how to address them. Two mechanisms can generate these political problems, either individually or in combination. First, the identity of who is responsible for (unanticipated) knock-on environmental effects is likely to be contested, especially when there is even a small amount of ambiguity in the base agreement. Second, differences in perceptions about the scope of the knock-on environmental effects, the actions necessary to address them, and the costs of doing so are likely to generate further political contestation.

Whereas climate change itself is typically viewed as a "global commons" type of problem, any knock-on environmental effects are likely to have a different problem structure. Scholars of international environmental politics, following Oran Young, have frequently classified problems into one of four categories: international commons, shared natural resources, transboundary externalities, and linked issues (Young 1994, 20–26). International commons are physical or biological systems that lie wholly or largely outside the jurisdiction of any one state but are valued by many, such as the ozone layer. Shared natural resources extend into the jurisdiction of two or more states, such as fishing stocks. Transboundary externalities occur when activities in one state produce results that affect those living in other states, such as loss of rainforests. Linked issues stem from "efforts to devise social institutions to deal with environmental concerns [that] have unintended consequences affecting other regimes and vice versa," such as when environmental treaties conflict with the World Trade Organization (Young 1994, 24–25; on regime complexes, see Colgan et al. 2012). Scholars have used these categories to study the effectiveness of regimes (Young and Zürn 2006).

Efforts to place knock-on environmental hazards into a single category are likely to fail. Instead, policy responses will have to recognize the hybrid nature of the problem. Increasingly, scholars argue that climate change should not be seen as a single issue but rather as a metaenvironmental problem (Levin et al. 2012; Thompson 2010). The knock-on environmental hazards associated with military bases could easily become a hybrid, multiheaded environmental problem that has components in each of Young's categories. This metaenvironmental problem structure is not unique to military bases.[3] It is worth noting, however, that the hybrid structure makes it more likely to generate a range of subnational, international, and transnational political effects, which leads to the second proposition:

> **P2.** If climate change creates knock-on environmental problems associated with a military base's infrastructure or wastes, they will create a mix of subnational, international, and transnational political contestation that raises the political costs of the military base.

Climate-related environmental hazards could represent a new kind of tension within international political alliances (Pressman 2008; Weitsman 2003). Such tensions raise the political costs of overseas military bases (Lutz 2009; Cooley and Nexon 2013; Kawato 2015; Holmes 2014). But intergovernmental relationships are not the only realm of potential contestation. Contestation is especially likely to occur between the operator's national government and the local inhabitants of the host country who are directly affected by base operations. Knock-on environmental problems are also likely to generate political tensions between groups in the same country (e.g., owing to differential levels of exposure within states). Locally affected residents are likely to try to lobby the municipal, subnational, or national governments to take action on their behalf, domestically and internationally.

This mix of inter- and subnational politics is made more complicated by the time inconsistency of preferences noted earlier. The host country's government is likely to use any ambiguity in the base agreement to its advantage, to try to hold the base operator legally or political responsible for adverse consequences that occur because of climate change (and, likewise, the operator might seek to interpret the agreement to its advantage). Additionally, political contestation is likely within the host country, as some subnational actors seek to hold others politically or legally accountable for the decisions made in the past, once the effects of climate change become clearer.

More broadly, the political contestation generated by knock-on environmental problems could be considered a new pathway leading from climate change to disputes or contentious politics. Researchers have already identified and debated several pathways leading from climate change to disputes, including

3. For instance, climate change caused in 2016 a major bloom of naturally occurring anthrax in western Siberia. See Revich and Podolnaya (2011).

disputes over how to reduce emissions (Depledge 2007; Andonova et al. 2009; Harrison and Sundstrom 2007; Levin et al. 2012), armed conflict owing to changing agricultural patterns (Raleigh et al. 2014; Hendrix and Salehyan 2012), frictions over possible forced migration (Barnett and Adger 2007), and tensions over newly available natural resources or shipping lanes in the Arctic (Borgerson 2008; Markowitz 2016). If climate change interacts with a preexisting latent environmental hazard associated with military sites, it creates an entirely new pathway for climate-related disputes. Indeed, the fact that the latent environmental hazard is located in a specific territory distinguishes it from pathways that lead more directly from global climate change. The territoriality of the latent hazard means that jurisdiction and political responsibility for the costs associated with the hazard can be contested more directly than the diffuse responsibility for global climate change itself.

It is worth acknowledging that military bases sometimes generate local environmental hazards even without climate change. I highlight climate-related hazards here because current thinking about how climate change will affect military bases typically focuses on more direct effects of climate change (e.g., rising sea levels) and misses the knock-on environmental effects. Consequently, military planners are less likely to have budgeted for, or even considered, cleanup or compensation costs of knock-on effects of climate change (US Navy 2010, 2011).

Project Iceworm in Greenland

I probe the plausibility of the new theoretical framework using some recent scientific projections of abandoned US military bases in Greenland under climate change (Colgan et al. 2016). I selected this case not because it creates a particularly devastating environmental hazard but because it could prove to be an indicator of things to come for some of the hundreds of other active or abandoned military sites. A nascent case like Project Iceworm is helpful because of its location on the leading edge of climate change. The Iceworm case is also highly relevant for the active military base in Greenland (at Thule) that is vital to US strategic goals; Thule is the most expensive overseas base in the entire US network and the keystone to the American strategy for the Arctic.

Project Iceworm was an ambitious plan by the US Army to build a ballistic missile complex buried in the near-surface ice sheet of northwest Greenland near Thule Air Base. Between 1953 and 1967, five precursor bases were built and maintained at four sites under the auspices of the North Atlantic Treaty Organization (NATO), as part of a clandestine program to explore the feasibility of deploying up to 600 ballistic missiles armed with nuclear warheads (Petersen 2008).[4] These missiles were to be mounted on mobile rail cars, constantly

4. It was proposed that each NATO member have direct control of a portion of the Iceworm arsenal, making it a multinational deterrent.

moving over railway track hidden in tunnels within the ice sheet. Constant mobility would make the missiles difficult or impossible for the Soviets to locate and destroy, thereby ensuring that the United States would have second-strike nuclear capability, a key element of nuclear deterrence theory. Project Iceworm also figured in the intraservice rivalry within the US military, as the Army tried to match the strategic nuclear mandates of the Air Force and Navy (Weiss 2001).

US military operations in Greenland were, and are, governed by the Defense of Greenland Agreement of 1951. The treaty gives the US permission to build and operate military bases on Greenland, in consultation with the Danish government. In 1951, Greenland was a colony of Denmark. It was upgraded in 1953 to a county-like status within the Kingdom of Denmark. Between 1979 and 2009, however, Greenland transitioned to a self-governing overseas administrative division of Denmark. As such, it is now a semisovereign territory, though Denmark retains rights and responsibilities in the area of foreign policy.

Five bases at four sites were associated with Project Iceworm, all located in northwest Greenland (Figure 1). The first two bases were identical radar stations called Site I and Site II. They were small, year-round surface bases, active between 1953 and 1957. The third was Tuto Tunnels, which variously operated seasonally and year-round between 1958 and 1962. The fourth was Camp Fistclench, co-located with Site II, which operated seasonally 1957–1958 and year-round 1959–1960. The fifth base was Camp Century, which operated year-round 1959–1963 and then seasonally 1964–1967. Publicly, Camp Century was a joint US–Danish science operation, though in practice, the Danish personnel responsible for overseeing its activities were usually posted at Thule. A portable nuclear generator powered Camp Century. Together, the four sites represent approximately 1,500 person-years of US Army occupancy.

Ultimately, Project Iceworm was abandoned. The US Joint Chiefs of Staff gave up on it for one, or a combination, of three reasons: the development of

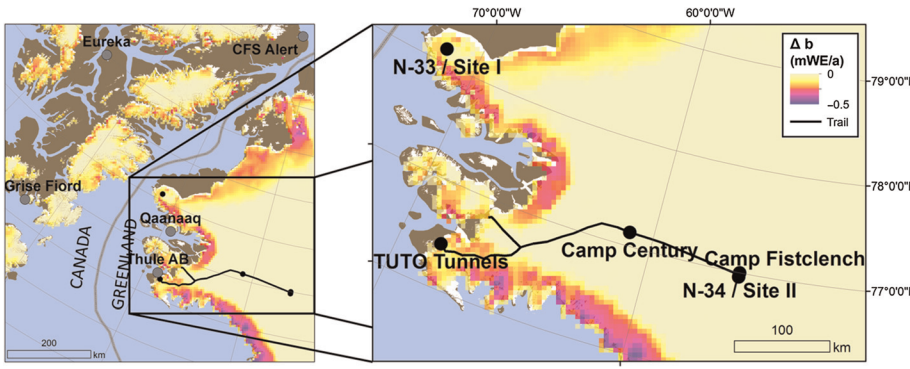

Figure 1
Locations of Project Iceworm Military Sites in Greenland (The online version of this article contains this figure in color: https://www.mitpressjournals.org/doi/pdf/10.1162/GLEP_a_00443)

longer-range intercontinental ballistic missiles (ICBMs), geotechnical challenges associated with the ice tunnels, and anticipated Danish resistance to the plan. ICBMs undermined the strategic logic of Project Iceworm by providing an alternative deterrent threat against the Soviets. US policy aimed for a "nuclear triad" based on three delivery systems: submarines, bombers, and missiles. Initially, the best missiles were only medium range and had to be located relatively close to the Soviet Union (e.g., in Europe). That proximity made them vulnerable, but by the early 1960s, longer-range ICBMs were operational. That development weakened the strategic logic for Project Iceworm. At the same time, the technical challenges associated with building and maintaining an under-ice railroad and nuclear arsenal in Greenland began to mount (Petersen 2008). Those challenges might have been surmountable, but the army did not have a chance to pursue them. The third factor was the political and legal difficulties associated with the Danish government, which had a nominally nuclear-free foreign policy.[5] The public only learned of Project Iceworm in 1997 via a US freedom of information request by Danish academic researchers (Weiss 2001, 31).

The bases were sequentially abandoned with minimal decommissioning under the explicit assumption that the bases, and their pollutants, would be "preserved for eternity" by perpetually accumulating snow (Clark et al. 1962). That assumption now looks incorrect.

Climate Change and the Risk of Remobilized Pollution in Greenland

Climate change is dramatically affecting the weather patterns in Greenland, more than most places on Earth. The Greenland ice sheet is currently shrinking, as more ice melts each summer than accumulates each winter. The increasingly negative surface balance, or net ice melt, of the ice sheet is likely eventually to expose the Iceworm wastes buried, albeit on a different timescale for each site. Indeed, climate change is already exposing and remobilizing some toxic materials (associated with Tuto Tunnels). At the other sites, the waste is currently buried, and surface exposure will take many years (perhaps fifty) to occur. Current scientific inquiries seek to determine exactly how much waste is at each site and how much time will pass before exposure becomes irreversible at each site (Figure 2) (Colgan et al. 2016). As the waste comes closer to the surface, pollutants can remobilize by entering the water supply.

Three questions are highly important for understanding the nature of the environmental risk. First, when will pollution remobilization occur? After remobilization, it becomes difficult or impossible to contain the pollutants by environmental remediation efforts. To determine when remobilization will occur, scientists need to know the precise location and depth of the waste. For

5. The United States had nuclear weapons in Greenland in the period 1958–1965, even though Denmark had a nuclear-free policy for its home/metropolitan territory. See Fuhrmann and Sechser (2014).

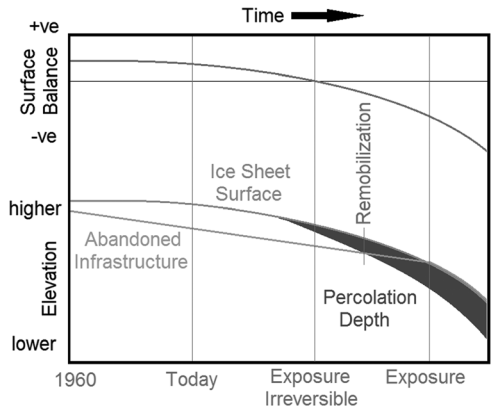

Figure 2
Conceptual Overview of Remobilization Timeline

The interaction between surface balance (transitioning from net snowfall to net melt), elevation, and abandoned infrastructure depth determines irreversible exposure (when surface balance becomes negative), remobilization (when percolation depth intercepts infrastructure depth), and exposure (when the ice sheet surface melts out infrastructure).

instance, Camp Century was excavated to a depth of eight meters below the surface when it was constructed in 1959, but that depth has now changed, as snowfall has accumulated on the surface. Once surface balance of the ice sheet switches from net snowfall to net melt at Camp Century, as is projected under the UN Intergovernmental Panel on Climate Change "business-as-usual" scenario, surface exposure is inevitable.

Second, how much pollution will be exposed? Considerable uncertainty exists about exactly what materials and how much were left at the four locations. A preliminary inventory of the type and volume of waste at the largest site, Camp Century, estimates that the site hosts 9,200 metric tons of physical waste associated with base infrastructure, 20,000 liters of chemical waste associated with diesel fuel, and 24 million liters of biological waste associated with untreated sewage (Colgan et al. 2016). Many metric tons of materials at these sites are likely contaminated with polychlorinated biphenyls (PCBs), though the exact quantity is unknown. In addition, there are poorly defined but nontrivial quantities of low-level radioactive waste. The PCBs probably represent the largest environmental risk to human and animal health, as they bioaccumulate when ingested and can move up the food chain through local hunting (Poland et al. 2001). The quantity of waste at the other three sites is unknown and awaits future research.

The third question is where the pollution could go. Qaanaaq, a civilian community 103 kilometers north of Thule Air Base, is the most geographically susceptible Greenlandic population. Similarly, Grise Fiord, a civilian community 362 kilometers west of Thule Air Base, is the most susceptible in Canada.

The traditional hunting grounds of both these communities include southern Nares Straight and northern Baffin Bay. If remobilized, PCBs from the four sites would likely bioaccumulate within the marine ecosystem in this region. The pollution also represents some degree of bioaccumulation risk to American personnel at Thule Air Base. This risk is probably small, however, because Americans typically eat imported food rather than locally sourced "country food." However, the risk is not zero, because it is possible that the remobilized pollutants could enter the water supplies for the base or that there are considerably more pollutants than are documented.

Empirical Plausibility of the Theoretical Framework

The Iceworm case provides empirical information to assess the plausibility of the theoretical framework developed earlier. Before doing so, some additional legal and historical background is needed. The 1951 Defense of Greenland Agreement provides a legal framework for US military activities, but it allows for a certain amount of political and legal interpretation. For instance, Article XI states that "all property provided by the Government of the United States of America and located in Greenland shall remain the property of the Government of the United States of America…. [This property] may be removed from Greenland free of any restriction, or disposed of in Greenland by the Government of the United States of America *after consultation with the Danish authorities*" (emphasis added).

Denmark could argue that it was not fully consulted regarding the decommissioning of certain abandoned military sites, and thus any abandoned waste there remains a US responsibility. Furthermore, the proposed deployment area of Project Iceworm lay outside the US defense areas defined in the 1951 treaty. Consequently, the Iceworm system could not have been built legally without the express authorization of the government (and parliament) of Denmark (Petersen 1998). If asked, the answer almost certainly would have been no: Denmark officially had a nuclear-free policy. The nuclear status of Greenland itself was legally unclear, but the Danish government, let alone its electorate, was never officially approached with a request or plan to deploy nuclear missiles to Greenland (Petersen 2008, 77, 89; Nielsen and Nielsen 2016).

The difficulty with that argument, however, is that the Danish prime minister, H. C. Hansen, appears to have indicated to the US in 1957 that he did not *want* to be consulted on the issue. On November 13, 1957, US ambassador Val Peterson secretly approached Hansen and asked him officially whether the Danish government wished to be informed in case the US chose to place nuclear weapons in Greenland. The Danish prime minister responded five days later by handing the ambassador a paper that he described as "informal, personal, top secret and limited to one copy for each side" (Petersen 2008, 90). That paper gave a very carefully crafted nonanswer to the ambassador's question, containing the line "I do not think that your remarks give rise to any comments

from my side" (quoted in Petersen 2008, 90). The note appears to give the Americans tacit permission to proceed—and was interpreted as doing so by the US military—while maintaining Hansen's plausible deniability on the issue. A Danish internal memo in 1959 stated, "The Government has not meant to explore whether atomic munitions are stored from time to time—or constantly—in the U.S.-operated defense areas in Greenland."[6] The Hansen paper did not become public until 1995 (Petersen 2008, 91). The US might argue, therefore, that it adequately consulted with the Danish.

Setting aside the virtues of those arguments, others might insist that the US and/or Denmark was responsible for damages. Other than Greenland, Canada is most likely to be negatively affected by remobilized pollution. This could reduce goodwill among the NATO parties, and it is unclear which state(s) would be most eager to avoid an escalation of the dispute. If the US is interested in maintaining or expanding its military presence in the Arctic, as its 2013 *National Strategy for the Arctic Region* suggests, goodwill from Canada and Denmark might be highly valued. This could be costly. For instance, in 1996, the US agreed to contribute US$ 100 million to Canada's decommissioning of the Distant Early Warning (DEW) stations in its Arctic territory (Canadian Ministry of Aboriginal Affairs and Northern Development 2014, 6). Similar payments, proportionately scaled, might be used to prevent, mitigate, or compensate for environmental damages associated with the legacy pollutants from Project Iceworm.

Even without any legal liability, the political consequences for the US could be considerable. The legacy of abandoned US bases affects the reputation of the US when it seeks to negotiate or renegotiate base agreements in Greenland or Canada, and possibly other parts of the world. Cognizant of this risk, the US undertook a United States–Denmark–Greenland Declaration in 2004 on military cooperation that says, "The common goals are to protect the environment and to prevent detrimental effects from any activities to the health and safety of residents of Greenland."[7] Environmental hazards associated with abandoned US military bases elsewhere in the world suggest that they can create considerable political controversy and erode goodwill (Wegman and Bailey 1994).

Consider now the two propositions. The first proposition (P1: if climate change interacts strongly with a military base's infrastructure or wastes, it will create knock-on political problems that are distinct from those associated with climate change per se) is supported. Table 1 provides evidence of knock-on political problems. Unlike climate change, the pollution associated with Project Iceworm is not a problem of the international commons (the first of Young's four categories), but it has aspects of each of the other three categories. Left unattended, remobilized pollution will despoil a shared natural resource (second category), namely, the water and traditional food sources used by people in Greenland and Canada. Transboundary externalities (third category) stem from the spread

6. Foreign Office paper, June 4, 1959, UM 105.F.2.B/1, quoted in Petersen (2008, 91).
7. http://denmark.usembassy.gov/gl/iaenvironment.html, last accessed June 10, 2016.

Table 1
Evidence of Political Contestation Over Project Iceworm Wastes

Dimension	*Evidence to Date*
Between the US, Denmark, Others	1. Denmark commits 150 million kroner to study issue; no promise (yet) on responsibility over cleanup 2. US Department of Defense statement neither confirms nor denies responsibility for cleanup
Between Greenland and Other Actors	1. Greenland accuses Denmark of lying about pollution 2. Greenland brings complaint to the UN 3. Greenland links Iceworm cleanup to bargaining with US over Thule Air Base
Between Subnational Actors Within Greenland	1. Iceworm pollution debated in Greenland's parliament 2. Greenland's prime minister fires the foreign minister over how to handle the issue
Between Transnational Actors	1. Online petitions requesting cleanup by US

of the pollution itself and from the political and financial costs potentially incurred by the US, Denmark, and others. Finally, the case links together environmental concerns and international military cooperation via the 1951 US–Denmark defense agreement (fourth category). These various aspects of the problem make it difficult to place neatly in any one category.

Instead, the case demonstrates a "cue ball effect" of climate change. In billiards, the cue ball is in motion first, but it soon hits other balls and puts them into motion. Similarly, in this case, a changing climate (an international commons) interacts with another environmental subsystem (ice-covered pollution) and thereby creates further issues that fall into the other three categories. This cue ball effect might actually characterize many potential problems associated with climate change, and thus scholars should take note.

The preliminary evidence also appears to substantiate the second proposition (P2: if climate change creates knock-on environmental problems associated with a military base's infrastructure or wastes, they will create a mix of subnational, international, and transnational political contestation that raises the political costs of the military base), though the evidence is more complex. The evidence from the Iceworm case alone is sufficient to show that climate change creates knock-on environmental problems and that these problems generate multiple forms of political contestation. It is plausible but not yet fully clear in the Iceworm case that this contestation will raise the political costs of the military base. However, there is evidence from other cases (not related to climate change) that environmental hazards do raise political opposition.

The potential for remobilized pollutants in Greenland creates four dimensions of political contestation: between the US, Denmark, and Canada; between increasingly autonomous Greenland and other actors; between subnational actors within Greenland, Denmark, or Canada; and between various transnational actors. Table 1 summarizes the evidence of contestation, consistent with P1 and P2.

The first dimension is international. As discussed earlier, the 1951 treaty contains enough ambiguity for it to be used by both Denmark and the US to argue that the other is legally or politically responsible for any Project Iceworm pollution that gets remobilized. Denmark recently committed funds (150 million kroner) to conducting environmental monitoring and studies of the pollution but has not (yet) accepted responsibility for cleanup (Olsen 2016; *Berlingske* 2017). Similarly, a 2016 US government press statement on Camp Century neither confirms nor denies responsibility for the pollution (quoted in Billing 2016).

The second dimension involves Greenland, where there is already direct evidence of contestation. In 2016, Greenland's foreign minister accused his Danish counterpart of lying on the issue of Camp Century.[8] Greenland also filed a complaint on the issue at the UN (Breum 2017). In addition, Greenland's government is linking the Iceworm pollution to the ever-evolving bargain with the US over Thule Air Base. Much of Greenland's population views the US military negatively, especially those whose families were affected by the forced migration of Qaanaaq away from the Thule site in 1953. So Greenland might, for instance, insist on environmental remediation at Camp Century and the other abandoned bases as part of the price for allowing the US to stay at Thule. The foreign minister has already identified the Camp Century environmental liability as a condition for Greenland's permission for continued US operations at Thule (Vittus Qujaukitsoq, quoted in *Berlingske* 2016). Consistent with my theoretical framework, both the *identity* of who is responsible for the knock-on environmental effects of climate change and the *scope of required action* are being contested by Greenland, Denmark, and the US, albeit still in early stages at the time of writing.

The third dimension is the potential for political tensions within affected countries, most likely Greenland and Canada. Actual food contamination—or even the prospect of it—creates political tension among various stakeholders in those countries. Greenland policy makers exhibited outrage in 2016 when the news of the scientific findings about the Camp Century pollution was made public, and the issue was discussed in parliament.[9] And in 2017, the prime minister fired the foreign minister over how to handle the issue (Breum 2017).

The fourth dimension is transnational contestation (Zellen 2009; Berry et al. 2016). There is limited evidence of such activity: there are online petitions requesting the American government take responsibility for the pollution.[10]

8. Hannenstad, https://tinyurl.com/y7pa6qbz, last accessed December 5, 2017.
9. https://tinyurl.com/y93mds4o, last accessed June 2, 2017.
10. https://tinyurl.com/y7uwlzrw, last accessed June 25, 2017.

Overall, though, there is significant evidence of various forms of political contestation in the Iceworm case. The question is whether it can raise the political costs of the military base. There are some early signs that it will, as indicated earlier, but nothing conclusive. It is perhaps more instructive to examine the US experience in the Philippines. Negative health effects associated with toxic materials left at Clark Air Base generated political grievances and considerable resentment toward the US military when at least seventy-six people died and sixty-eight others were sickened.[11] Then, in October 2012, American ships dumped toxic waste into Subic Bay, spurring anti-Americanism in a traditionally pro-American country and setting the stage for multiple public rallies.[12] A major protest in April 2014 saw Filipinos shouting anti-Obama slogans when President Barack Obama toured the Philippines,[13] and then in 2016, hundreds of protesters burned US flags and carried placards that read "US troops out now" while marching to the presidential palace in Manila.[14] That same year, President Rodrigo Duterte declared his hostility toward the US and tried to realign the Philippines toward a closer relationship with China. It would be a mistake, of course, to draw a straight line between the American environmental waste and Duterte's political realignment away from the US. It is plausible, however, that the pollution contributed to Filipino grievances and played a modest role in facilitating Duterte's move.

Environmental hazards are likely to raise the political costs of a base only when no major security threat is immediately present that would outweigh environmental concerns. For instance, environment-related frustrations with the US military base in South Korea show no signs of ruining the political relationship, given the threat North Korea poses.[15] When no immediate security threat is present, however, it does seem that environmental politics can harm the political relationship that allows overseas military bases to function.

Conclusions

Climate change is on course to remobilize Arctic pollutants at abandoned US military bases associated with Project Iceworm. The ultimate Iceworm legacy for future military cooperation between the US, Denmark, Greenland, and even Canada is unknown, but political contestation is already occurring. Climate change could create a new class of liabilities and political challenges for overseas military bases.

The issue of unfunded environmental liabilities associated with military bases is significant for both policy makers and scholars. For policy makers in

11. https://tinyurl.com/3uj9cxm, last accessed June 1, 2016.
12. https://tinyurl.com/ayu6rv4, last accessed November 27, 2017.
13. https://tinyurl.com/yaeu7xhp, last accessed November 27, 2017.
14. https://tinyurl.com/zmfweh5, last accessed November 27, 2017.
15. https://tinyurl.com/y86nxfor, last accessed November 27, 2017.

the US, the Iceworm case indicates that climate change could impose additional costs on overseas military operations, beyond those already identified by the Department of Defense (US Department of Defense 2015; US Navy 2010, 2011). Failure to address those costs—regardless of whether they are legal or "merely" political—could compromise the government's ability to operate overseas military bases, such as the one at Thule, Greenland. For scholars, the issue of unfunded environmental liabilities speaks to a debate about military bases. Some scholars believe that a lighter military footprint can help reduce friction between the US military and host nations (Kawato 2015). Others argue that the critical issue is not the size or location of the US presence but whether the local population believes in the legitimacy of its operations (Holmes 2014, 209). To the extent that climate change creates new knock-on environmental problems associated with military bases, the perceived legitimacy of overseas military bases is likely to depend on how the US responds to those problems.

Climate change and various related knock-on environmental effects seem likely to become even more salient for military sites over time. Climate change reverberates into other environmental issues, potentially generating a combination of subnational, international, and transnational political contestation. This article therefore contributes to conceptualizing climate change as a meta-environmental problem rather than as a single issue. This way of viewing climate change, as having multiple hydra-headed effects with different problem structures, is gaining currency among scholars of international environmental politics (Levin et al. 2012; Keohane and Victor 2011). The study of Project Iceworm will give this scholarly community new empirical and conceptual material from which to develop and refine theories.

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